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**DEVELOPMENT DOCUMENT FOR
EFFLUENT LIMITATIONS GUIDELINES
AND NEW SOURCE PERFORMANCE STANDARDS**

**MISCELLANEOUS FOODS AND BEVERAGES
POINT SOURCE CATEGORY**

PART IV



**EFFLUENT GUIDELINES DIVISION
OFFICE OF WATER AND HAZARDOUS MATERIALS
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460**

MARCH 1975

NOTICE

The attached document is a DRAFT CONTRACTOR'S REPORT. It includes technical information and recommendations submitted by the Contractor to the United States Environmental Protection Agency ("EPA") regarding the subject industry. It is being distributed for review and comment only. The report is not an official EPA publication and it has not been reviewed by the Agency.

The report, including the recommendations, will be undergoing extensive review by EPA, Federal and State agencies, public interest organizations and other interested groups and persons during the coming weeks. The report and in particular the contractor's recommended effluent guidelines and standards of performance is subject to change in any and all respects.

The regulations to be published by EPA under Sections 304(b) and 306 of the Federal Water Pollution Control Act, as amended, will be based to a large extent on the report and the comments received on it. However, pursuant to Sections 304(b) and 306 of the Act, EPA will also consider additional pertinent technical and economic information which is developed in the course of review of this report by the public and within EPA. EPA is currently performing an economic impact analysis regarding the subject industry, which will be taken into account as part of the review of the report. Upon completion of the review process, and prior to final promulgation of regulations, an EPA report will be issued setting forth EPA's conclusions regarding the subject industry, effluent limitations guidelines and standards of performance applicable to such industry. Judgements necessary to promulgation of regulations under Sections 304(b) and 306 of the Act, of course, remain the responsibility of EPA. Subject to these limitations, EPA is making this draft contractor's report available in order to encourage the widest possible participation of interested persons in the decision making process at the earliest possible time.

The report shall have standing in any EPA proceeding or court proceeding only to the extent that it represents the views of the Contractor who studied the subject industry and prepared the information and recommendations. It cannot be cited, referenced, or represented in any respect in any such proceedings as a statement of EPA's views regarding the subject industry.

U. S. Environmental Protection Agency
Office of Water and Hazardous Materials
Effluent Guidelines Division
Washington, D. C. 20460

Please note: Because of the volume of this report, it has been printed in the following manner: "Miscellaneous Foods and Beverages.:

Part I	Pgs. 1-292	Section I-IV
Part II	Pgs. 293-500	Section V-VI
Part III	Pgs. 501-840	Section VIII
Part IV	Pgs. 841-1196	Section VIII (partial)
Part V	Pgs. 1197-1548	Section VIII (cont.) - XIV

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PART IV

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FOR:
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SECTION VIII

COST, ENERGY AND NON-WATER QUALITY ASPECTS

This section presents an evaluation of the costs, energy requirements, and non-water quality aspects associated with the treatment and control alternatives developed in Section VII in terms of the model processes and plants developed in Section V.

COST AND REDUCTION BENEFITS OF ALTERNATIVE TREATMENT AND CONTROL TECHNOLOGIES

In absence of complete cost information for individual processes, the cost figures developed herein are based on reliable actual cost figures reported for various installations coupled with engineering estimates. An estimate completely applicable to all members of an entire industry is obviously impossible. For instance, it must be realized that land costs vary widely. Construction cost, in terms of both labor and material costs, is another element that is highly variable. The costs presented herein have been developed for the different industry subcategories, rather than the entire industry, thus reducing some of the variability expected in costs. These costs are, nevertheless, intended to serve as a guide only, principally for subsequent economic impact analysis to be conducted by the U.S. Environmental Protection Agency.

Assumptions for Cost Analysis

The following assumptions are common for all of the cost estimates in this section:

1. All costs are reported in August 1972 dollars. All engineering cost estimates were made in December 1974 costs and converted to August 1972 dollars by the Construction Cost Index of the Engineering News Record.
2. Annual interest rate for capital stock is taken to be eight percent.
3. All investment cost is depreciated over a period of 20 years except rolling stock which is depreciated over ten years.
4. Salvage value is taken as zero at the end of the depreciation period.
5. Depreciation is attributed by the straight line method.

6. Total yearly cost = (investment cost/2) (0.08) + yearly depreciation cost + operating cost.
7. Power costs = \$0.04/kw-hr.
8. Excavation and fill is estimated at \$3.92/cu m (\$3.00/cu yd) for December 1974.
9. Personnel costs for operation is \$5.00/hr plus 50 percent fringe benefits, administration, and other overhead.
10. All capital construction work is performed by an outside contractor using normal profit margins.
11. When between 10 and 20 aeration units are purchased, a discount of 5.0 percent is obtained. When more than 20 units are purchased, the discount is 7.5 percent.
12. The December 1974 cost of steel is \$0.20/kg (\$0.45/lb).
13. The December 1974 cost of concrete is \$134/cu m (\$175/cu yd).
14. The December 1974 cost of contracted truck hauling of dewatered sludge or solid waste is \$0.77/cu m (\$1.00/cu yd).
15. The December 1974 cost of contracted truck hauling of liquid sludge or wastewater is \$5.28/1000 l (\$20.00/1000 gal).

The Feasibility and Costs of Municipal Treatment

Although the purpose of the document is to recommend effluent limitations guidelines for point source discharges into navigable waters, discharge to municipal treatment systems is a viable alternative for some installations and is now the case for many existing plants. To avoid redundancy, costs for this alternative are not provided for every subcategory, but are addressed in the following discussion.

The combined treatment of municipal and industrial wastes often offers an attractive alternative for industry, if municipal treatment is available. Many plants within the miscellaneous foods and beverages industry discharge to municipal sewers and, in fact, all plants within some of the subcategories discussed in this document use municipal treatment. Pre-treatment for these industrial wastes varies from non-existent to the equivalent of secondary treatment.

Many of those plants which do not presently utilize municipal facilities may not have the feasible option to do so because of location restraints. Others do not use municipal treatment by choice because of municipal treatment cost or because they had already invested heavily in separate treatment facilities before municipal treatment became available.

It is conceivable that some plants currently discharging to municipal treatment will in the future decide to provide separate treatment as municipal charges will inevitably increase. It is even more conceivable that more stringent requirements for pretreatment will be made by municipalities in the future.

Municipal wastewater charges vary widely, as was illustrated in a survey by Maystre and Geyer (155) in 1970. The results of the survey indicated that about 10 percent of small cities, 15 percent of middle size cities, and 20 percent of larger cities had industrial waste charges. All of the 28 cities responding to the inquiry based surcharges on BOD and suspended solids, or their equivalents per unit volume, and on the excess loads of the individual plant relative to some average value stipulated by ordinance. Some cities also considered excess loads of grease and chlorine demand.

Based on the unit costs of treatment applied by the 28 cities, the investigators calculated the surcharge cost per month for two hypothetical industries, both having BOD and suspended solids concentrations of 800 mg/l, but one industry having a flow of 2830 cu m/month (100,000 cu ft/month) and the other a flow of 28,320 cu m/month (one million cu ft/month). The surcharge for the smaller industry ranged from \$8/month to \$269/month while the surcharge for the larger industry ranged from \$78/month to \$2690/month.

VEGETABLE OIL PROCESSING AND REFINING

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 1 - Oilseed Crushing, Except Olive Oil, by Direct Solvent Extraction and Prepress Operations

A model plant representative of subcategory A 1 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which processes 816 kkg (900 ton) of raw oilseed per day.

Alternative A 1-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 816 kkg (900 ton) per day plant is 148 cu m/day (0.039 MG) per day. The BOD waste load is 0.061 kg/kkg (0.122 lb/ton), the suspended solids load is 0.038 kg/kkg (0.076 lb/ton), and the oil and grease load is 0.069 kg/kkg (0.138 lb/ton). The model plant developed is assumed to discharge its process wastewater and noncontact waters separately, and to provide gravity separation and skimming of process waters. Floatable oils and sludges from the gravity separation are pumped to an in-plant oil recovery system.

Costs: 0
Reduction Benefits: None

Alternative A 1-II - This alternative provides a flow equalization basin, complete-mix activated sludge, secondary clarification, a sludge recirculating pump, a sludge thickening tank, and a sludge holding tank.

The resulting BOD waste load is 0.0072 kg/kkg (0.014 lb/ton), the suspended solids load is 0.0090 kg/kkg (0.018 lb/ton) and the oil and grease load is 0.0054 kg/kkg (0.011 lb/ton).

Costs: Total investment cost: \$172,650
Total yearly cost: \$ 32,580

An itemized breakdown of costs is presented in Table 163. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 88.2 percent
SS: 76.3 percent
O&G: 92.2 percent

Alternative A 1-III - This alternative provides in addition to Alternative A 1-II dual media filtration with a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.0036 kg/kkg (0.0072 lb/ton), the suspended solids load is 0.0045 kg/kkg (0.0090 lb/ton) and the oil and grease load is 0.0027 kg/kkg (0.0054 lb/ton).

Costs: Total investment cost: \$189,960
Total yearly cost: \$ 37,680

An itemized breakdown of costs is presented in Table 164. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.1 percent
SS: 88.2 percent
O&G: 96.0 percent

A cost efficiency curve is presented in Figure 265.

Alternative A 1-IV - This alternative provides a flow equalization basin, an aerated lagoon system, and a settling pond.

The resulting BOD waste load is 0.0072 kg/kkg (0.014 lb/ton), the suspended solids load is 0.0090 kg/kkg (0.018 lb/ton) and the oil and grease load is 0.0054 kg/kkg (0.011 lb/ton).

Costs: Total investment cost: \$154,740
Total yearly cost: \$ 38,870

An itemized breakdown of costs is presented in Table 165. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is

TABLE 163

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 1-II
(OILSEED SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 88.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	97510.00
2. LAND	55640.00
3. ENGINEERING	9750.00
4. CONTINGENCY	9750.00
TOTAL	172650.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	4830.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	2500.00
TOTAL	19820.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	19820.00
2. YEARLY INVESTMENT COST RECOVERY	6910.00
3. DEPRECIATION	5850.00
TOTAL	32580.00

TABLE 164

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 1-III
(OILSEED SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	111940.00
2. LAND	55640.00
3. ENGINEERING	11190.00
4. CONTINGENCY	11190.00
TOTAL	189960.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	6990.00
3. CHEMICALS	0.0
4. MAINTENANCE SUPPLIES	3880.00
TOTAL	23360.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	23360.00
2. YEARLY INVESTMENT COST RECOVERY	7600.00
3. DEPRECIATION	6720.00
TOTAL	37680.00

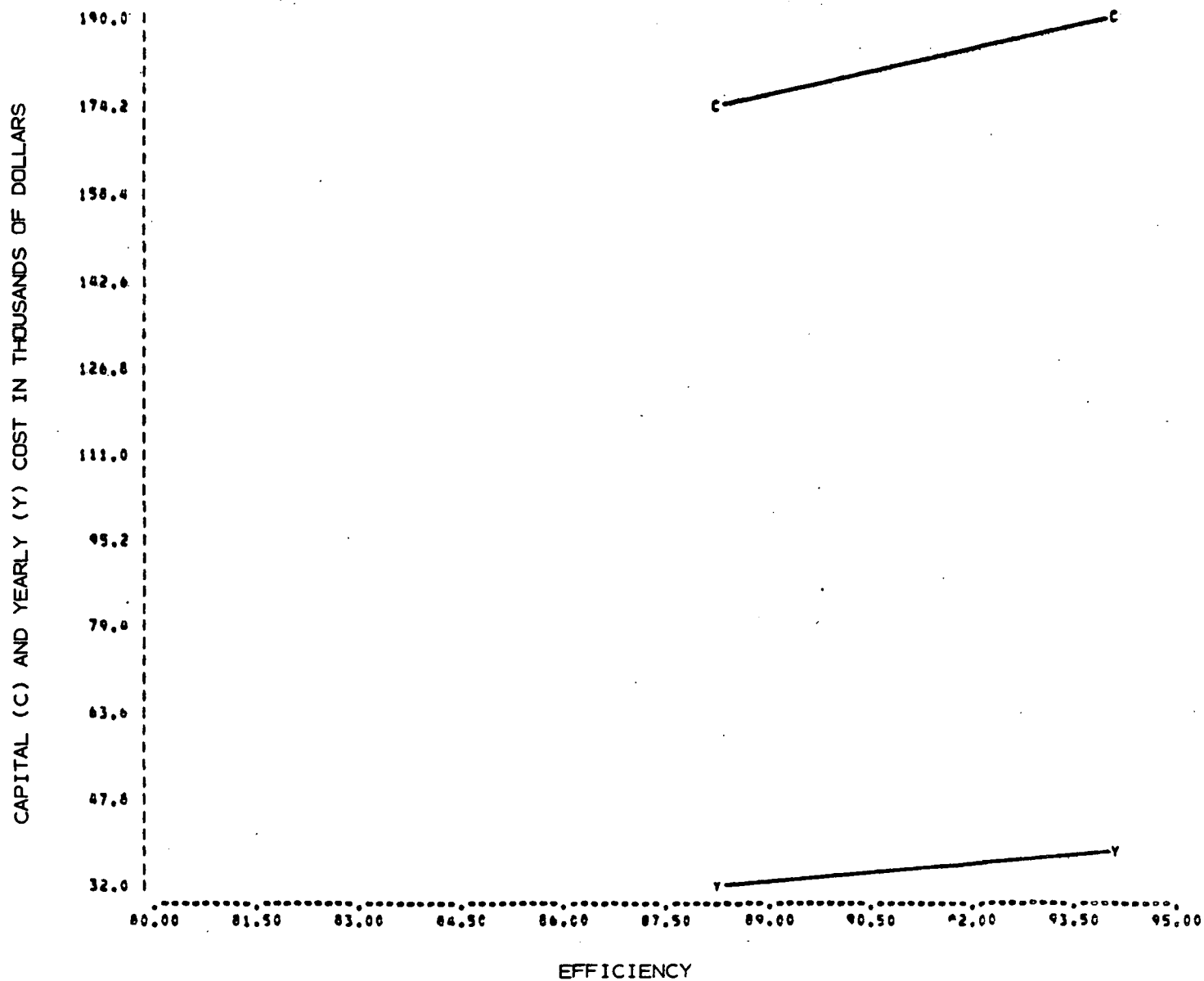


FIGURE 265

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A1, ALTERNATIVE II & III

TABLE 165

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 1-IV
(OILSEED SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 88.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	123110.00
2. LAND	3330.00
3. ENGINEERING	12310.00
4. CONTINGENCY	12310.00
5. PVC LINER	3680.00
TOTAL	154740.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	10600.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	1920.00
5. PVC LINER	100.00
TOTAL	25110.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	25110.00
2. YEARLY INVESTMENT COST RECOVERY	6190.00
3. DEPRECIATION	7570.00
TOTAL	38870.00

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further assumed that one operator is required.

Reduction Benefits: BOD: 88.2 percent
SS: 76.3 percent
O&G: 92.2 percent

Alternative A 1-V - This alternative provides in addition to Alternative A 1-IV dual media filtration with a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.036 kg/kg (0.0072 lb/ton), the suspended solids load is 0.0045 kg/kg (0.0090 lb/ton) and the oil and grease load is 0.0027 kg/kg (0.0054 lb/ton).

Costs: Total investment cost: \$172,050
Total yearly cost: \$ 43,970

An itemized breakdown of costs is presented in Table 166. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.1 percent
SS: 88.2 percent
O&G: 96.0 percent

A cost efficiency curve is presented in Figure 266.

Alternative A 1-VI - This alternative provides a flow equalization basin, and pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil and grease waste skimmings are pumped to an in-plant oil reclamation system.

The resulting BOD waste load is 0.018 kg/kg (0.036 lb/ton), the suspended solids load is 0.011 kg/kg (0.022 lb/ton), and the oil and grease load is 0.021 kg/kg (0.042 lb/ton).

Costs: Total investment cost: \$149,370
Total yearly cost: \$ 31,200

An itemized breakdown of costs is presented in Table 167. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 69.8 percent
SS: 70.2 percent
O&G: 70.3 percent

Alternative A 1-VII - This alternative provides in addition to Alternative A 1-VI a complete mix activated sludge unit, secondary clarification, a sludge recirculating pump, a sludge thickening tank, and sludge hauling.

TABLE 166

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 1-V
(OILSEED SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

P...PUMPING STATION
C...EQUALIZATION BASIN
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	137540.00
2. LAND	3330.00
3. ENGINEERING	13750.00
4. CONTINGENCY	13750.00
5. PVC LINER	3680.00
TOTAL	172050.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	12760.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	3300.00
5. PVC LINER	100.00
TOTAL	28650.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	28650.00
2. YEARLY INVESTMENT	
COST RECOVERY	6880.00
3. DEPRECIATION	8440.00
TOTAL	43970.00

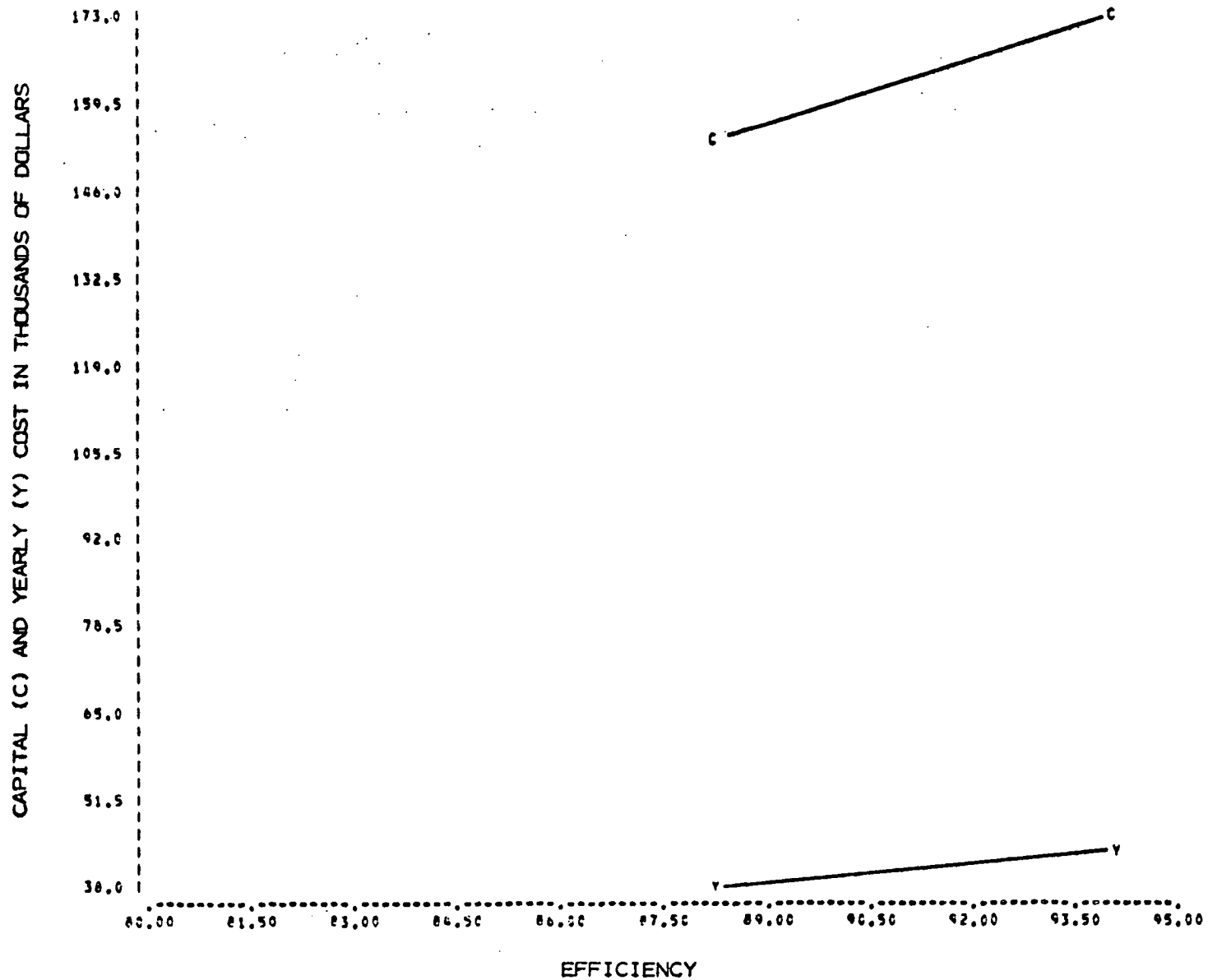


FIGURE 2 66

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A1, ALTERNATIVES IV & V

TABLE 167

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 1-VI
(OILSEED SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1..CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	78110.00
2. LAND	55640.00
3. ENGINEERING	7810.00
4. CONTINGENCY	7810.00
TOTAL	149370.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	2120.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	5930.00
TOTAL	20540.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	20540.00
2. YEARLY INVESTMENT COST RECOVERY	5970.00
3. DEPRECIATION	4690.00
TOTAL	31200.00

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The resulting BOD waste load is 0.0036 kg/kg (.0072 lb/ton), the suspended solids load is 0.0045 kg/kg (0.0090 lb/ton) and the oil and grease load is 0.0027 kg/kg (0.0054 lb/ton).

Costs: Total investment cost: \$209,480
Total yearly cost: \$ 40,690

An itemized breakdown of costs is presented in Table 168. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.1 percent
SS: 88.2 percent
O&G: 96.0 percent

A cost efficiency curve is presented in Figure 267.

Alternative A 1-VIII - This alternative provides in addition to Alternative A 1-VI (dissolved air flotation) an aerated lagoon system including a settling pond.

The resulting BOD waste load is 0.0036 kg/kg (0.0072 lb/ton), the suspended solids load is 0.0045 kg/kg (0.0090 lb/ton) and the oil and grease load is 0.0027 kg/kg (0.0054 lb/ton).

Costs: Total investment cost: \$188,460
Total yearly cost: \$ 43,300

An itemized breakdown of costs is presented in Table 169. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.1 percent
SS: 88.2 percent
O&G: 96.0 percent

A cost efficiency curve is presented in Figure 268.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 2 - Oilseed Crushing, Except Olive Oil, by Mechanical Screw Press Operations

No model plant was developed for this subcategory in Section V as the industry presently discharges less than 4000 liters (1000 gallon) of process wastewater per day to municipal facilities. In Section VII two alternatives were considered as being applicable engineering alternatives for handling these small volumes of waste.

Alternative A 2-I - This alternative provides no additional treatment.

TABLE 168

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 1-VII
(OILSEED SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
P...PUMPING STATION
C...EQUALIZATION BASIN
J...AIR FLOTATION
K...ACTIVATED SLUDGE
R...SLUDGE THICKENER
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	127360.00
2. LAND	56640.00
3. ENGINEERING	12740.00
4. CONTINGENCY	12740.00
TOTAL	209480.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	4850.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	7330.00
TOTAL	24670.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	24670.00
2. YEARLY INVESTMENT COST RECOVERY	8380.00
3. DEPRECIATION	7640.00
TOTAL	40690.00

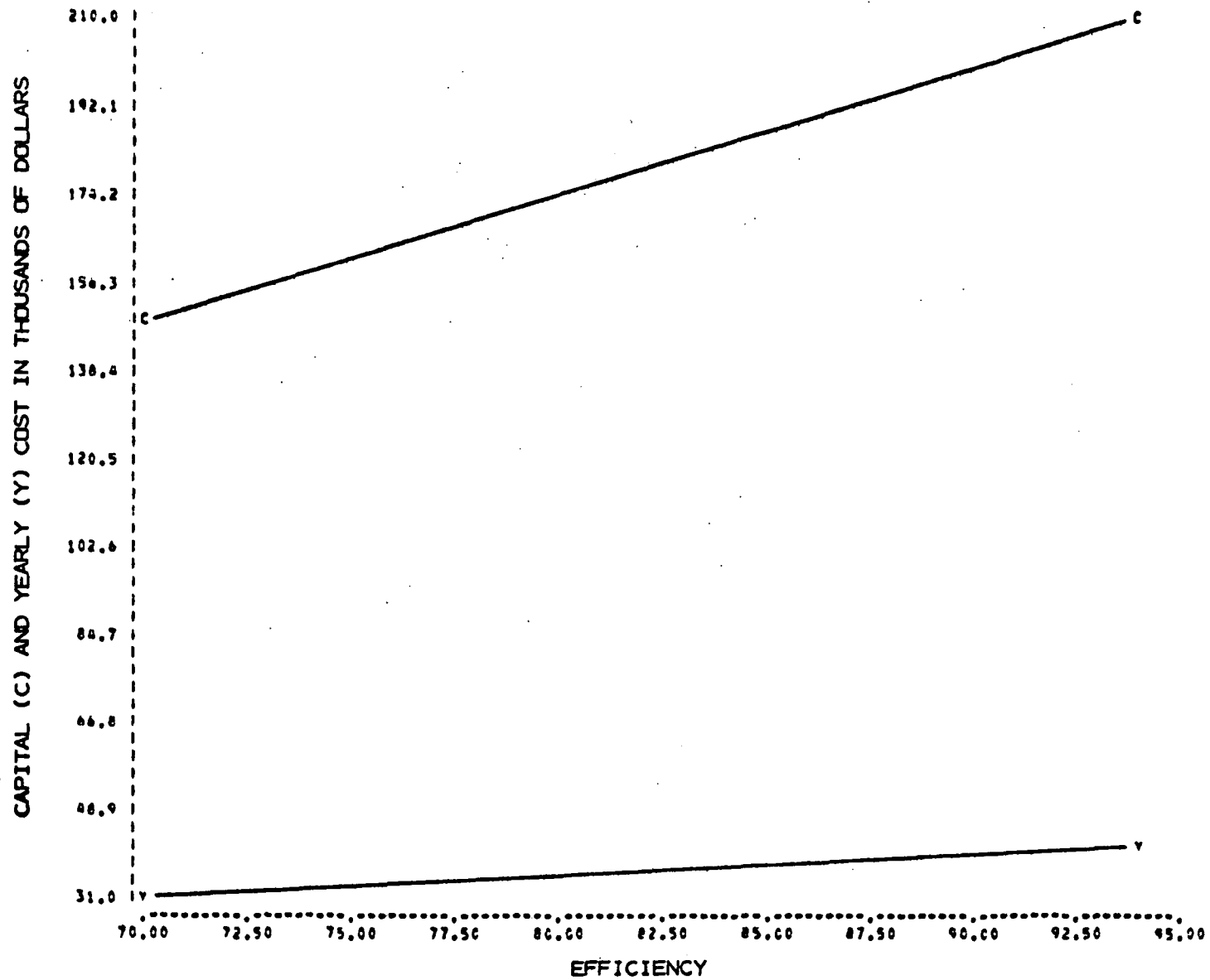


FIGURE 267

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A1, ALTERNATIVES VI & VII

TABLE 169

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 1-VIII
(OILSEED SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	151210.00
2. LAND	3330.00
3. ENGINEERING	15120.00
4. CONTINGENCY	15120.00
5. PVC LINER	3680.00
TOTAL	188460.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	6780.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	7130.00
5. PVC LINER	100.00
TOTAL	26500.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	26500.00
2. YEARLY INVESTMENT COST RECOVERY	7540.00
3. DEPRECIATION	9260.00
TOTAL	43300.00

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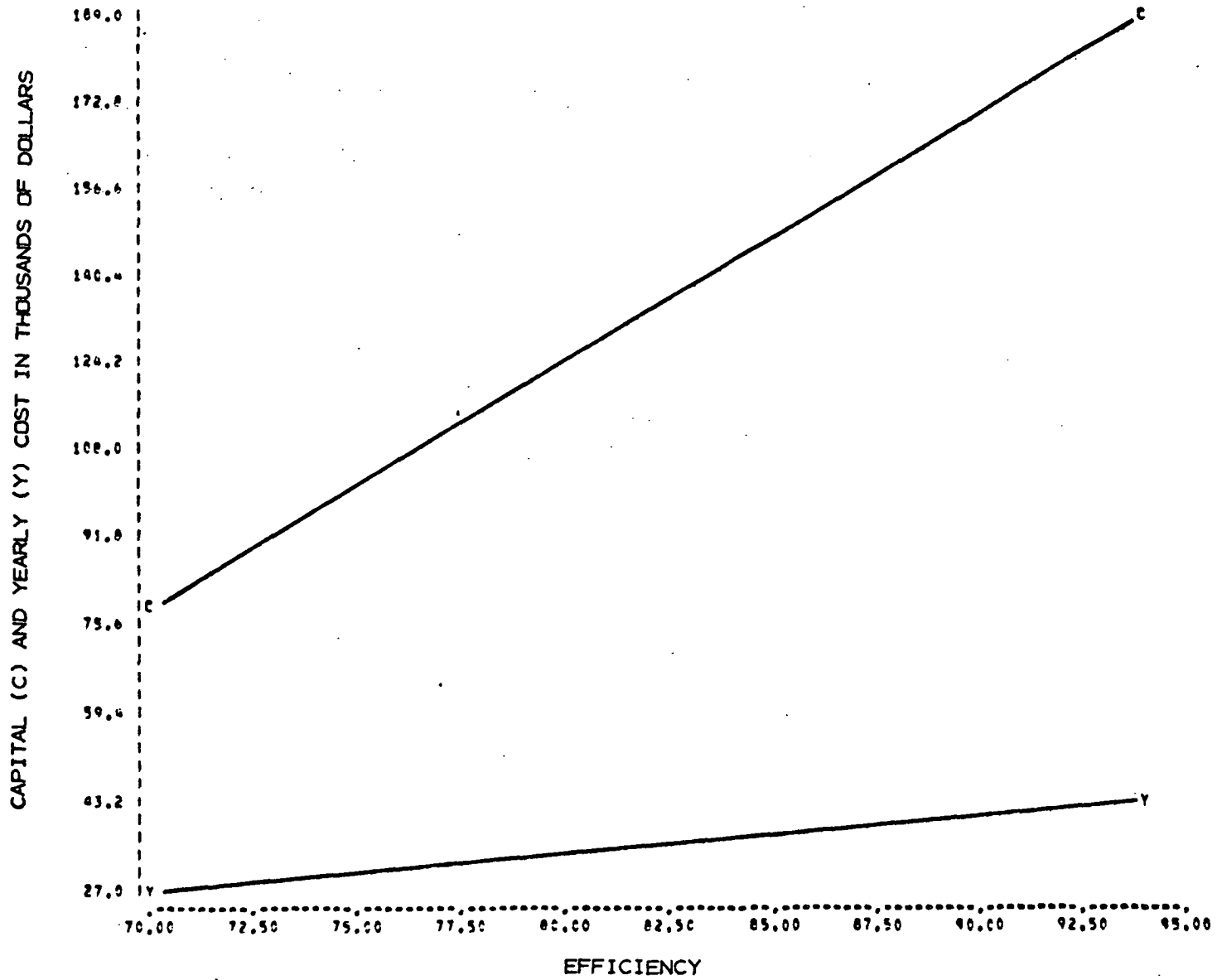


FIGURE 268

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A1, ALTERNATIVE VIII

Costs: 0
 Reduction Benefits: None

Alternative A 2-II - This alternative consists of a storage tank and truck hauling of the wastewater to a municipal sewage treatment facility or suitable land disposal site. The resulting waste volume to be trucked averages less than 4000 liter (1000 gallon) per day.

Costs: Total investment cost: \$19,450
 Total yearly costs: \$ 1,510
 Reduction Benefits: 100

Cost and Reduction Benefits of Alternative Treatment Technologies
 for Subcategory A 3 - Hydraulic Pressing and Solvent Extraction of Olive Oil

A model plant representative of Subcategory A 3 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, three alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which utilizes 21.7 kkg (24 ton) of whole olives and 65.3 kkg (74 ton) of cannery pits and culls per day to produce olive oil. It is estimated that the effluent from the model plant is 10.9 cu m (0.0029 MG) per day. The BOD concentration is 63,000 mg/l, the suspended solids concentration is 14,000 mg/l, and the oil and grease concentration is 3220 mg/l.

Alternative A 3-I - This alternative consists of a pumping station, a holding tank and spray irrigation of the raw waste effluent.

The resulting BOD waste load is 0.0 kg/kkg (0.0 lb/ton), the suspended solids load is 0.0 kg/kkg (0.0 lb/ton), and the oil and grease load is 0.0 kg/kkg (0.0 lb/ton).

Costs: Total investment cost: \$40,850
 Total yearly cost: \$ 5,460

An itemized breakdown of costs is presented in Table 170. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operators are required.

Reduction Benefits: BOD: 100 percent
 SS: 100 percent
 O&G: 100 percent

Alternative A 3-II - This alternative consists of four 0.10 ha (0.25 acre) evaporation ponds, lined with PVC fabric to prevent contamination of the fresh water aquifer.

The resulting BOD waste load is 0.0 kg/kkg (0.0 lb/ton), the suspended solids load is 0.0 kg/kkg (0.0 lb/ton), and the oil and grease load is 0.0 kg/kkg (0.0 lb/ton).

TABLE 170

ITEMIZED COST SUMMARY FOR ALTERNATIVE A3-I
(OLIVE OIL, HYDRAULIC PRESS AND SOLVENT EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
L...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	31020.00
2. LAND	3630.00
3. ENGINEERING	3100.00
4. CONTINGENCY	3100.00
TOTAL	40850.00

YEARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	850.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	1120.00
TOTAL	1970.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	1970.00
2. YEARLY INVESTMENT COST RECOVERY	1630.00
3. DEPRECIATION	1860.00
TOTAL	5460.00

Costs: Total investment cost: \$60,330
Total yearly cost: \$ 6,920

An itemized breakdown of costs is presented in Table 171. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

Alternative A 3-III - This alternative consists of land spreading the raw waste effluent.

The resulting BOD waste load is 0.0 kg/kkg (0.0 lb/ton), the suspended solids load is 0.0 kg/kkg (0.0 lb/ton), and the oil and grease load is 0.0 kg/kkg (0.0 lb/ton).

Costs: Total investment cost: \$21,720
Total yearly cost: \$ 8,330

An itemized breakdown of costs is presented in Table 172. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 4 - Mechanical Screw Pressing for the Recovery of Olive Oil

A model plant representative of Subcategory A 4 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, three alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which utilizes 43.5 kkg (48 ton) of whole olives per day to produce olive oil. It is estimated that the effluent from a 43.5 kkg (48 ton) per day plant is 114 cu m (0.030 MG) per day. The BOD waste load is 78.2 kg/kkg (156 lb/ton), the suspended solids load is 149 kg/kkg (297 lb/ton), and the oil and grease load is 52 kg/kkg (104 lb/ton).

Alternative A 4-I - This alternative consists of a pumping station a holding tank and spray irrigation of the raw waste effluent.

The resulting BOD waste load is 0.0 kg/kkg (0.0 lb/ton), the suspended solids load is 0.0 kg/kkg (0.0 lb/ton), and the oil and grease load is 0.0 kg/kkg (0.0 lb/ton).

Costs: Total investment cost: \$92,030
Total yearly cost: \$10,840

TABLE 171
ITEMIZED COST SUMMARY FOR ALTERNATIVE A3-II

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN A 3-II
DESIGN EFFICIENCY...100 PERCENT BOD REDUCTION

TREATMENT MODULES:

EVAPORATION POND

INVESTMENT COSTS:

1.	CONSTRUCTION	48,170.00
2.	LAND	2,920.00
3.	ENGINEERING	4,820.00
4.	CONTINGENCY	4,820.00
	TOTAL	60,330.00

YEARLY OPERATING COSTS:

1.	LABOR	300.00
2.	POWER	0.00
3.	CHEMICALS	0.00
4.	MAINTENANCE & SUPPLIES	340.00
	TOTAL	1,640.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	1,640.00
2.	YEARLY INVESTMENT	
	COST RECOVERY	2,410.00
3.	DEPRECIATION	2,870.00
	TOTAL	6,920.00

TABLE 172

ITEMIZED COST SUMMARY FOR ALTERNATIVE A3-III

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN A3-III
 DESIGN EFFICIENCY...100 PERCENT BOD REDUCTION

TREATMENT MODULES:

PUMPING STATION
 LAND APPLICATION

INVESTMENT COSTS:

1. CONSTRUCTION	16,720.00
2. LAND	1,660.00
3. ENGINEERING	1,670.00
4. CONTINGENCY	1,670.00
TOTAL	21,720.00

YEARLY OPERATING COSTS:

1. LABOR	6,230.00
2. POWER	100.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	130.00
TOTAL	6,460.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	6,460.00
2. YEARLY INVESTMENT COST RECOVERY	870.00
3. DEPRECIATION	1,000.00
TOTAL	8,330.00

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An itemized breakdown of costs is presented in Table 173. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

Alternative A 4-II - This alternative consists of four 0.4 ha (1.0 acre) evaporation ponds lined with PVC fabric to prevent contamination of the fresh water aquifer.

The resulting BOD waste load is 0.0 kg/kg (0.0 lb/ton), the suspended solids load is 0.0 kg/kg (0.0 lb/ton), and the oil and grease load is 0.0 kg/kg (0.0 lb/ton).

Costs: Total investment cost: \$254,970
Total yearly cost: \$ 49,530

An itemized breakdown of costs is presented in Table 174. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

Alternative A 4-III - This alternative consists of land spreading the raw waste effluent.

The resulting BOD waste load is 0.0 kg/kg (0.0 lb/ton), the suspended solids load is 0.0 kg/kg (0.0 lb/ton), and oil and grease load is 0.0 kg/kg (0.0 lb/ton).

Costs: Total investment cost: \$46,140
Total yearly cost: \$11,390

An itemized breakdown of costs is presented in Table 175. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

Cost and Reduction Benefits of Alternative Treatment Technologies
for Subcategory A 5 - Processing of Edible Oil by Caustic Refining

A model plant representative of Subcategory A 5 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels

TABLE 173

ITEMIZED COST SUMMARY FOR ALTERNATIVE A4-I
(OLIVE OIL, MECHANICAL SCREW PRESS EXTRACTION)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	66150.00
2. LAND	12660.00
3. ENGINEERING	6610.00
4. CONTINGENCY	6610.00
TOTAL	92030.00

EARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	980.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	2210.00
TOTAL	3190.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	3190.00
2. YEARLY INVESTMENT	
COST RECOVERY	3680.00
3. DEPRECIATION	3970.00
TOTAL	10840.00

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TABLE 174

ITEMIZED COST SUMMARY FOR ALTERNATIVE A4-II

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN A4-II
DESIGN EFFICIENCY...100 PERCENT

TREATMENT MODULES:

EVAPORATION POND

INVESTMENT COSTS:

1. CONSTRUCTION	205,010.00
2. LAND	3,960.00
3. ENGINEERING	20,500.00
4. CONTINGENCY	20,500.00
TOTAL	254,970.00

YEARLY OPERATING COSTS:

1. LABOR	1,660.00
2. POWER	0.00
3. CHEMICALS	0.00
4. MAINTENANCE & SUPPLIES	25,370.00
TOTAL	27,030.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	27,030.00
2. YEARLY INVESTMENT COST RECOVERY	10,200.00
3. DEPRECIATION	12,300.00
TOTAL	49,530.00

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TABLE 175
ITEMIZED COST SUMMARY FOR ALTERNATIVE A4-III

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN A4-III
DESIGN EFFICIENCY...100 PERCENT

TREATMENT MODULES:

PUMPING STATION
LAND APPLICATION

INVESTMENT COSTS:

1. CONSTRUCTION	32,920.00
2. LAND	6,640.00
3. ENGINEERING	3,290.00
4. CONTINGENCY	3,290.00
TOTAL	46,140.00

YEARLY OPERATING COSTS:

1. LABOR	6,230.00
2. POWER	830.00
3. CHEMICALS	0.00
4. MAINTENANCE & SUPPLIES	500.00
TOTAL	7,560.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	7,560.00
2. YEARLY INVESTMENT	
COST RECOVERY	1,850.00
3. DEPRECIATION	1,980.00
TOTAL	11,390.00

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of waste reductions for the edible oil model plant which refines 454 kkg (500 ton) of crude edible oil per day.

Alternative A 5-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 314 cu m per day. The BOD waste load is 4.59 kg/kkg (9.18 lb/ton), the suspended solids load is 2.49 kg/kkg (4.98 lb/ton), and the oil and grease load is 2.39 kg/kkg (4.78 lb/ton). The model plant developed for Subcategory A 5 is assumed to have separate discharge of non-contact and process wastewaters, in-plant gravity separation, skimming, pH control, and an oil recovery system for the skimmed oil and water wastes.

Costs: 0
Reduction Benefits: None

Alternative A 5-II - This alternative provides pressurized air floatation utilizing chemical flocculating agents to enhance the formation and floatability of wastes. Oil and grease skimmings are pumped to an in-plant oil recovery system.

The resulting BOD waste load is 1.37 kg/kkg (2.74 lb/ton), the suspended solids load is 0.75 kg/kkg (1.50 lb/ton), and the oil and grease load is 0.73 kg/kkg (1.46 lb/ton).

Costs: Total investment cost: \$145,530
Total yearly cost: \$ 42,500

An itemized breakdown of costs is presented in Table 176. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 70.1 percent
SS: 70.0 percent
O&G: 69.5 percent

Alternative A 5-III - This alternative provides in addition to Alternative A 5-II a complete mix activated sludge unit including a secondary clarifier, sludge recirculation, sludge thickening, vacuum filtration, and a sludge holding tank.

The resulting BOD waste load is 0.069 kg/kkg (0.14 lb/ton), the suspended solids load is 0.069 kg/kkg (0.14 lb/ton), and the oil and grease load is 0.069 kg/kkg (0.14 lb/ton).

Costs: Total investment cost: \$354,770
Total yearly cost: \$ 82,560

An itemized breakdown of costs is presented in Table 177. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

TABLE 176

ITEMIZED COST SUMMARY FOR ALTERNATIVE A5-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
B1...CONTROL HOUSE
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	71300.00
2. LAND	59970.00
3. ENGINEERING	7130.00
4. CONTINGENCY	7130.00
TOTAL	145530.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	1490.00
3. CHEMICALS	0.0
4. MAINTENANCE SUPPLIES	5920.00
TOTAL	32400.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	32400.00
2. YEARLY INVESTMENT COST RECOVERY	5820.00
3. DEPRECIATION	4280.00
TOTAL	42500.00

TABLE 177

ITEMIZED COST SUMMARY FOR ALTERNATIVE A5-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
B1...CONTROL HOUSE
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	245660.00
2. LAND	59970.00
3. ENGINEERING	24570.00
4. CONTINGENCY	24570.00
TOTAL	354770.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	15350.00
3. CHEMICALS	2610.00
4. MAINTENANCE&SUPPLIES	10680.00
TOTAL	53630.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	53630.00
2. YEARLY INVESTMENT COST RECOVERY	14190.00
3. DEPRECIATION	14740.00
TOTAL	82560.00

Reduction Benefits: BOD: 98.5 percent
SS: 97.2 percent
O&G: 97.1 percent

Alternative A 5-IV - This alternative provides in addition to Alternative A 5-III dual media pressure filtration equipped with a pump to generate sufficient head for filter operation.

The resulting BOD waste load is 0.035 kg/kg (0.070 lb/ton), the suspended solids load is 0.035 kg/kg (0.070 lb/ton), and the oil and grease load is 0.014 kg/kg (0.028 lb/ton).

Costs: Total investment cost: \$386,850
Total yearly cost: \$ 91,380

An itemized breakdown of costs is presented in Table 178. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.5 percent
SS: 99.6 percent
O&G: 99.7 percent

Alternative A 5-V - This alternative provides in addition to Alternative A 5-IV an activated carbon adsorption unit before final discharge.

The resulting BOD waste load is 0.021 kg/kg (0.042 lb/ton), the suspended solids load is 0.017 kg/kg (0.034 lb/ton), and the oil and grease load is 0.007 kg/kg (0.014 lb/ton).

Costs: Total investment cost: \$459,900
Total yearly cost: \$117,120

An itemized breakdown of costs is presented in Table 179. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.5 percent
SS: 99.6 percent
O&G: 99.7 percent

A cost efficiency curve is presented in Figure 269.

Alternative A 5-VI - This alternative provides in addition to Alternative A 5-II (i.e., dissolved air flotation) an aerated lagoon with a settling pond.

The resulting BOD waste load is 0.069 kg/kg (0.14 lb/ton), the suspended solids load is 0.069 kg/kg (0.14 lb/ton), and the oil and grease load is 0.069 kg/kg (0.14 lb/ton).

TABLE 178

ITEMIZED COST SUMMARY FOR ALTERNATIVE A5-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
B1...CONTROL HOUSE
J...AIR FLOTATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	272400.00
2. LAND	59970.00
3. ENGINEERING	27240.00
4. CONTINGENCY	27240.00
TOTAL	386850.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	20450.00
3. CHEMICALS	2610.00
4. MAINTENANCE&SUPPLIES	11520.00
TOTAL	59570.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	59570.00
2. YEARLY INVESTMENT COST RECOVERY	15470.00
3. DEPRECIATION	16340.00
TOTAL	91380.00

TABLE 179

ITEMIZED COST SUMMARY FOR ALTERNATIVE A5-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY,... 99.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
B1...CONTROL HOUSE
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1.	CONSTRUCTION	333270.00
2.	LAND	59970.00
3.	ENGINEERING	33330.00
4.	CONTINGENCY	33330.00
	TOTAL	459900.00

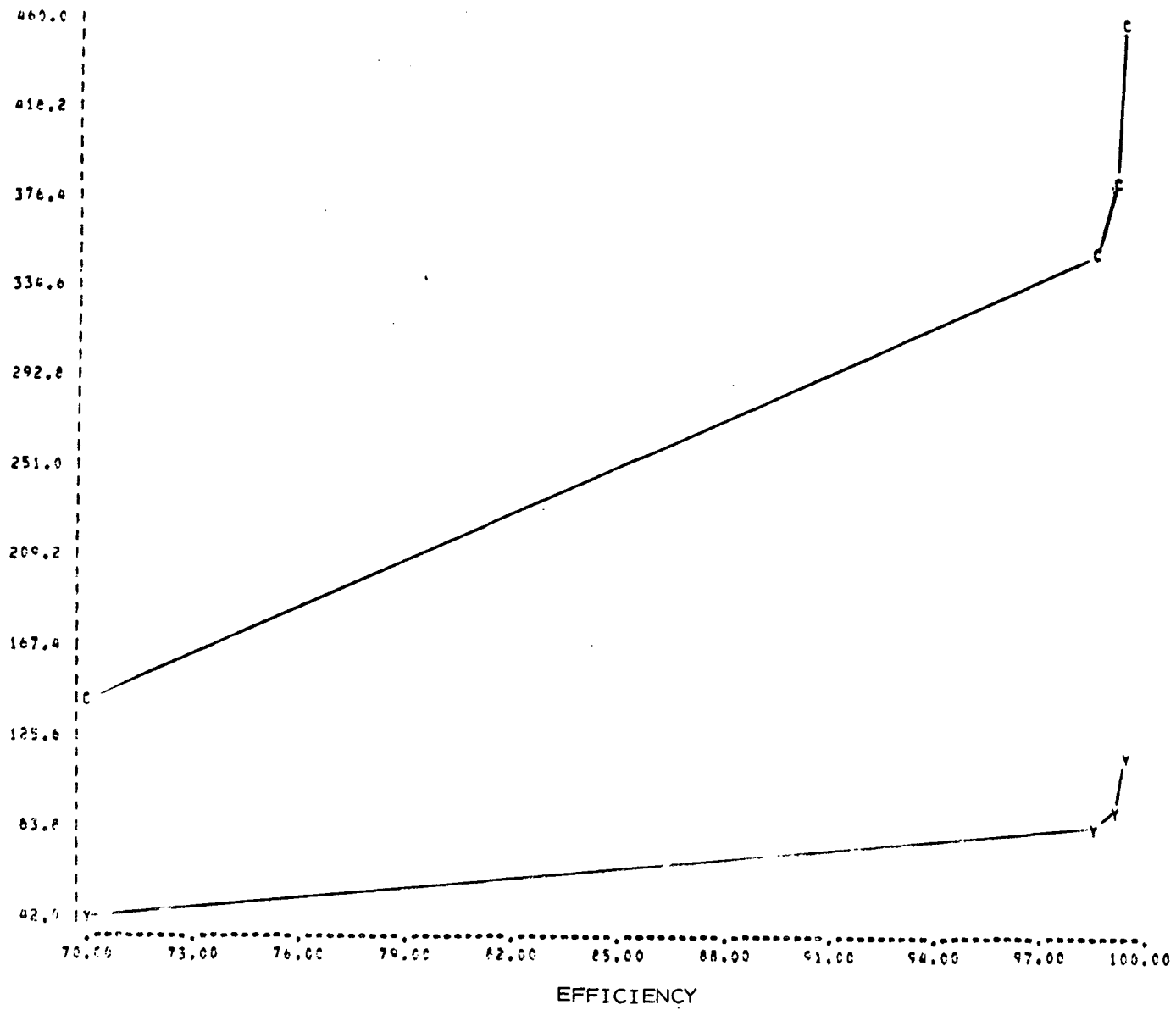
YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	23520.00
3.	CHEMICALS	2610.00
4.	MAINTENANCE&SUPPLIES	27600.00
	TOTAL	78720.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	78720.00
2.	YEARLY INVESTMENT COST RECOVERY	18400.00
3.	DEPRECIATION	20000.00
	TOTAL	117120.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS



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FIGURE 269

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A5, ALTERNATIVES II THRU V

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Costs: Total investment cost: \$249,080
Total yearly cost: \$ 92,170

An itemized breakdown of costs is presented in Table 180. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.2 percent
O&G: 97.1 percent

Alternative A 5-VII - This alternative provides in addition to Alternative A 5-VI dual media pressure filtration and a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.035 kg/kkg (0.070 lb/ton), the suspended solids load is 0.035 kg/kkg (0.070 lb/ton), and the oil and grease load is 0.014 kg/kkg (0.028 lb/ton).

Costs: Total investment cost: \$281,160
Total yearly cost: \$101,010

An itemized breakdown of costs is presented in Table 181. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 99.2 percent
SS: 99.2 percent
O&G: 99.4 percent

Alternative A 5-VIII - This alternative provides in addition to Alternative A 5-VII an activated carbon adsorption unit before final discharge.

The resulting BOD waste load is 0.021 kg/kkg (0.042 lb/ton), the suspended solids load is 0.017 kg/kkg (0.034 lb/ton), and the oil and grease load is 0.007 kg/kkg (0.014 lb/ton).

Costs: Total investment cost: \$354,210
Total yearly cost: \$126,730

An itemized breakdown of costs is presented in Table 182. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 99.5 percent
SS: 99.6 percent
O&G: 99.7 percent

A cost efficiency curve is presented in Figure 270.

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TABLE 180

ITEMIZED COST SUMMARY FOR ALTERNATIVE A5-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

R...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	20070.00
2. LAND	4000.00
3. ENGINEERING	20080.00
4. CONTINGENCY	20080.00
5. PVC LINER	4150.00
TOTAL	249080.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	46490.00
3. CHEMICALS	0.00
4. MAINTENANCE & SUPPLIES	10370.00
5. PVC LINER	210.00
TOTAL	69960.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	69960.00
2. YEARLY INVESTMENT COST RECOVERY	90000.00
3. DEPRECIATION	12250.00
TOTAL	172510.00

TABLE 181

ITEMIZED COST SUMMARY FOR ALTERNATIVE A5-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	227510.00
2. LAND	4000.00
3. ENGINEERING	22750.00
4. CONTINGENCY	22750.00
5. PVC LINER	4150.00
TOTAL	281160.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	51990.00
3. CHEMICALS	0.0
4. MAINTENANCE SUPPLIES	11250.00
5. PVC LINER	210.00
TOTAL	75900.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	75900.00
2. YEARLY INVESTMENT COST RECOVERY	11250.00
3. DEPRECIATION	13600.00
TOTAL	100750.00

TABLE 182

ITEMIZED COST SUMMARY FOR ALTERNATIVE A5-VIII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

E...PUMPING STATION
J...AIR FLUTATION
L...AERATED LAGOON
R...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	288380.00
2. LAND	4000.00
3. ENGINEERING	28840.00
4. CONTINGENCY	2884.00
5. PVC LINER	4150.00
TOTAL	334210.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	55060.00
3. CHEMICALS	300.00
4. MAINTENANCE & SUPPLIES	2724.00
5. PVC LINER	210.00
TOTAL	70784.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	70784.00
2. YEARLY INVESTMENT	
COST RECOVERY	14176.80
3. DEPRECIATION	4000.00
TOTAL	56607.20

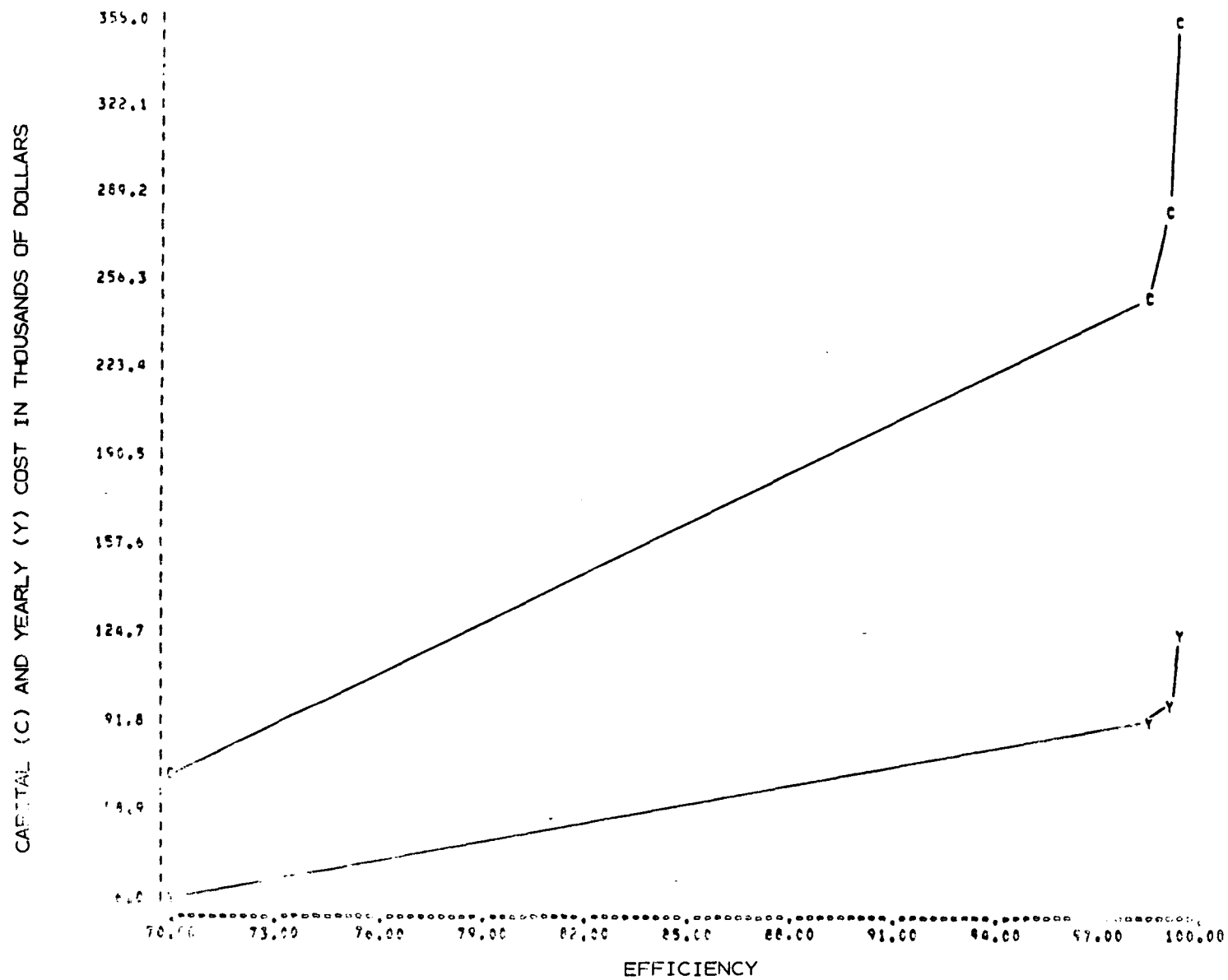


FIGURE 270
INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A₅, ALTERNATIVES VI THRU VIII

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 6 - Edible Oil Processing by Caustic Refining and Acidulation

A model plant representative of Subcategory A 6 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which refines 454 kkg (500 ton) of crude edible oil per day.

Alternative A 6-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 534 cu m (0.141 MG) per day. The BOD waste load is 8.95 kg/kkg (17.90 lb/ton), the suspended solids load is 4.03 kg/kkg (8.06 lb/ton), and the oil and grease load is 3.51 kg/kkg (7.02 lb/ton). The model plant developed for Subcategory A 6 is assumed to have separate discharge of non-contact and process wastewaters, in-plant gravity separation, skimming, pH control, and an oil recovery system for the skimmed oil and water wastes.

Costs: 0
Reduction Benefits: None

Alternative A 6-II - This alternative provides for the addition of pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

The resulting BOD waste load is 2.68 kg/kkg (5.36 lb/ton), the suspended solids load is 1.21 kg/kkg (2.42 lb/ton), and the oil and grease load is 1.05 kg/kkg (2.10 lb/ton).

Costs: Total investment cost: \$154,540
Total yearly cost: \$ 44,140

An itemized breakdown of costs is presented in Table 183. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 70 percent
SS: 70 percent
O&G: 70 percent

Alternative A 6-III - This alternative provides for the addition of activated sludge, secondary clarification, sludge recirculation, pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every four days. The activated sludge unit also includes a control house and two full-time operators.

TABLE 183

ITEMIZED COST SUMMARY FOR ALTERNATIVE A6-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
R1...CONTROL HOUSE
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	76790.00
2. LAND	62390.00
3. ENGINEERING	7680.00
4. CONTINGENCY	7680.00
TOTAL	154540.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	2140.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	6220.00
TOTAL	33350.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	33350.00
2. YEARLY INVESTMENT COST RECOVERY	6180.00
3. DEPRECIATION	4610.00
TOTAL	44140.00

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The resulting BOD waste load is 0.13 kg/kkg (0.27 lb/ton), the suspended solids load is 0.12 kg/kkg (0.24 lb/ton), and the oil and grease load is 0.10 kg/kkg (0.21 lb/ton).

Costs: Total investment cost: \$460,940
Total yearly cost: \$105,880

An itemized breakdown of costs is presented in Table 184. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.0 percent
O&G: 97.0 percent

Alternative A 6-IV - This alternative provides for the addition of dual media pressure filtration with pump stations to generate sufficient head for the filter operation.

The resulting BOD waste load is 0.067 kg/kkg (0.13 lb/ton), the suspended solids load is 0.061 kg/kkg (0.12 lb/ton), and the oil and grease load is 0.023 kg/kkg (0.046 lb/ton).

Costs: Total investment cost: \$497,190
Total yearly cost: \$116,050

An itemized breakdown of costs is presented in Table 185. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.3 percent
SS: 98.5 percent
O&G: 99.3 percent

Alternative A 6-V - This alternative provides for the addition of activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.035 kg/kkg (0.070 lb/ton), the suspended solids load is 0.030 kg/kkg (0.060 lb/ton), and the oil and grease load is 0.012 kg/kkg (0.024 lb/ton).

Costs: Total investment cost: \$620,340
Total yearly cost: \$148,780

An itemized breakdown of costs is presented in Table 186. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.3 percent
O&G: 99.6 percent

A cost efficiency curve is presented in Figure 271.

DRAFT

TABLE 184

ITEMIZED COST SUMMARY FOR ALTERNATIVE A6-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
B1...CONTROL HOUSE
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	332190.00
2. LAND	62310.00
3. ENGINEERING	33220.00
4. CONTINGENCY	33220.00
TOTAL	460940.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	26000.00
3. CHEMICALS	3480.00
4. MAINTENANCE & SUPPLIES	13040.00
TOTAL	67510.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	67510.00
2. YEARLY INVESTMENT COST RECOVERY	14440.00
3. DEPRECIATION	1990.00
TOTAL	105850.00

TABLE 185

ITEMIZED COST SUMMARY FOR ALTERNATIVE A6-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
B1...CONTROL HOUSE
J...AIR FLOTATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	362400.00
2. LAND	62310.00
3. ENGINEERING	36240.00
4. CONTINGENCY	36240.00
TOTAL	497190.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	32330.00
3. CHEMICALS	3480.00
4. MAINTENANCE&SUPPLIES	13620.00
TOTAL	74420.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	74420.00
2. YEARLY INVESTMENT COST RECOVERY	19890.00
3. DEPRECIATION	21740.00
TOTAL	116050.00

TABLE 186

ITEMIZED COST SUMMARY FOR ALTERNATIVE A6-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
B1...CONTROL HOUSE
J...AIR FLOTATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	465030.00
2. LAND	62310.00
3. ENGINEERING	46500.00
4. CONTINGENCY	46500.00
TOTAL	620340.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	36660.00
3. CHEMICALS	3480.00
4. MAINTENANCE&SUPPLIES	30940.00
TOTAL	96070.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	96070.00
2. YEARLY INVESTMENT COST RECOVERY	24810.00
3. DEPRECIATION	27900.00
TOTAL	148780.00

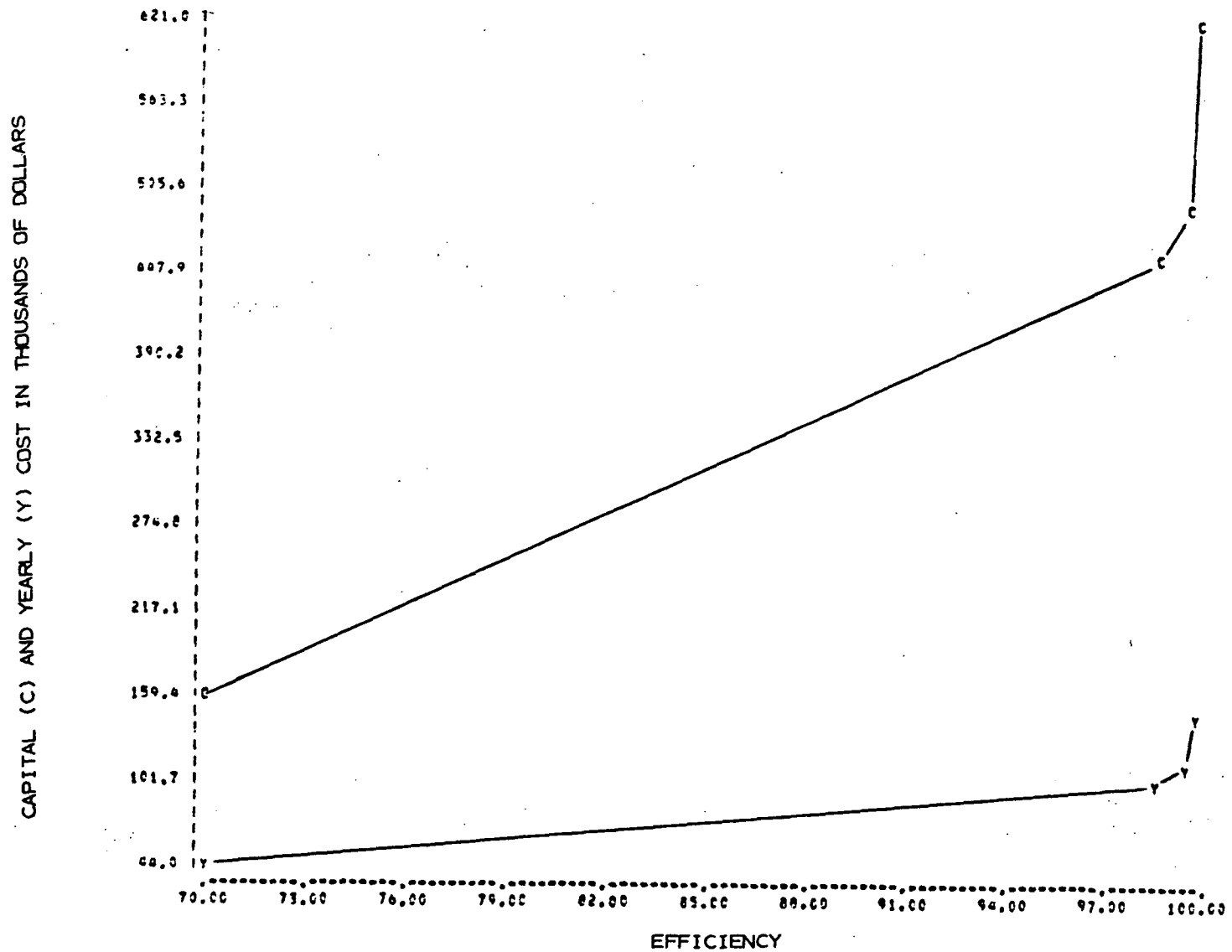


FIGURE 271

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A6, ALTERNATIVES II THRU V

Alternative A 6-VI - This alternative provides in addition to Alternative A 6-II (i.e., dissolved air flotation) an aerated lagoon system including a settling pond.

The resulting BOD waste load is 0.13 kg/kkg (0.27 lb/ton), the suspended solids load is 0.12 kg/kkg (0.24 lb/ton), and the oil and grease load is 0.10 kg/kkg (0.21 lb/ton).

Costs: Total investment cost: \$374,050
Total yearly cost: \$152,640

An itemized breakdown of costs is presented in Table 187. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.0 percent
O&G: 97.0 percent

Alternative A 6-VII - This alternative provides in addition to Alternative A 6-VI dual media pressure filtration with a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.067 kg/kkg (0.13 lb/ton), the suspended solids load is 0.061 kg/kkg (0.12 lb/ton), and the oil and grease load is 0.023 kg/kkg (0.046 lb/ton).

Costs: Total investment cost: \$410,300
Total yearly cost: \$162,800

An itemized breakdown of costs is presented in Table 188. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.5 percent
O&G: 99.3 percent

Alternative A 6-VIII - This alternative provides in addition to Alternative A 6-VII an activated carbon adsorption unit prior to final discharge.

The resulting BOD waste load is 0.035 kg/kkg (0.070 lb/ton), the suspended solids load is 0.030 kg/kkg (0.060 lb/ton), and the oil and grease load is 0.012 kg/kkg (0.024 lb/ton).

Costs: Total investment cost: \$533,480
Total yearly cost: \$195,540

An itemized breakdown of costs is presented in Table 189. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

TABLE 187

ITEMIZED COST SUMMARY FOR ALTERNATIVE A6-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
J...AIR FLUTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	300110.00
2. LAND	5000.00
3. ENGINEERING	30010.00
4. CONTINGENCY	30010.00
5. PVC LINER	8420.00
TOTAL	374050.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	9150.00
3. CHEMICALS	0.00
4. MAINTENANCE&SUPPLIES	1400.00
5. PVC LINER	50.00
TOTAL	21790.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	21790.00
2. YEARLY INVESTMENT COST RECOVERY	1496.00
3. DEPRECIATION	1496.00
TOTAL	15360.00

TABLE 188

ITEMIZED COST SUMMARY FOR ALTERNATIVE A6-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	37,000.00
2. LAND	300.00
3. ENGINEERING	2,000.00
4. CONTINGENCY	0.00
5. PVC LINER	90.00
TOTAL	41,290.00

YEARLY OPERATING COSTS:

1. LABOR	1249.00
2. POWER	97920.00
3. CHEMICALS	0.00
4. MAINTENANCE & SUPPLIES	370.00
5. PVC LINER	350.00
TOTAL	102,689.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	102,689.00
2. YEARLY INVESTMENT COST RECOVER	0.00
3. DEPRECIATION	0.00
TOTAL	102,689.00

TABLE 189

ITEMIZED COST SUMMARY FOR ALTERNATIVE A6-VIII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT ON-LINE
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	432960.00
2. LAND	5000.00
3. ENGINEERING	13300.00
4. CONTINGENCY	3300.00
5. PVC LINER	8920.00
TOTAL	533480.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	102250.00
3. CHEMICALS	0.00
4. MAINTENANCE & SUPPLIES	3250.00
5. PVC LINER	350.00
TOTAL	117040.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COSTS	117040.00
2. YEARLY INVESTMENT COST RECOVERY	533480.00
3. DEPRECIATION	117040.00
TOTAL	767560.00

Reduction Benefits: BOD: 99.6 percent
SS: 99.3 percent
O&G: 99.6 percent

A cost efficiency curve is presented in Figure 272.

Cost and Reduction Benefits of Alternative Treatment Technologies for
Subcategory A 7 - Edible Oil Processing by Caustic Refining,
Acidulation, Oil Processing, and Deodorization

A model plant representative of Subcategory A 7 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which refines 454 kkg (500 ton) of crude edible oil per day.

Alternative A 7-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 1147 cu m (0.303 MG) per day. The BOD waste load is 16.09 kg/kkg (32.18 lb/ton), the suspended solids load is 7.84 kg/kkg (15.68 lb/ton), and the oil and grease load is 3.93 kg/kkg (7.86 lb/ton). The model plant developed for Subcategory A 7 is assumed to have separate discharge of process and non-contact wastewater, in-plant gravity, separation, skimming, pH control, and an oil recovery system for skimmed oil and water wastes.

Costs: 0
Reduction Benefits: None

Alternative A 7-II - This alternative provides for the addition of pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

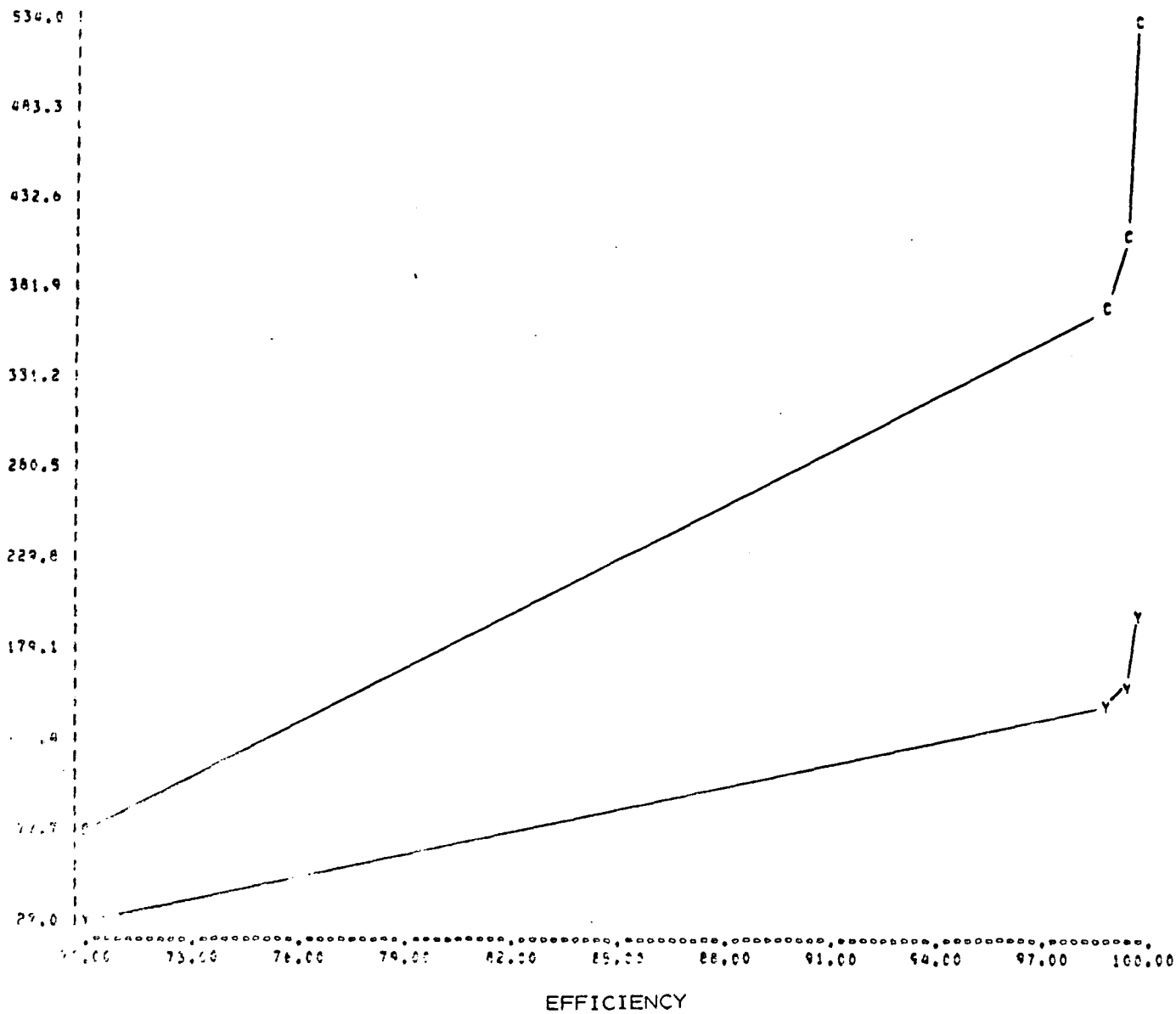
The resulting BOD waste load is 4.85 kg/kkg (9.70 lb/ton), the suspended solids load is 2.35 kg/kkg (4.70 lb/ton), and the oil and grease load is 1.13 kg/kkg (2.26 lb/ton).

Costs: Total investment cost: \$193,640
Total yearly cost: \$ 49,530

An itemized breakdown of costs is presented in Table 190. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 69.8 percent
SS: 70.0 percent
O&G: 71.3 percent

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS



DRAFT

FIGURE 272
INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A6, ALTERNATIVES VI THRU VIII

TABLE 190

ITEMIZED COST SUMMARY FOR ALTERNATIVE A7-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1..CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	100280.00
2. LAND	73300.00
3. ENGINEERING	10030.00
4. CONTINGENCY	10030.00
TOTAL	193640.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	3840.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	6930.00
TOTAL	35760.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	35760.00
2. YEARLY INVESTMENT COST RECOVERY	7750.00
3. DEPRECIATION	6020.00
TOTAL	49530.00

Alternative A 7-III - This alternative provides in addition to Alternative A 7-II complete mix activated sludge, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every ten days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.25 kg/kkg (0.50 lb/ton), the suspended solids load is 0.25 kg/kkg (0.50 lb/ton), and the oil and grease load is 0.25 kg/kkg (0.50 lb/ton).

Costs: Total investment cost: \$672,560
Total yearly cost: \$151,370

An itemized breakdown of costs is presented in Table 191. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.4 percent
SS: 96.8 percent
O&G: 93.6 percent

Alternative A 7-IV - This alternative provides in addition to Alternative A 7-III dual media pressure filtration with a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.13 kg/kkg (0.25 lb/ton), the suspended solids load is 0.13 kg/kkg (0.25 lb/ton), and the oil and grease load is 0.051 kg/kkg (0.10 lb/ton).

Costs: Total investment cost: \$718,630
Total yearly cost: \$164,520

An itemized breakdown of costs is presented in Table 192. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.4 percent
O&G: 98.7 percent

Alternative A 7-V - This alternative provides in addition to Alternative A 7-IV activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.076 kg/kkg (0.15 lb/ton), the suspended solids load is 0.063 kg/kkg (0.13 lb/ton), and the oil and grease load is 0.025 kg/kkg (0.050 lb/ton).

Costs: Total investment cost: \$1,009,970
Total yearly cost: \$ 216,450

TABLE 191

ITEMIZED COST SUMMARY FOR ALTERNATIVE A7-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	499380.00
2. LAND	73300.00
3. ENGINEERING	49940.00
4. CONTINGENCY	49940.00
TOTAL	672560.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	46720.00
3. CHEMICALS	5530.00
4. MAINTENANCE & SUPPLIES	17270.00
TOTAL	94510.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	94510.00
2. YEARLY INVESTMENT COST RECOVERY	26000.00
3. DEPRECIATION	29940.00
TOTAL	150450.00

TABLE 192

ITEMIZED COST SUMMARY FOR ALTERNATIVE A7-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	537770.00
2. LAND	73300.00
3. ENGINEERING	53780.00
4. CONTINGENCY	53780.00
TOTAL	718630.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	55000.00
3. CHEMICALS	5530.00
4. MAINTENANCE SUPPLIES	17980.00
TOTAL	103500.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	103500.00
2. YEARLY INVESTMENT COST RECOVERY	26750.00
3. DEPRECIATION	32270.00
TOTAL	164520.00

An itemized breakdown of costs is presented in Table 193. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.5 percent
SS: 99.2 percent
O&G: 99.4 percent

A cost efficiency curve is presented in Figure 273.

Alternative A 7-VI - This alternative provides in addition to Alternative A 7-II an aerated lagoon and settling pond.

The resulting BOD waste load is 0.25 kg/kkg (0.50 lb/ton), the suspended solids load is 0.25 kg/kkg (0.50 lb/ton), and the oil and grease load is 0.25 kg/kkg (0.50 lb/ton).

Costs: Total investment cost: \$607,720
Total yearly cost: \$266,550

An itemized breakdown of costs is presented in Table 194. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.4 percent
SS: 96.8 percent
O&G: 93.6 percent

Alternative A 7-VII - This alternative provides in addition to Alternative A 7-VI dual media pressure filtration and a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.13 kg/kkg (0.25 lb/ton), the suspended solids load is 0.13 kg/kkg (0.25 lb/ton), and the oil and grease load is 0.051 kg/kkg (0.10 lb/ton).

Costs: Total investment cost: \$653,790
Total yearly cost: \$279,680

An itemized breakdown of costs is presented in Table 195. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.4 percent
O&G: 98.7 percent

Alternative A 7-VIII - This alternative provides in addition to Alternative A 7-VII activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.076 kg/kkg (0.15 lb/ton), the suspended solids load is 0.063 kg/kkg (0.13 lb/ton), and the oil and grease load is 0.025 kg/kkg (0.050 lb/ton).

TABLE 193

ITEMIZED COST SUMMARY FOR ALTERNATIVE A7-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	776390.00
2. LAND	73300.00
3. ENGINEERING	77640.00
4. CONTINGENCY	77640.00
TOTAL	1004970.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	63540.00
3. CHEMICALS	5530.00
4. MAINTENANCE & SUPPLIES	35610.00
TOTAL	129670.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	129670.00
2. YEARLY INVESTMENT COST RECOVERY	210450.00
3. DEPRECIATION	46500.00
TOTAL	210450.00

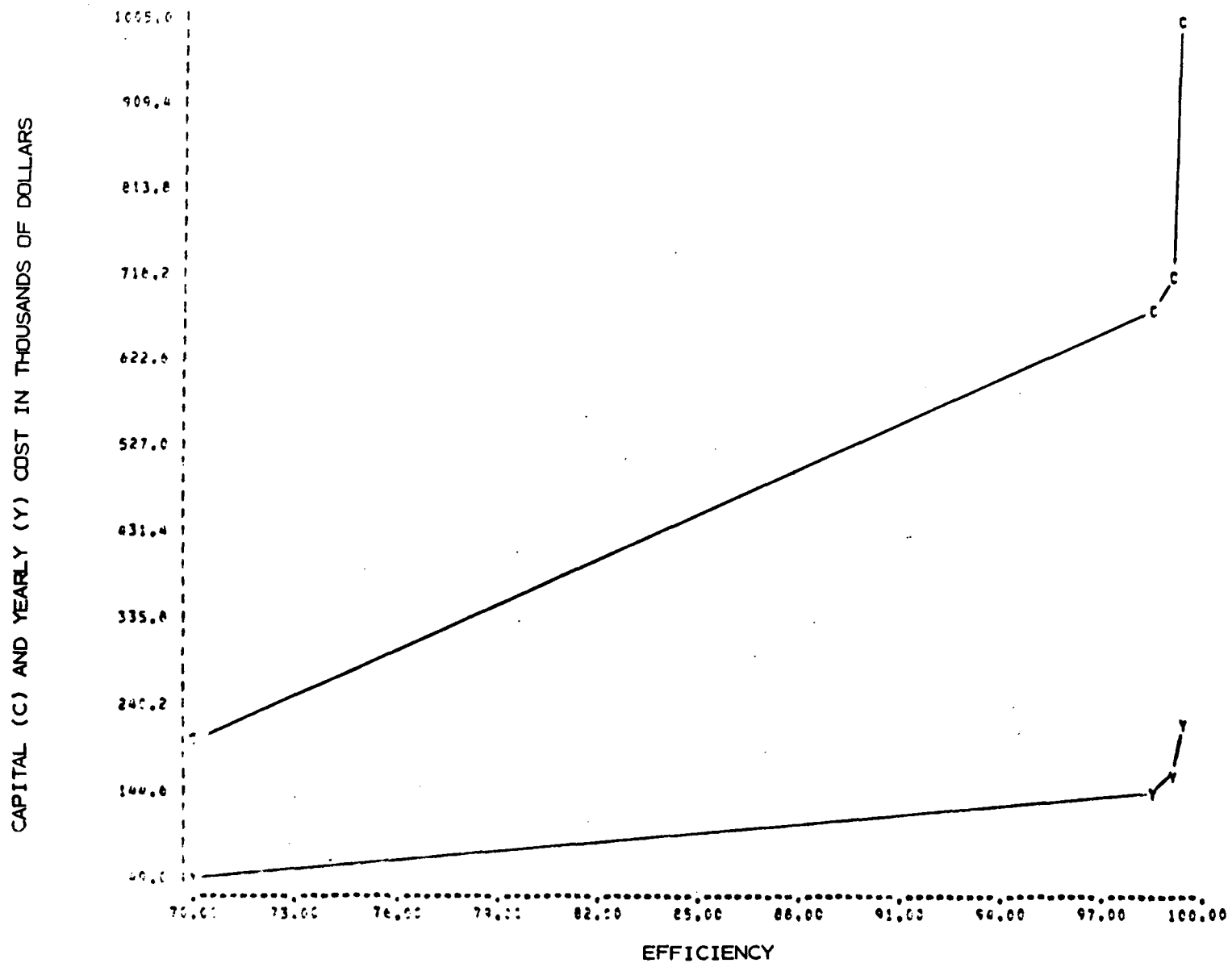


FIGURE 273

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A7, ALTERNATIVES II THRU V

TABLE 194

ITEMIZED COST SUMMARY FOR ALTERNATIVE A7-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	487230.00
2. LAND	6780.00
3. ENGINEERING	48720.00
4. CONTINGENCY	48720.00
5. PVC LINER	16270.00
TOTAL	607720.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	164250.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	22210.00
5. PVC LINER	740.00
TOTAL	212190.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	212190.00
2. YEARLY INVESTMENT	
COST RECOVERY	24310.00
3. DEPRECIATION	30050.00
TOTAL	2-6550.00

TABLE 195

ITEMIZED COST SUMMARY FOR ALTERNATIVE A7-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
M...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	525820.00
2. LAND	6780.00
3. ENGINEERING	52580.00
4. CONTINGENCY	52580.00
5. PVC LINER	16270.00
TOTAL	653790.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	172530.00
3. CHEMICALS	0.00
4. MAINTENANCE & SUPPLIES	12520.00
5. PVC LINER	130.00
TOTAL	223130.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	223130.00
2. YEARLY INVESTMENT COST RECOVERY	26140.00
3. DEPRECIATION	32550.00
TOTAL	279680.00

Costs: Total investment cost: \$940,130
 Total yearly cost: \$331,620

An itemized breakdown of costs is presented in Table 196. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.5 percent
 SS: 99.2 percent
 O&G: 99.4 percent

A cost efficiency curve is presented in Figure 274.

Cost and Reduction Benefits of Alternative Treatment Technologies
 for Subcategory A 8 - Edible Oil Processing by Caustic Refining,
 Oil Processing, and Deodorization

A model plant representative of Subcategory A 8 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which refines 454 kkg (500 ton) of crude edible oil per day.

Alternative A 8-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 927 cu m (0.245 MG) per day. The BOD waste load is 11.73 kg/kkg (23.46 lb/ton), the suspended solids load is 6.30 kg/kkg (12.60 lb/ton), and the oil and grease load is 2.81 kg/kkg (5.62 lb/ton). The model plant developed for Subcategory A 8 is assumed to have separate discharge of process and non-contact wastewaters, in-plant gravity separation, skimming, pH control, and an oil recovery system for the skimmed oil and water wastes.

Costs: 0
 Reduction Benefits: None

Alternative A 8-II - This alternative provides pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

The resulting BOD waste load is 3.53 kg/kkg (7.06 lb/ton), the suspended solids load is 1.90 kg/kkg (3.8 lb/ton), and the oil and grease load is 0.86 kg/kkg (1.72 lb/ton).

Costs: Total investment cost: \$192,460
 Total yearly cost: \$ 49,060

An itemized breakdown of costs is presented in Table 197. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

TABLE 196

ITEMIZED COST SUMMARY FOR ALTERNATIVE A7-VIII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	764240.00
2. LAND	6780.00
3. ENGINEERING	76420.00
4. CONTINGENCY	76420.00
5. PVC LINER	16270.00
TOTAL	940130.00

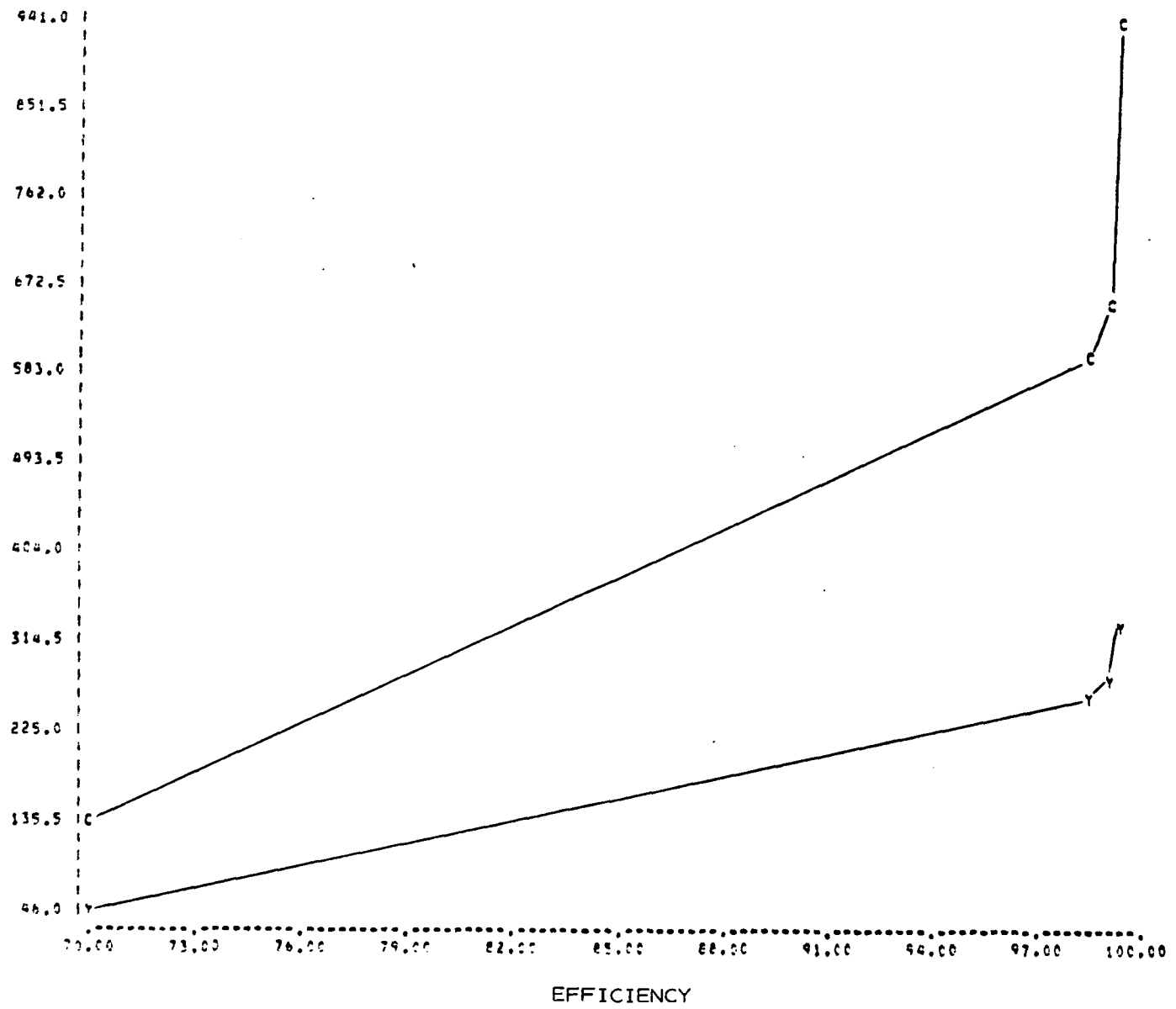
YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	181070.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	40540.00
5. PVC LINER	740.00
TOTAL	247340.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	247340.00
2. YEARLY INVESTMENT	
COST RECOVERY	37610.00
3. DEPRECIATION	46670.00
TOTAL	331620.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS



DRAFT

FIGURE 274
INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A7 ALTERNATIVES VI THRU VIII

TABLE 197

ITEMIZED COST SUMMARY FOR ALTERNATIVE A8-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
Y...HOLDING TANK

INVESTMENT COSTS:

1.	CONSTRUCTION	102070.00
2.	LAND	69970.00
3.	ENGINEERING	10210.00
4.	CONTINGENCY	10210.00
	TOTAL	192460.00

YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	3310.00
3.	CHEMICALS	0.0
4.	MAINTENANCE & SUPPLIES	6940.00
	TOTAL	35240.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	35240.00
2.	YEARLY INVESTMENT COST RECOVERY	7700.00
3.	DEPRECIATION	6120.00
	TOTAL	49060.00

Reduction Benefits: BOD: 69.9 percent
SS: 69.8 percent
O&G: 69.4 percent

Alternative A 8-III - This alternative provides in addition to Alternative A 8-II complete mix activated sludge, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every seven days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.20 kg/kkg (0.41 lb/ton), the suspended solids load is 0.20 kg/kkg (0.41 lb/ton), and the oil and grease load is 0.10 kg/kkg (0.20 lb/ton).

Costs: Total investment cost: \$585,720
Total yearly cost: \$128,180

An itemized breakdown of costs is presented in Table 198. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.3 percent
SS: 96.8 percent
O&G: 96.4 percent

Alternative A 8-IV - This alternative provides in addition to Alternative A 8-III dual media pressure filtration with a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.10 kg/kkg (0.20 lb/ton), the suspended solids load is 0.10 kg/kkg (0.20 lb/ton), and the oil and grease load is 0.041 kg/kkg (0.082 lb/ton).

Costs: Total investment cost: \$628,590
Total yearly cost: \$140,210

An itemized breakdown of costs is presented in Table 199. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.1 percent
SS: 98.4 percent
O&G: 98.2 percent

Alternative A 8-V - This alternative provides in addition to Alternative A 8-IV activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.051 kg/kkg (0.10 lb/ton), the suspended solids load is 0.051 kg/kkg (0.10 lb/ton), and the oil and grease load is 0.020 kg/kkg (0.040 lb/ton).

TABLE 198

ITEMIZED COST SUMMARY FOR ALTERNATIVE A8-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
Y...HOLDING TANK
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	429790.00
2. LAND	69970.00
3. ENGINEERING	42980.00
4. CONTINGENCY	42980.00
TOTAL	585720.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	34590.00
3. CHEMICALS	4100.00
4. MAINTENANCE & SUPPLIES	15280.00
TOTAL	78960.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	78960.00
2. YEARLY INVESTMENT COST RECOVERY	23430.00
3. DEPRECIATION	25790.00
TOTAL	128180.00

TABLE 199

ITEMIZED COST SUMMARY FOR ALTERNATIVE A8-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
Y...HOLDING TANK
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	465520.00
2.	LAND	69970.00
3.	ENGINEERING	46550.00
4.	CONTINGENCY	46550.00
	TOTAL	628590.00

YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	42110.00
3.	CHEMICALS	4100.00
4.	MAINTENANCE & SUPPLIES	15940.00
	TOTAL	87140.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	87140.00
2.	YEARLY INVESTMENT COST RECOVERY	25140.00
3.	DEPRECIATION	27930.00
	TOTAL	140210.00

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Costs: Total investment cost: \$856,530
Total yearly cost: \$183,240

An itemized breakdown of costs is presented in Table 200. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.3 percent

A cost efficiency curve is presented in Figure 275.

Alternative A 8-VI - This alternative provides in addition to Alternative A 8-II (i.e., dissolved air flotation) an aerated lagoon including a settling pond.

The resulting BOD waste load is 0.20 kg/kkg (0.41 lb/ton), the suspended solids load is 0.20 kg/kkg (0.41 lb/ton), and the oil and grease load is 0.10 kg/kkg (0.20 lb/ton).

Costs: Total investment cost: \$488,440
Total yearly cost: \$206,100

An itemized breakdown of costs is presented in Table 201. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.3 percent
SS: 96.8 percent
O&G: 96.4 percent

Alternative A 8-VII - This alternative provides in addition to Alternative A 8-VI dual media pressure filtration with a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.10 kg/kkg (0.20 lb/ton), the suspended solids load is 0.10 kg/kkg (0.20 lb/ton), and the oil and grease load is 0.041 kg/kkg (0.082 lb/ton).

Costs: Total investment cost: \$531,310
Total yearly cost: \$218,140

An itemized breakdown of costs is presented in Table 202. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.1 percent
SS: 98.4 percent
O&G: 98.5 percent

TABLE 200

ITEMIZED COST SUMMARY FOR ALTERNATIVE A8-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
Y...HOLDING TANK
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	655460.00
2. LAND	69970.00
3. ENGINEERING	65550.00
4. CONTINGENCY	65550.00
TOTAL	856530.00

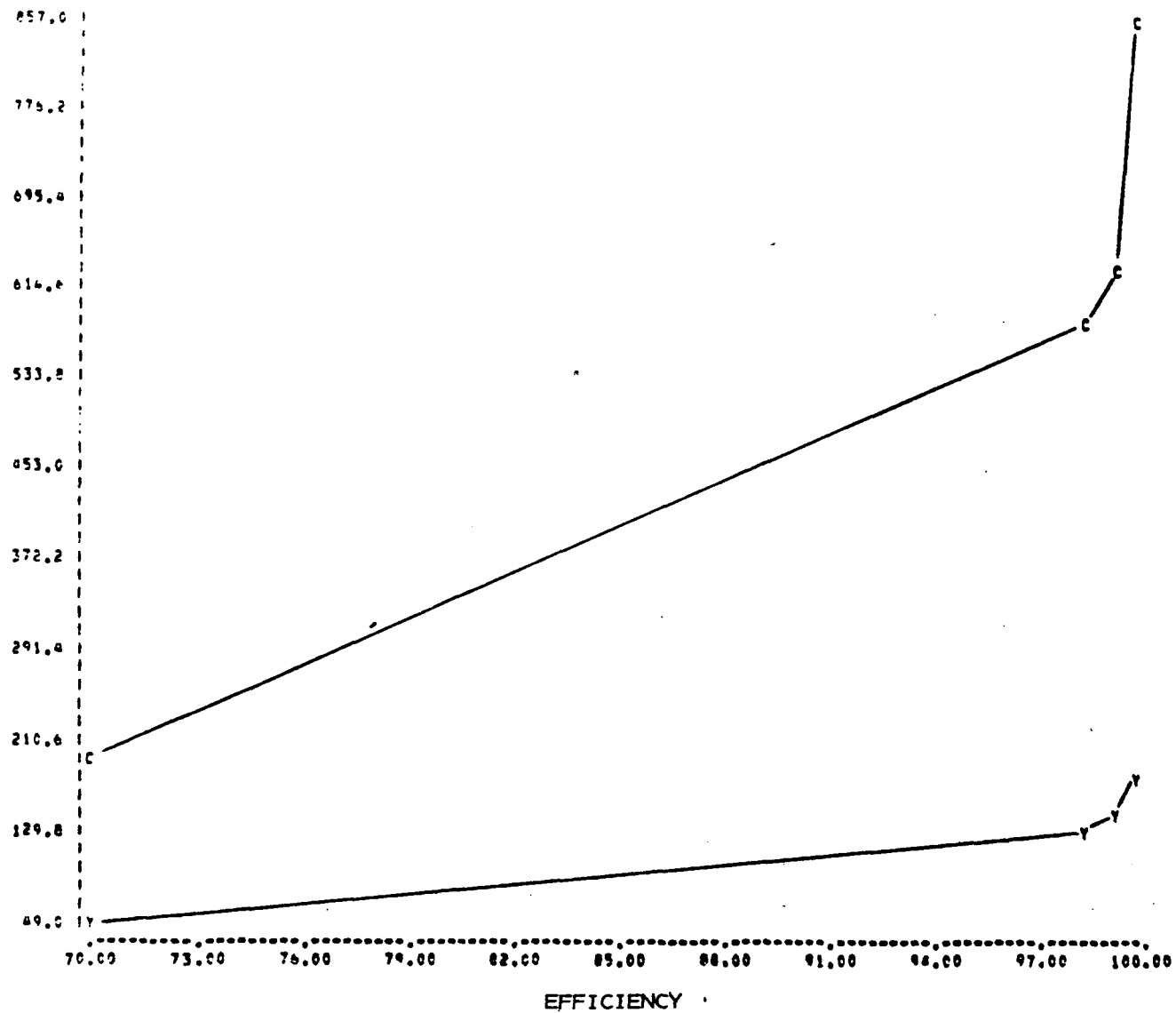
YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	49140.00
3. CHEMICALS	4100.00
4. MAINTENANCE&SUPPLIES	31420.00
TOTAL	109650.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	109650.00
2. YEARLY INVESTMENT COST RECOVERY	34260.00
3. DEPRECIATION	39330.00
TOTAL	183240.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS



DRAFT

FIGURE 275

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A8, ALTERNATIVES II THRU V

TABLE 201

ITEMIZED COST SUMMARY FOR ALTERNATIVE A8-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

P1..CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	391870.00
2. LAND	6000.00
3. ENGINEERING	39190.00
4. CONTINGENCY	39190.00
5. PVC LINER	12190.00
TOTAL	488440.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	119100.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	17750.00
5. PVC LINER	600.00
TOTAL	162440.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	162440.00
2. YEARLY INVESTMENT COST RECOVERY	19540.00
3. DEPRECIATION	24120.00
TOTAL	206100.00

TABLE 202

ITEMIZED COST SUMMARY FOR ALTERNATIVE A8-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
R...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	427600.00
2. LAND	6000.00
3. ENGINEERING	42760.00
4. CONTINGENCY	42760.00
5. PVC LINER	12190.00
TOTAL	531310.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	126620.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	18410.00
5. PVC LINER	600.00
TOTAL	170620.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	170620.00
2. YEARLY INVESTMENT	
COST RECOVERY	21250.00
3. DEPRECIATION	26270.00
TOTAL	218140.00

DRAFT

Alternative A 8-VIII - This alternative provides in addition to Alternative A 8-VII activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.051 kg/kkg (0.10 lb/ton), the suspended solids load is 0.051 kg/kkg (0.10 lb/ton), and the oil and grease load is 0.020 kg/kkg (0.040 lb/ton).

Costs: Total investment cost: \$759,220
Total yearly cost: \$263,200

An itemized breakdown of costs is presented in Table 203. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.3 percent

A cost efficiency curve is presented in Figure 276.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 9 - Edible Oil Processing by Caustic Refining, Acidulation, Oil Processing, Deodorization, and Shortening and Table Oil Processing

A model plant representative of Subcategory A 9 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which refines 454 kkg (500 ton) of crude edible oil per day.

Alternative A 9-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 1320 cu m (0.349 MG) per day. The BOD waste load is 17.12 kkg (34.24 lb/ton), the suspended solids load is 8.68 kg/kkg (17.36 lb/ton), and the oil and grease load is 4.35 kg/kkg (8.70 lb/ton).

The model plant developed for Subcategory A 9 is assumed to have separate discharge of process and non-contact wastewaters, in-plant gravity separation and skimming, pH control, and an oil recovery system for reclamation of waste oil and grease skimmings.

Cost: 0
Reduction Benefits: None

Alternative A 9-II - This alternative provides the addition of pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

914

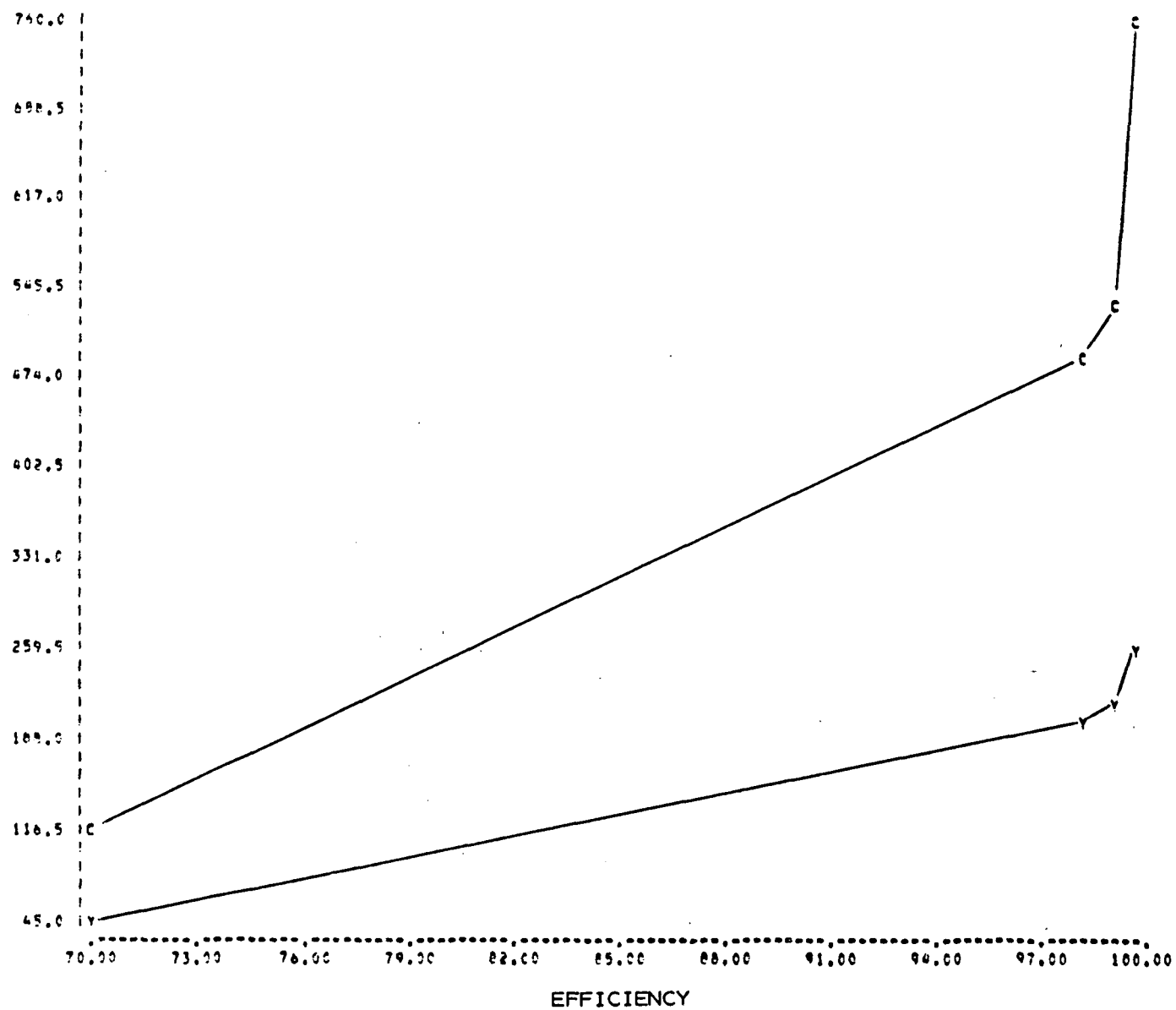


FIGURE 276

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A8, ALTERNATIVES II AND VI THRU VII

TABLE 203

ITEMIZED COST SUMMARY FOR ALTERNATIVE A8-VIII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
P...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	617530.00
2. LAND	6000.00
3. ENGINEERING	61750.00
4. CONTINGENCY	61750.00
5. PVC LINER	12190.00
TOTAL	759220.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	133650.00
3. CHEMICALS	0.0
4. MAINTENANCE SUPPLIES	35930.00
5. PVC LINER	600.00
TOTAL	195170.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	195170.00
2. YEARLY INVESTMENT COST RECOVERY	30370.00
3. DEPRECIATION	37640.00
TOTAL	263200.00

DRAFT

The resulting BOD waste load is 5.15 kg/kkg (10.30 lb/ton), the suspended solids load is 2.62 kg/kkg (5.24 lb/ton), and the oil and grease load is 1.31 kg/kkg (2.62 lb/ton).

Costs: Total investment cost: \$201,480
Total yearly cost: \$ 50,560

An itemized breakdown of costs is presented in Table 204. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 70.0 percent
SS: 70.0 percent
O&G: 70.0 percent

Alternative A 9-III - This alternative provides in addition to Alternative A 9-II complete mix activated sludge, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every nine days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.26 kg/kkg (0.52 lb/ton), the suspended solids load is 0.26 kg/kkg (0.52 lb/ton), and the oil and grease load is 0.13 kg/kkg (0.26 lb/ton).

Costs: Total investment cost: \$694,590
Total yearly cost: \$157,600

An itemized breakdown of costs is presented in Table 205. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.0 percent
O&G: 97.0 percent

Alternative A 9-IV - This alternative provides with the addition of Alternative A 9-III dual media pressure filtration with a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.13 kg/kkg (0.26 lb/ton), the suspended solids load is 0.13 kg/kkg (0.26 lb/ton), and the oil and grease load is 0.058 kg/kkg (0.12 lb/ton).

Costs: Total investment cost: \$743,140
Total yearly cost: \$171,620

An itemized breakdown of costs is presented in Table 206. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

TABLE 204

ITEMIZED COST SUMMARY FOR ALTERNATIVE A9-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	104050.00
2. LAND	76630.00
3. ENGINEERING	10400.00
4. CONTINGENCY	10400.00
TOTAL	201480.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	4250.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	7020.00
TOTAL	36260.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	36260.00
2. YEARLY INVESTMENT COST RECOVERY	8060.00
3. DEPRECIATION	6240.00
TOTAL	50560.00

TABLE 205

ITEMIZED COST SUMMARY FOR ALTERNATIVE A9-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	514960.00
2. LAND	76630.00
3. ENGINEERING	51500.00
4. CONTINGENCY	51500.00
TOTAL	694590.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	50340.00
3. CHEMICALS	5830.00
4. MAINTENANCE & SUPPLIES	17760.00
TOTAL	98920.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	98920.00
2. YEARLY INVESTMENT COST RECOVERY	27780.00
3. DEPRECIATION	30900.00
TOTAL	157600.00

TABLE 206

ITEMIZED COST SUMMARY FOR ALTERNATIVE A9-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
R...PUMPING STATION
J...AIR FLCTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	555430.00
2. LAND	76630.00
3. ENGINEERING	55540.00
4. CONTINGENCY	55540.00
TOTAL	743140.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	59230.00
3. CHEMICALS	5830.00
4. MAINTENANCE&SUPPLIES	18510.00
TOTAL	108560.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	108560.00
2. YEARLY INVESTMENT COST RECOVERY	29730.00
3. DEPRECIATION	33330.00
TOTAL	171620.00

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Reduction Benefits: BOD: 99.2 percent
SS: 98.5 percent
O&G: 98.6 percent

Alternative A 9-V - This alternative provides with the addition of Alternative A 9-IV activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.073 kg/kkg (0.15 lb/ton), the suspended solids load is 0.073 kg/kkg (0.15 lb/ton), and the oil and grease load is 0.029 kg/kkg (0.058 lb/ton).

Costs: Total investment cost: \$1,075,830
Total yearly cost: \$ 229,000

An itemized breakdown of costs is presented in Table 207. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.3 percent

A cost efficiency curve is presented in Figure 277.

Alternative A 9-VI - This alternative provides in addition to Alternative A 9-II (i.e., dissolved air flotation) an aerated lagoon system including a settling pond.

The resulting BOD waste load is 0.26 kg/kkg (0.52 lb/ton), the suspended solids load is 0.26 kg/kkg (0.52 lb/ton), and the oil and grease load is 0.13 kg/kkg (0.26 lb/ton).

Costs: Total investment cost: \$684,150
Total yearly cost: \$305,590

An itemized breakdown of costs is presented in Table 208. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.0 percent
O&G: 97.0 percent

Alternative A 9-VII - This alternative provides with the addition of Alternative A 9-VI dual media pressure filtration with a pump station to generate a sufficient head for filter operation.

The resulting BOD waste load is 0.13 kg/kkg (0.26 lb/ton), the suspended solids load is 0.13 kg/kkg (0.26 lb/ton), and the oil and grease load is 0.058 kg/kkg (0.13 lb/ton).

TABLE 207

ITEMIZED COST SUMMARY FOR ALTERNATIVE A9-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	832660.00
2. LAND	76630.00
3. ENGINEERING	83270.00
4. CONTINGENCY	83270.00
TOTAL	1075830.00

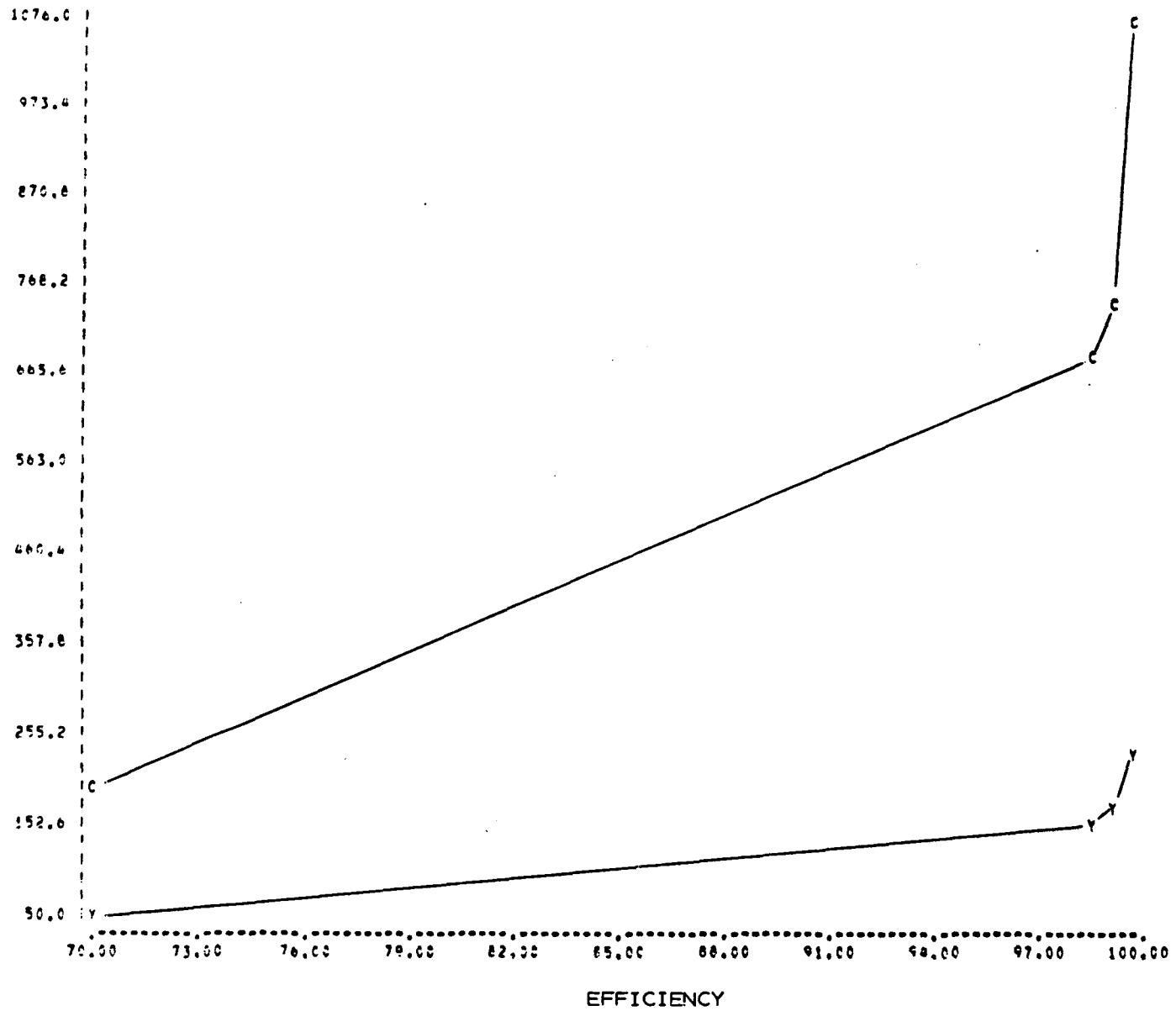
YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	68970.00
3. CHEMICALS	5830.00
4. MAINTENANCE&SUPPLIES	36220.00
TOTAL	136010.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	136010.00
2. YEARLY INVESTMENT COST RECOVERY	43030.00
3. DEPRECIATION	49960.00
TOTAL	229000.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS



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FIGURE 277

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A9, ALTERNATIVES II THROUGH V

TABLE 208

ITEMIZED COST SUMMARY FOR ALTERNATIVE A9-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
P...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	547730.00
2. LAND	7830.00
3. ENGINEERING	54770.00
4. CONTINGENCY	54770.00
5. PVC LINER	19050.00
TOTAL	684150.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	193820.00
3. CHEMICALS	0.0
4. MAINTENANCE SUPPLIES	24730.00
5. PVC LINER	860.00
TOTAL	244400.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	244400.00
2. YEARLY INVESTMENT COST RECOVERY	27370.00
3. DEPRECIATION	33820.00
TOTAL	305590.00

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Costs: Total investment cost: \$732,710
Total yearly cost: \$319,590

An itemized breakdown of costs is presented in Table 209. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.5 percent
O&G: 98.6 percent

Alternative A 9-VIII - This alternative provides in addition to Alternative A 9-VII activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.073 kg/kkg (0.15 lb/ton), the suspended solids load is 0.073 kg/kkg (0.15 lb/ton), and the oil and grease load is 0.029 kg/kkg (0.058 lb/ton).

Costs: Total investment cost: \$1,065,380
Total yearly cost: \$ 376,990

An itemized breakdown of costs is presented in Table 210. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.3 percent

A cost efficiency curve is presented in Figure 278.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 10, Edible Oil Production by Caustic Refining, Oil Processing, Deodorization, and Shortening and Table Oil Production

A model plant representative of Subcategory A 10 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which refines 454 kkg (500 ton) of crude edible oil per day.

Alternative A 10-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 1101 cu m (0.291 MG) per day. The BOD waste load is 12.76 kg/kkg (25.52 lb/ton), the suspended solids load is 7.14 kg/kkg (14.28 lb/ton), and the oil and grease load is 3.23 kg/kkg (6.46 lb/ton).

The model plant developed for Subcategory A 10 is assumed to have separate discharge of process and non-contact wastewaters, in-plant gravity

TABLE 209

ITEMIZED COST SUMMARY FOR ALTERNATIVE A9-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	588190.00
2.	LAND	7830.00
3.	ENGINEERING	58820.00
4.	CONTINGENCY	58820.00
5.	PVC LINER	19050.00
	TOTAL	732710.00

YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	202720.00
3.	CHEMICALS	0.0
4.	MAINTENANCE SUPPLIES	25470.00
5.	PVC LINER	860.00
	TOTAL	254040.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	254040.00
2.	YEARLY INVESTMENT COST RECOVERY	29310.00
3.	DEPRECIATION	36240.00
	TOTAL	319590.00

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TABLE 210

ITEMIZED COST SUMMARY FOR ALTERNATIVE A9-VIII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	865420.00
2. LAND	7830.00
3. ENGINEERING	86540.00
4. CONTINGENCY	86540.00
5. PVC LINER	19050.00
TOTAL	1065380.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	212450.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	43190.00
5. PVC LINER	860.00
TOTAL	281490.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	281490.00
2. YEARLY INVESTMENT COST RECOVERY	42620.00
3. DEPRECIATION	52880.00
TOTAL	376990.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

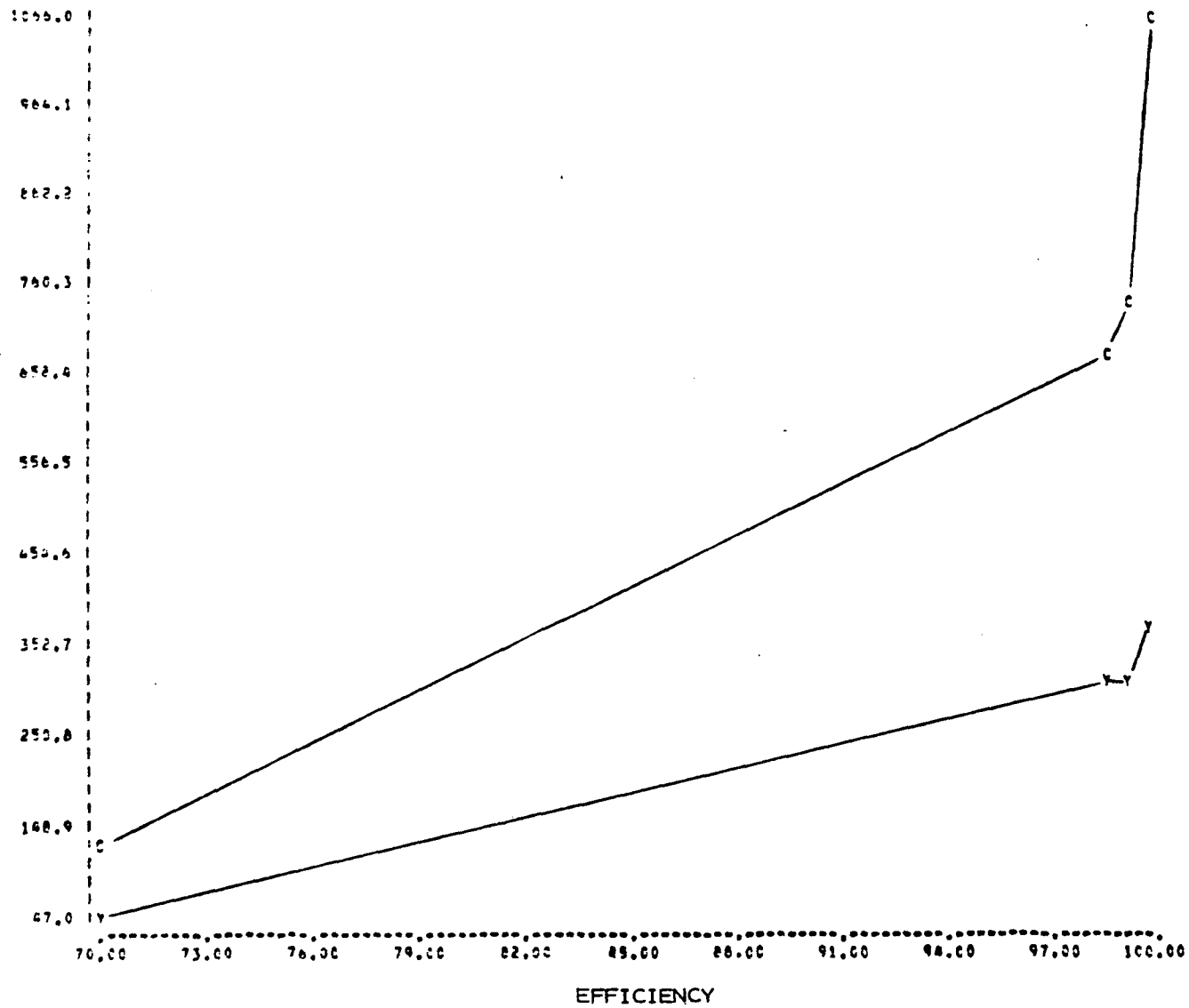


FIGURE 278

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A9, ALT. II AND VI THROUGH VIII

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separation and skimming, pH control, and an oil recovery system for reclamation of waste oil and grease skimmings.

Costs: 0
Reduction Benefits: None

Alternative A 10-II - This alternative provides for the addition of pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

The resulting BOD waste load is 3.82 kg/kg (7.64 lb/ton), the suspended solids load is 2.18 kg/kg (4.36 lb/ton), and the oil and grease load is 0.95 kg/kg (1.89 lb/ton).

Costs: Total investment cost: \$191,780
Total yearly cost: \$ 49,200

An itemized breakdown of costs is presented in Table 211. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 70.0 percent
SS: 69.5 percent
O&G: 70.0 percent

Alternative A 10-III - This alternative provides in addition to Alternative A 10-II, complete mix activated sludge, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every six days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.19 kg/kg (0.39 lb/ton), the suspended solids load is 0.22 kg/kg (0.44 lb/ton), and the oil and grease load is 0.097 kg/kg (0.19 lb/ton).

Costs: Total investment cost: \$600,850
Total yearly cost: \$133,730

An itemized breakdown of costs is presented in Table 212. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 96.9 percent
O&G: 97.0 percent

Alternative A 10-IV - This alternative provides in addition to Alternative A 10-III dual media pressurized filtration with a pump station to generate sufficient head for filter operation.

TABLE 211

ITEMIZED COST SUMMARY FOR ALTERNATIVE A10-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	98740.00
2. LAND	73300.00
3. ENGINEERING	9870.00
4. CONTINGENCY	9870.00
TOTAL	191780.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	3730.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	6890.00
TOTAL	35610.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	35610.00
2. YEARLY INVESTMENT COST RECOVERY	7670.00
3. DEPRECIATION	5920.00
TOTAL	49200.00

TABLE 212

ITEMIZED COST SUMMARY FOR ALTERNATIVE A10-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	439630.00
2. LAND	73300.00
3. ENGINEERING	43960.00
4. CONTINGENCY	43960.00
TOTAL	600850.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	38380.00
3. CHEMICALS	4340.00
4. MAINTENANCE&SUPPLIES	15610.00
TOTAL	83320.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	83320.00
2. YEARLY INVESTMENT COST RECOVERY	24030.00
3. DEPRECIATION	26380.00
TOTAL	133730.00

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The resulting BOD waste load is 0.097 kg/kkg (0.19 lb/ton), the suspended solids load is 0.11 kg/kkg (0.22 lb/ton), and the oil and grease load is 0.048 kg/kkg (0.096 lb/ton).

Costs: Total investment cost: \$646,270
Total yearly cost: \$146,640

An itemized breakdown of costs is presented in Table 213. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.5 percent
O&G: 98.5 percent

Alternative A 10-V - This alternative provides in addition to Alternative A 10-IV activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.048 kg/kkg (0.096 lb/ton), the suspended solids load is 0.056 kg/kkg (0.11 lb/ton), and the oil and grease load is 0.024 kg/kkg (0.048 lb/ton).

Costs: Total investment cost: \$919,530
Total yearly cost: \$199,530

An itemized breakdown of costs is presented in Table 214. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.2 percent

A cost efficiency curve is presented in Figure 279.

Alternative A 10-VI - This alternative provides in addition to Alternative A 10-II (i.e., dissolved air flotation) an aerated lagoon and a settling pond.

The resulting BOD waste load is 0.19 kg/kkg (0.39 lb/ton), the suspended solids load is 0.22 kg/kkg (0.44 lb/ton), and the oil and grease load is 0.097 kg/kkg (0.19 lb/ton).

Costs: Total investment cost: \$600,480
Total yearly cost: \$262,740

An itemized breakdown of costs is presented in Table 215. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

TABLE 213

ITEMIZED COST SUMMARY FOR ALTERNATIVE A10-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 J...AIR FLOTATION
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 S...VACUUM FILTRATION
 Y...HOLDING TANK
 B...PUMPING STATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	477470.00
2. LAND	73300.00
3. ENGINEERING	47750.00
4. CONTINGENCY	47750.00
TOTAL	646270.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	46500.00
3. CHEMICALS	4340.00
4. MAINTENANCE&SUPPLIES	16310.00
TOTAL	92140.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	92140.00
2. YEARLY INVESTMENT COST RECOVERY	25850.00
3. DEPRECIATION	28650.00
TOTAL	146640.00

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TABLE 214

ITEMIZED COST SUMMARY FOR ALTERNATIVE A10-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
R...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	705190.00
2. LAND	73300.00
3. ENGINEERING	70520.00
4. CONTINGENCY	70520.00
TOTAL	919530.00

YEARLY OPERATING COSTS:

1. LABOR	27490.00
2. POWER	54700.00
3. CHEMICALS	4340.00
4. MAINTENANCE & SUPPLIES	33910.00
TOTAL	120440.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	120440.00
2. YEARLY INVESTMENT	
COST RECOVERY	36780.00
3. DEPRECIATION	42310.00
TOTAL	199530.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

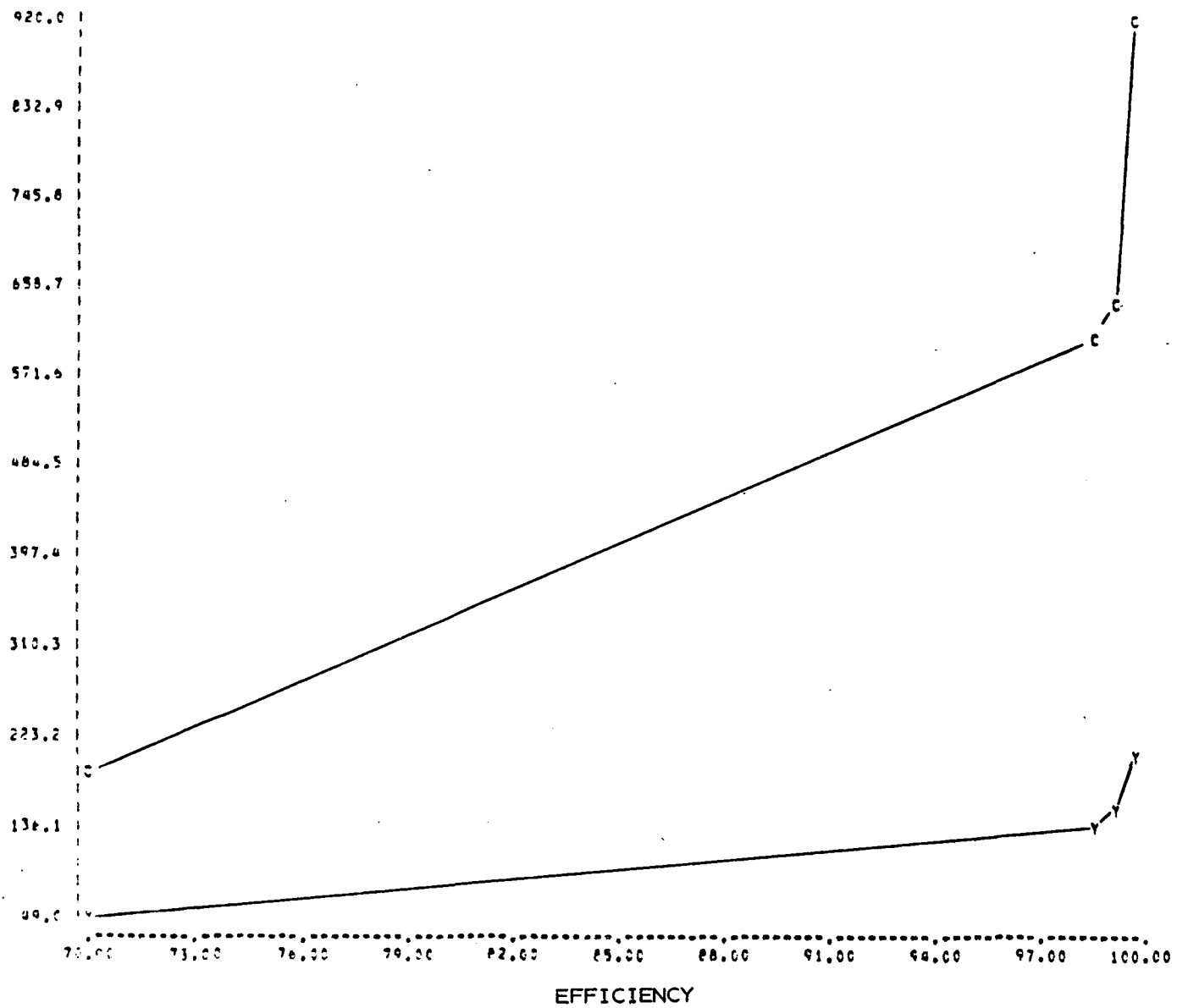


FIGURE 279

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A10, ALT. II THROUGH V

TABLE 215

ITEMIZED COST SUMMARY FOR ALTERNATIVE A10-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
P...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	481230.00
2. LAND	7000.00
3. ENGINEERING	48120.00
4. CONTINGENCY	48120.00
5. PVC LINER	16010.00
TOTAL	600480.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	161970.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	21380.00
5. PVC LINER	710.00
TOTAL	209050.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	209050.00
2. YEARLY INVESTMENT COST RECOVERY	24020.00
3. DEPRECIATION	29670.00
TOTAL	262740.00

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Reduction Benefits: BOD: 98.5 percent
SS: 96.9 percent
O&G: 97.0 percent

Alternative A 10-VII - This alternative provides in addition to Alternative A 10-VI dual media pressurized filtration with a pump station to generate a sufficient head for filter operation.

The resulting BOD waste load is 0.097 kg/kg (0.19 lb/ton), the suspended solids load is 0.11 kg/kg (0.22 lb/ton), and the oil and grease load is 0.048 kg/kg (0.096 lb/ton).

Costs: Total investment cost: \$645,910
Total yearly cost: \$275,650

An itemized breakdown of costs is presented in Table 216. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.5 percent
O&G: 98.5 percent

Alternative A 10-VIII - This alternative provides in addition to Alternative A 10-VII activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.048 kg/kg (0.096 lb/ton), the suspended solids load is 0.056 kg/kg (0.11 lb/ton), and the oil and grease load is 0.024 kg/kg (0.048 lb/ton).

Costs: Total investment cost: \$919,160
Total yearly cost: \$326,050

An itemized breakdown of costs is presented in Table 217. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.2 percent

A cost efficiency curve is presented in Figure 280.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 11, Edible Oil Processing By Caustic Refining, Acidulation, Oil Processing, and Deodorization, and the Production of Shortening, Table Oils, and Margarine

A model plant representative of Subcategory A 11 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various

TABLE 216

ITEMIZED COST SUMMARY FOR ALTERNATIVE A10-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

P1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	519080.00
2. LAND	7000.00
3. ENGINEERING	51910.00
4. CONTINGENCY	51910.00
5. PVC LINER	16010.00
TOTAL	645910.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	170090.00
3. CHEMICALS	0.0
4. MAINTENANCE SUPPLIES	22070.00
5. PVC LINER	710.00
TOTAL	217860.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	217860.00
2. YEARLY INVESTMENT COST RECOVERY	25840.00
3. DEPRECIATION	31950.00
TOTAL	275650.00

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TABLE 217

ITEMIZED COST SUMMARY FOR ALTERNATIVE A10-VIII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	746790.00
2. LAND	7000.00
3. ENGINEERING	74680.00
4. CONTINGENCY	74680.00
5. PVC LINER	16010.00
TOTAL	919160.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	178290.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	39680.00
5. PVC LINER	710.00
TOTAL	243670.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	243670.00
2. YEARLY INVESTMENT COST RECOVERY	36770.00
3. DEPRECIATION	45610.00
TOTAL	326050.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

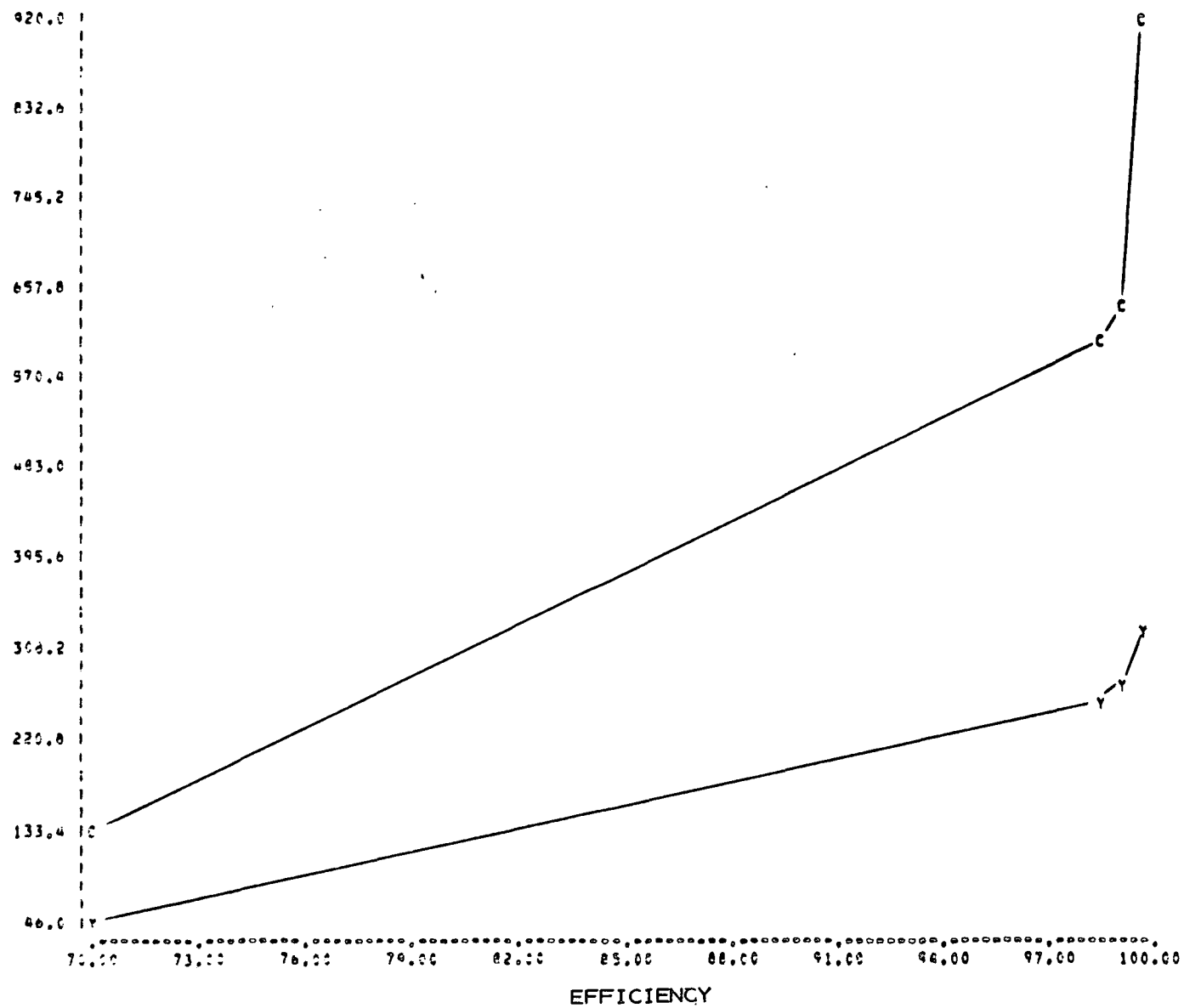


FIGURE 280

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A₁₀, ALTERNATIVES II AND VI THROUGH VIII

levels of waste reductions for the model plant which refines 454 kkg (500 ton) of crude edible oil per day.

Alternative A 11-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 1574 cu m (0.416 MG) per day. The BOD waste load is 20.57 kg/kkg (41.14 lb/ton), the suspended solids load is 10.98 kg/kkg (21.96 lb/ton), and the oil and grease load is 9.95 kg/kkg (19.90 lb/ton).

The model plant developed for Subcategory A 11 is assumed to have separate discharge of process and non-contact wastewaters, in-plant gravity separation and skimming, pH control, and an oil recovery system for reclamation of waste oil and grease skimmings.

Cost: 0
Reduction Benefits: None

Alternative A 11-II - This alternative provides for the addition of pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

The resulting BOD waste load is 6.14 kg/kkg (12.28 lb/ton), the suspended solids load is 3.33 kg/kkg (6.66 lb/ton), and the oil and grease load is 2.92 kg/kkg (5.84 lb/ton).

Costs: Total investment cost: \$215,730
Total yearly cost: \$ 52,410

An itemized breakdown of costs is presented in Table 218. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 70.1 percent
SS: 69.7 percent
O&G: 70.6 percent

Alternative A 11-III - This alternative provides in addition to Alternative A 11-II complete mix activated sludge, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every eight days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.31 kg/kkg (0.62 lb/ton), the suspended solids load is 0.35 kg/kkg (0.70 lb/ton), and the oil and grease load is 0.30 kg/kkg (0.60 lb/ton).

TABLE 218

ITEMIZED COST SUMMARY FOR ALTERNATIVE A11-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	113140.00
2. LAND	79970.00
3. ENGINEERING	11310.00
4. CONTINGENCY	11310.00
TOTAL	215730.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	4840.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	7160.00
TOTAL	36990.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	36990.00
2. YEARLY INVESTMENT COST RECOVERY	8630.00
3. DEPRECIATION	6790.00
TOTAL	52410.00

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Costs: Total investment cost: \$761,790
Total yearly cost: \$175,830

An itemized breakdown of costs is presented in Table 219. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.2 percent
O&G: 97.0 percent

Alternative A 11-IV - This alternative provides in addition to Alternative A 11-III dual media pressure filtration with a pump station to generate a sufficient head for filter operation.

The resulting BOD waste load is 0.16 kg/kkg (0.31 lb/ton), the suspended solids load is 0.17 kg/kkg (0.35 lb/ton), and the oil and grease load is 0.069 kg/kkg (0.14 lb/ton).

Costs: Total investment cost: \$813,980
Total yearly cost: \$191,110

An itemized breakdown of costs is presented in Table 220. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.4 percent
O&G: 99.3 percent

Alternative A 11-V - This alternative provides in addition to Alternative A 11-IV activated carbon adsorption before final discharge.

The resulting BOD waste load is 0.076 kg/kkg (0.15 lb/ton), the suspended solids load is 0.087 kg/kkg (0.17 lb/ton), and the oil and grease load is 0.035 kg/kkg (0.070 lb/ton).

Costs: Total investment cost: \$1,214,140
Total yearly cost: \$ 256,440

An itemized breakdown of costs is presented in Table 221. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.6 percent

A cost efficiency curve is presented in Figure 281.

TABLE 219

ITEMIZED COST SUMMARY FOR ALTERNATIVE A11-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1.	CONSTRUCTION	568180.00
2.	LAND	79970.00
3.	ENGINEERING	56820.00
4.	CONTINGENCY	56820.00
	TOTAL	761790.00

YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	59940.00
3.	CHEMICALS	6980.00
4.	MAINTENANCE & SUPPLIES	19360.00
	TOTAL	111270.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	111270.00
2.	YEARLY INVESTMENT COST RECOVERY	30470.00
3.	DEPRECIATION	34090.00
	TOTAL	175830.00

TABLE 220

ITEMIZED COST SUMMARY FOR ALTERNATIVE A11-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
E...PUMPING STATION
M...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	611670.00
2. LAND	79970.00
3. ENGINEERING	61170.00
4. CONTINGENCY	61170.00
TOTAL	813980.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	69730.00
3. CHEMICALS	6980.00
4. MAINTENANCE SUPPLIES	20150.00
TOTAL	121850.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	121850.00
2. YEARLY INVESTMENT COST RECOVERY	32560.00
3. DEPRECIATION	36700.00
TOTAL	191110.00

TABLE 221

ITEMIZED COST SUMMARY FOR ALTERNATIVE A11-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
P...PUMPING STATION
A...AIR FLOTATION
F...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	945150.00
2. LAND	79970.00
3. ENGINEERING	94510.00
4. CONTINGENCY	94510.00
TOTAL	1214140.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	81200.00
3. CHEMICALS	6980.00
4. MAINTENANCE & SUPPLIES	37990.00
TOTAL	151160.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	151160.00
2. YEARLY INVESTMENT COST RECOVERY	48570.00
3. DEPRECIATION	56710.00
TOTAL	256440.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

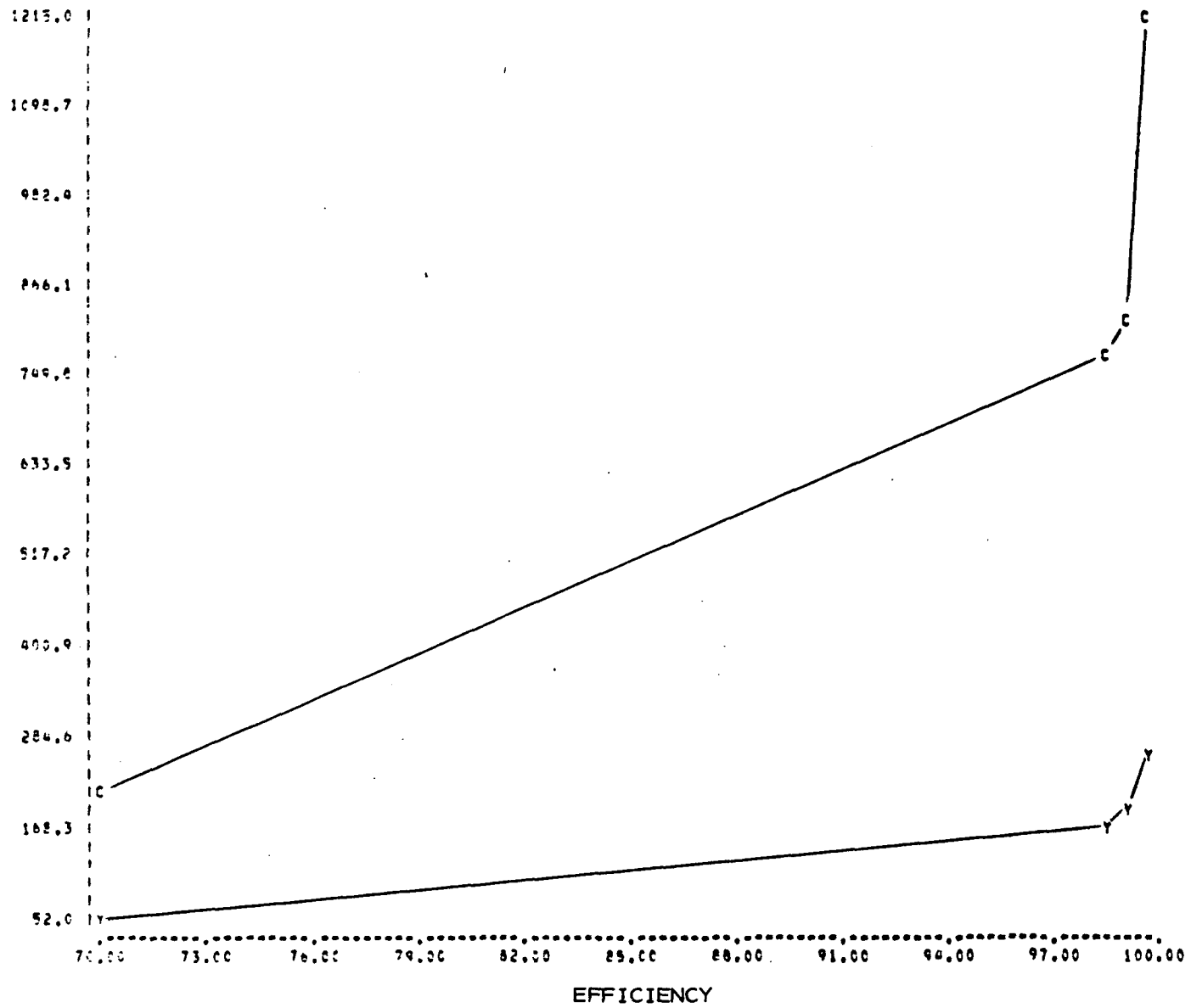


FIGURE 281

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A11, ALTERNATIVES II THROUGH V

Alternative A 11-VI - This alternative provides in addition to Alternative A 11-II (i.e., dissolved air flotation) an aerated lagoon system including a settling pond.

The resulting BOD waste load is 0.31 kg/kg (0.62 lb/ton), the suspended solids load is 0.35 kg/kg (0.70 lb/ton), and the oil and grease load is 0.30 kg/kg (0.60 lb/ton).

Costs: Total investment cost: \$768,500
Total yearly cost: \$353,770

An itemized breakdown of costs is presented in Table 222. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.2 percent
O&G: 97.0 percent

Alternative A 11-VII - This alternative provides in addition to Alternative A 11-VI dual media pressure filtration with a pump station to generate a sufficient head for filter operation.

The resulting BOD waste load is 0.16 kg/kg (0.31 lb/ton), the suspended solids load is 0.17 kg/kg (0.35 lb/ton), and the oil and grease load is 0.069 kg/kg (0.14 lb/ton).

Costs: Total investment cost: \$820,670
Total yearly cost: \$369,050

An itemized breakdown of costs is presented in Table 223. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.4 percent
O&G: 99.3 percent

Alternative A 11-VIII - This alternative provides in addition to Alternative A 11-VII activated carbon adsorption prior to final discharge to navigable waters.

The resulting BOD waste load is 0.076 kg/kg (0.15 lb/ton), the suspended solids load is 0.087 kg/kg (0.17 lb/ton), and the oil and grease load is 0.035 kg/kg (0.070 lb/ton).

Costs: Total investment cost: \$1,220,850
Total yearly cost: \$ 434,380

TABLE 222

ITEMIZED COST SUMMARY FOR ALTERNATIVE A11-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	614660.00
2. LAND	8660.00
3. ENGINEERING	61470.00
4. CONTINGENCY	61470.00
5. PVC LINER	22240.00
TOTAL	768500.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	230770.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	28260.00
5. PVC LINER	1020.00
TOTAL	285040.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	285040.00
2. YEARLY INVESTMENT COST RECOVERY	30740.00
3. DEPRECIATION	37990.00
TOTAL	353770.00

TABLE 223

ITEMIZED COST SUMMARY FOR ALTERNATIVE A11-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	658150.00
2. LAND	8660.00
3. ENGINEERING	65810.00
4. CONTINGENCY	65810.00
5. PVC LINER	22240.00
TOTAL	820670.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	240550.00
3. CHEMICALS	0.0
4. MAINTENANCE SUPPLIES	29060.00
5. PVC LINER	1020.00
TOTAL	295620.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	295620.00
2. YEARLY INVESTMENT COST RECOVERY	32830.00
3. DEPRECIATION	40600.00
TOTAL	369050.00

DRAFT

An itemized breakdown of costs is presented in Table 224. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.6 percent

A cost efficiency curve is presented in Figure 282.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 12, Edible Oil Processing by Caustic Refining, Oil Processing, and Deodorization, and the Production of Shortening, Table Oils, and Margarine

A model plant representative of Subcategory A 12 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which refines 454 kkg (500 ton) of edible oil per day.

Alternative A 12-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 454 kkg per day plant is 1355 cu m (0.358 MG) per day. The BOD waste load is 16.20 kg/kkg (32.40 lb/ton), the suspended solids load is 9.44 kg/kkg (18.88 lb/ton), and the oil and grease load is 8.83 kg/kkg (17.66 lb/ton).

The model plant developed for Subcategory A 12 is assumed to have separate discharge of process and non-contact wastewaters, in-plant gravity separation and skimming, pH control, and an oil recovery system for reclamation of waste oil and grease skimmings.

Costs: 0
Reduction Benefits: None

Alternative A 12-II - This alternative provides for the addition of pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

The resulting BOD waste load is 4.84 kg/kkg (9.68 lb/ton), the suspended solids load is 2.87 kg/kkg (5.74 lb/ton), and the oil and grease load is 2.69 kg/kkg (5.38 lb/ton).

Costs: Total investment cost: \$202,970
Total yearly cost: \$ 50,800

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TABLE 224

ITEMIZED COST SUMMARY FOR ALTERNATIVE A11-VIII
(EDIBLE OIL REFINING)

- ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
P...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	991630.00
2. LAND	8660.00
3. ENGINEERING	99160.00
4. CONTINGENCY	99160.00
5. PVC LINER	22240.00
TOTAL	1220850.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	252020.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	46910.00
5. PVC LINER	1020.00
TOTAL	324940.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	324940.00
2. YEARLY INVESTMENT COST RECOVERY	48830.00
3. DEPRECIATION	60610.00
TOTAL	434380.00

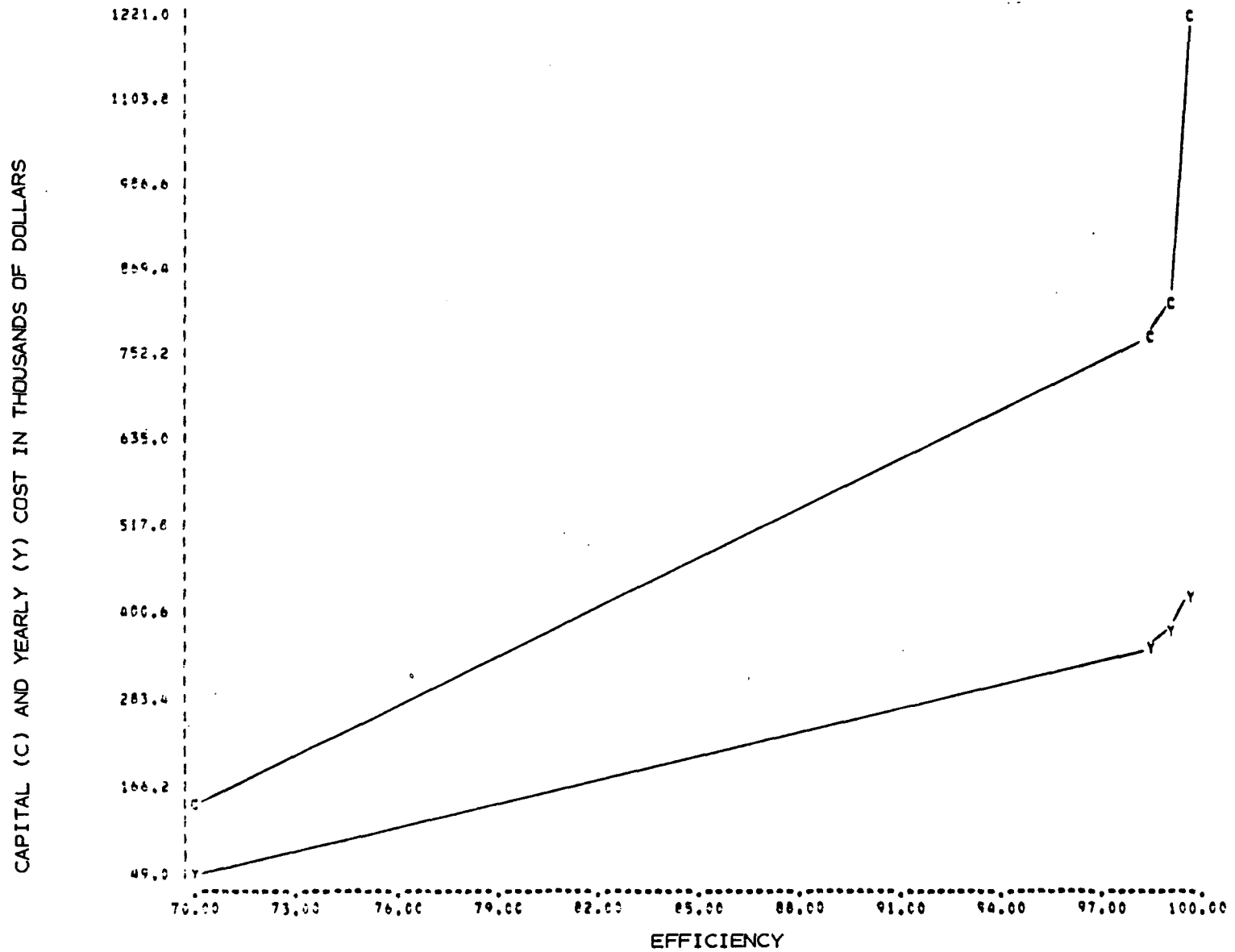


FIGURE 282

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A11, ALTERNATIVES II AND VI THROUGH VIII

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An itemized breakdown of costs is presented in Table 225. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 70.1 percent
SS: 69.6 percent
O&G: 69.5 percent

Alternative A 12-III - This alternative provides in addition to Alternative A 12-II complete mix activated sludge, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every five days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.24 kg/kkg (0.48 lb/ton), the suspended solids load is 0.29 kg/kkg (0.57 lb/ton), and the oil and grease load is 0.27 kg/kkg (0.54 lb/ton)

Costs: Total investment cost: \$672,950
Total yearly cost: \$152,640

An itemized breakdown of costs is presented in Table 226. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre).

Reduction Benefits: BOD: 98.5 percent
SS: 97.0 percent
O&G: 97.0 percent

Alternative A 12-IV - This alternative provides in addition to Alternative A 12-III dual media pressure filtration with a pump station to generate a sufficient head for filter operation.

The resulting BOD waste load is 0.12 kg/kkg (0.24 lb/ton), the suspended solids load is 0.14 kg/kkg (0.29 lb/ton), and the oil and grease load is 0.060 kg/kkg (0.12 lb/ton).

Costs: Total investment cost: \$722,000
Total yearly cost: \$166,810

An itemized breakdown of costs is presented in Table 227. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.3 percent
SS: 98.5 percent
O&G: 99.3 percent

Alternative A 12-V - This alternative provides in addition to Alternative A 12-IV activated carbon adsorption before final discharge to navigable waters.

TABLE 225

ITEMIZED COST SUMMARY FOR ALTERNATIVE A12-II
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	105280.00
2. LAND	76630.00
3. ENGINEERING	10530.00
4. CONTINGENCY	10530.00
TOTAL	202970.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	4330.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	7040.00
TOTAL	36360.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	36360.00
2. YEARLY INVESTMENT COST RECOVERY	8120.00
3. DEPRECIATION	6320.00
TOTAL	50800.00

TABLE 226

ITEMIZED COST SUMMARY FOR ALTERNATIVE A12-III
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	496940.00
2. LAND	76630.00
3. ENGINEERING	49690.00
4. CONTINGENCY	49690.00
TOTAL	672950.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	48150.00
3. CHEMICALS	5490.00
4. MAINTENANCE&SUPPLIES	17270.00
TOTAL	95900.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	95900.00
2. YEARLY INVESTMENT COST RECOVERY	26920.00
3. DEPRECIATION	29820.00
TOTAL	152640.00

TABLE 227

ITEMIZED COST SUMMARY FOR ALTERNATIVE A12-IV
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	537810.00
2. LAND	76630.00
3. ENGINEERING	53780.00
4. CONTINGENCY	53780.00
TOTAL	722000.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	57160.00
3. CHEMICALS	5490.00
4. MAINTENANCE&SUPPLIES	18020.00
TOTAL	105660.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	105660.00
2. YEARLY INVESTMENT	
COST RECOVERY	28880.00
3. DEPRECIATION	32270.00
TOTAL	166810.00

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The resulting BOD waste load is 0.060 kg/kkg (0.12 lb/ton), the suspended solids load is 0.072 kg/kkg (0.14 lb/ton), and the oil and grease load is 0.03 kg/kkg (0.06 lb/ton).

Costs: Total investment cost: \$1,063,760
Total yearly cost: \$ 225,270

An itemized breakdown of costs is presented in Table 228. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.6 percent

A cost efficiency curve is presented in Figure 283.

Alternative A 12-VI - This alternative provides in addition to Alternative A 12-II (i.e., dissolved air flotation) an aerated lagoon system including a settling pond.

The resulting BOD waste load is 0.24 kg/kkg (0.48 lb/ton), the suspended solids load is 0.29 kg/kkg (0.57 lb/ton), and the oil and grease load is 0.27 kg/kkg (0.54 lb/ton).

Costs: Total investment cost: \$706,850
Total yearly cost: \$319,260

An itemized breakdown of costs is presented in Table 229. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.0 percent
O&G: 97.0 percent

Alternative A 12-VII - This alternative provides in addition to Alternative A 12-VI dual media pressure filtration and a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.12 kg/kkg (0.24 lb/ton), the suspended solids load is 0.14 kg/kkg (0.29 lb/ton), and the oil and grease load is 0.060 kg/kkg (0.12 lb/ton).

Costs: Total investment cost: \$755,880
Total yearly cost: \$333,450

An itemized breakdown of costs is presented in Table 230. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

TABLE 228

ITEMIZED COST SUMMARY FOR ALTERNATIVE A12-V
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
R...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	822610.00
2. LAND	76630.00
3. ENGINEERING	82260.00
4. CONTINGENCY	82260.00
TOTAL	1063760.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	67130.00
3. CHEMICALS	5490.00
4. MAINTENANCE&SUPPLIES	35750.00
TOTAL	133360.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	133360.00
2. YEARLY INVESTMENT	
COST RECOVERY	42550.00
3. DEPRECIATION	49360.00
TOTAL	225270.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

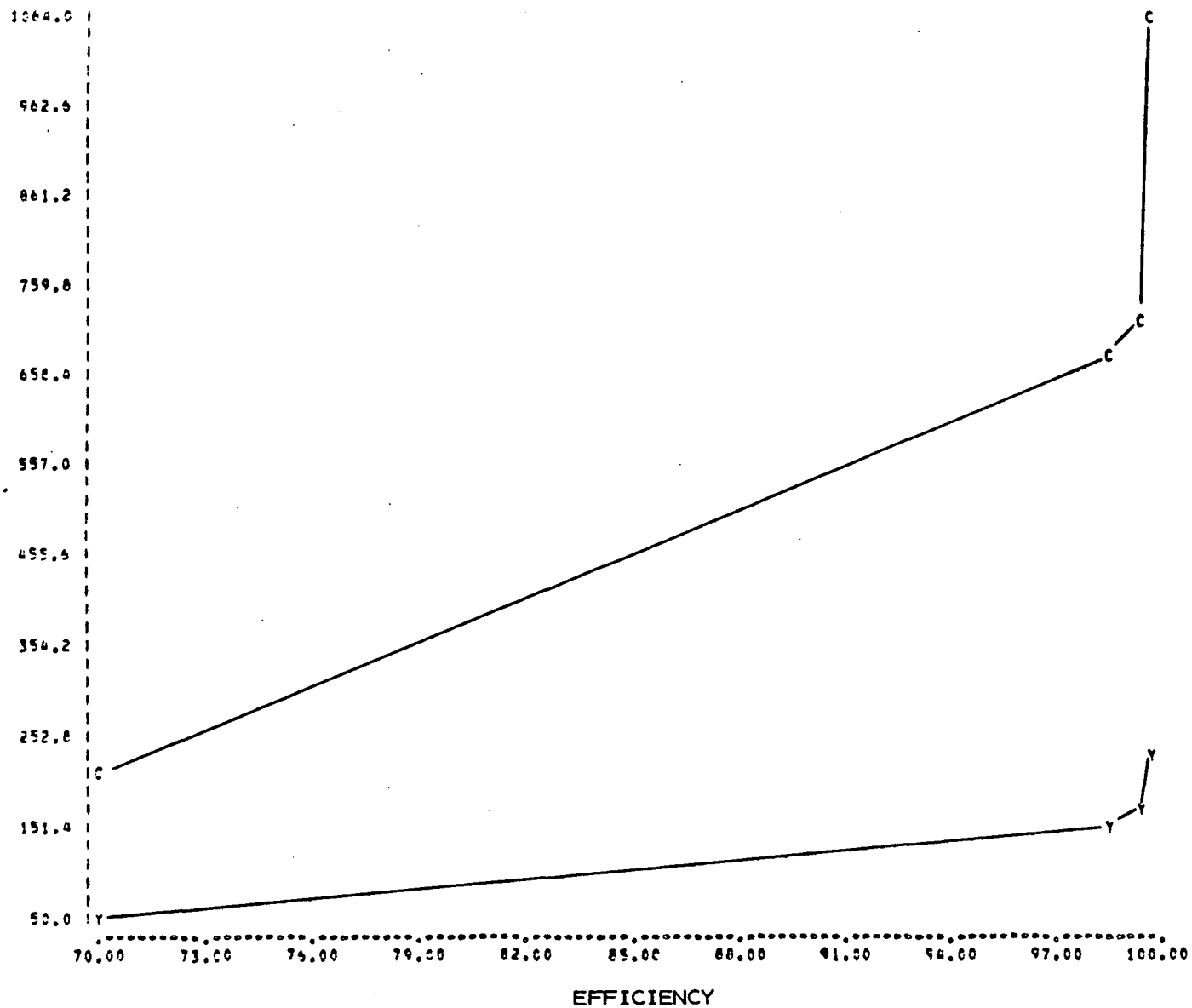


FIGURE 283

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A12, ALTERNATIVES II THROUGH V

TABLE 229

ITEMIZED COST SUMMARY FOR ALTERNATIVE A12-VI
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	565780.00
2. LAND	8000.00
3. ENGINEERING	56580.00
4. CONTINGENCY	56580.00
5. PVC LINER	19910.00
TOTAL	706850.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	204790.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	25390.00
5. PVC LINER	880.00
TOTAL	256050.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	256050.00
2. YEARLY INVESTMENT COST RECOVERY	28270.00
3. DEPRECIATION	34940.00
TOTAL	319260.00

TABLE 230

ITEMIZED COST SUMMARY FOR ALTERNATIVE A12-VII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	606650.00
2. LAND	8000.00
3. ENGINEERING	60660.00
4. CONTINGENCY	60660.00
5. PVC LINER	19910.00
TOTAL	755880.00

YEARLY OPERATING COSTS:

1. LABOR	24490.00
2. POWER	213800.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	26150.00
5. PVC LINER	860.00
TOTAL	265820.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	265820.00
2. YEARLY INVESTMENT COST RECOVERY	30240.00
3. DEPRECIATION	37390.00
TOTAL	333450.00

Reduction Benefits: BOD: 99.3 percent
SS: 98.5 percent
O&G: 99.3 percent

Alternative A 12-VIII - This alternative provides in addition to Alternative A 12-VII activated carbon adsorption before final discharge to navigable waters.

The resulting BOD waste load is 0.060 kg/kkg (0.12 lb/ton), the suspended solids load is 0.072 kg/kkg (0.14 lb/ton), and the oil and grease load is 0.030 kg/kkg (0.060 lb/ton).

Costs: Total investment cost: \$1,097,630
Total yearly cost: \$ 391,900

An itemized breakdown of costs is presented in Table 231. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.6 percent
SS: 99.2 percent
O&G: 99.6 percent

A cost efficiency curve is presented in Figure 284.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 13, Plasticizing and Packaging of Margarine

A model plant representative of Subcategory A 13 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, six alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which processes 227 kkg (250 ton) of margarine per day.

Alternative A 13-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 227 kkg per day plant is 340 cu m (0.09 MG) per day. The BOD waste load is 3.92 kg/kkg (7.84 lb/ton), the suspended solids load is 2.72 kg/kkg (5.44 lb/ton), and the oil and grease load is 5.81 kg/kkg (11.62 lb/ton).

The model plant developed for Subcategory A 13 is assumed to have separate discharge of process and non-contact wastewaters, in-plant gravity separation and skimming, pH control, and an oil recovery system for reclamation of waste oil and grease skimmings.

Cost: 0
Reduction Benefits: None

Alternative A 13-II - This alternative provides for the addition of pressurized air flotation utilizing chemical flocculating agents to enhance floc formation and floatability of wastes. Oil, water, and solid

TABLE 231

ITEMIZED COST SUMMARY FOR ALTERNATIVE A12-VIII
(EDIBLE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	891440.00
2. LAND	8000.00
3. ENGINEERING	89140.00
4. CONTINGENCY	89140.00
5. PVC LINER	19910.00
TOTAL	1097630.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	223770.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	43870.00
5. PVC LINER	880.00
TOTAL	293510.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	293510.00
2. YEARLY INVESTMENT COST RECOVERY	43910.00
3. DEPRECIATION	54480.00
TOTAL	391900.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

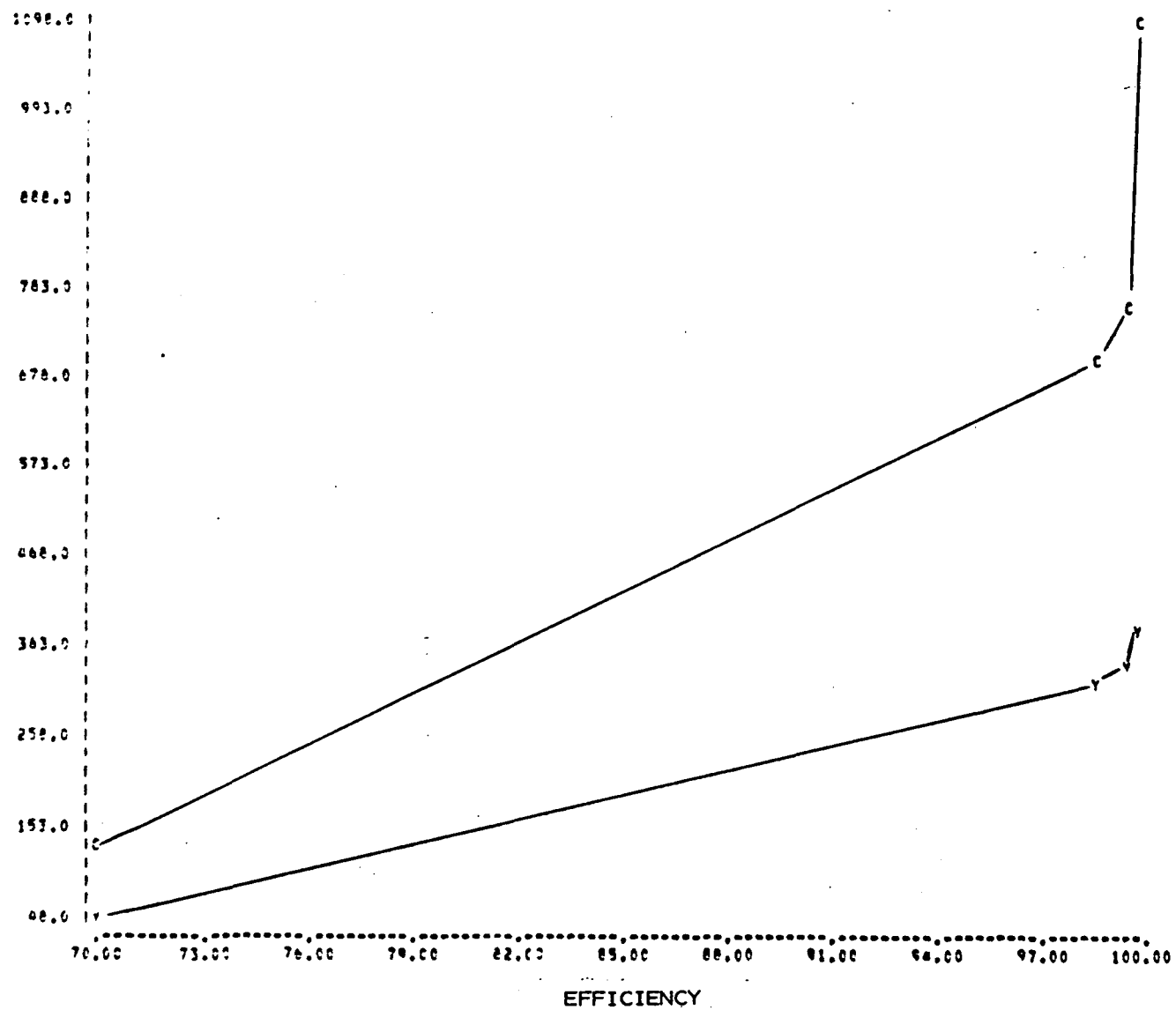


FIGURE 284

INVESTMENT AND YEARLY COST FOR SUBCATEGORY A12, ALTERNATIVES II AND VI THROUGH VIII

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waste skimmings are pumped to an in-plant oil reclamation system for dewatering, and recovery of inedible oils.

The resulting BOD waste load is 1.17 kg/kkg (2.34 lb/ton), the suspended solids load is 0.81 kg/kkg (1.62 lb/ton), and the oil and grease load is 1.75 kg/kkg (3.50 lb/ton).

Costs: Total investment cost: \$146,540
Total yearly cost: \$ 42,720

An itemized breakdown of costs is presented in Table 232. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 70.1 percent
SS: 70.1 percent
O&G: 70.0 percent

Alternative A 13-III - This alternative provides in addition to Alternative A 13-II complete mix activated sludge, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every 20 days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.060 kg/kkg (0.12 lb/ton), the suspended solids load is 0.075 kg/kkg (0.15 lb/ton), and the oil and grease load is 0.075 kg/kkg (0.15 lb/ton).

Costs: Total investment cost: \$295,200
Total yearly cost: \$ 70,200

An itemized breakdown of costs is presented in Table 233. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.2 percent
O&G: 98.7 percent

Alternative A 13-IV - This alternative provides in addition to Alternative A 13-III dual media pressure filtration and a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.03 kg/kkg (0.06 lb/ton), the suspended solids load is 0.037 kg/kkg (0.074 lb/ton), and the oil and grease load is 0.037 kg/kkg (0.074 lb/ton).

Costs: Total investment cost: \$327,930
Total yearly cost: \$ 79,280

TABLE 232

ITEMIZED COST SUMMARY FOR ALTERNATIVE A13-II
(MARGARINE PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 70.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION

INVESTMENT COSTS:

1. CONSTRUCTION	72150.00
2. LAND	59970.00
3. ENGINEERING	7210.00
4. CONTINGENCY	7210.00
TOTAL	146540.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	1570.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	5970.00
TOTAL	32530.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	32530.00
2. YEARLY INVESTMENT COST RECOVERY	5860.00
3. DEPRECIATION	4330.00
TOTAL	42720.00

TABLE 233

ITEMIZED COST SUMMARY FOR ALTERNATIVE A13-III
(MARGARINE PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	196030.00
2. LAND	59970.00
3. ENGINEERING	19600.00
4. CONTINGENCY	19600.00
TOTAL	295200.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	9690.00
3. CHEMICALS	2080.00
4. MAINTENANCE&SUPPLIES	9870.00
TOTAL	46630.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	46630.00
2. YEARLY INVESTMENT COST RECOVERY	11810.00
3. DEPRECIATION	11760.00
TOTAL	70200.00

An itemized breakdown of costs is presented in Table 234. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.6 percent
O&G: 99.4 percent

A cost efficiency curve is presented in Figure 285.

Alternative A 13-V - This alternative provides in addition to Alternative A 13-II (pressurized air flotation) an aerated lagoon system with a settling pond.

The resulting BOD waste load is 0.060 kg/kg (0.12 lb/ton), the suspended solids load is 0.075 kg/kg (0.15 lb/ton), and the oil and grease load is 0.075 kg/kg (0.15 lb/ton).

Costs: Total investment cost: \$277,070
Total yearly cost: \$110,220

An itemized breakdown of costs is presented in Table 235. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 98.5 percent
SS: 97.2 percent
O&G: 98.7 percent

Alternative A 13-VI - This alternative provides in addition to Alternative A 13-V dual media pressure filtration and a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.030 kg/kg (0.060 lb/ton), the suspended solids load is 0.037 kg/kg (0.074 lb/ton), and the oil and grease load is 0.037 kg/kg (0.074 lb/ton).

Costs: Total investment cost: \$309,790
Total yearly cost: \$119,300

An itemized breakdown of costs is presented in Table 236. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 99.2 percent
SS: 98.6 percent
O&G: 99.4 percent

A cost efficiency curve is presented in Figure 286.

TABLE 234

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 13-IV
(MARGARINE PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN (B1BJKQSY)BN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
H...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	223300.00
2. LAND	59970.00
3. ENGINEERING	22330.00
4. CONTINGENCY	22330.00
TOTAL	327930.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	15110.00
3. CHEMICALS	2080.00
4. MAINTENANCE&SUPPLIES	10580.00
TOTAL	52760.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	52760.00
2. YEARLY INVESTMENT COST RECOVERY	13120.00
3. DEPRECIATION	13400.00
TOTAL	79280.00

970

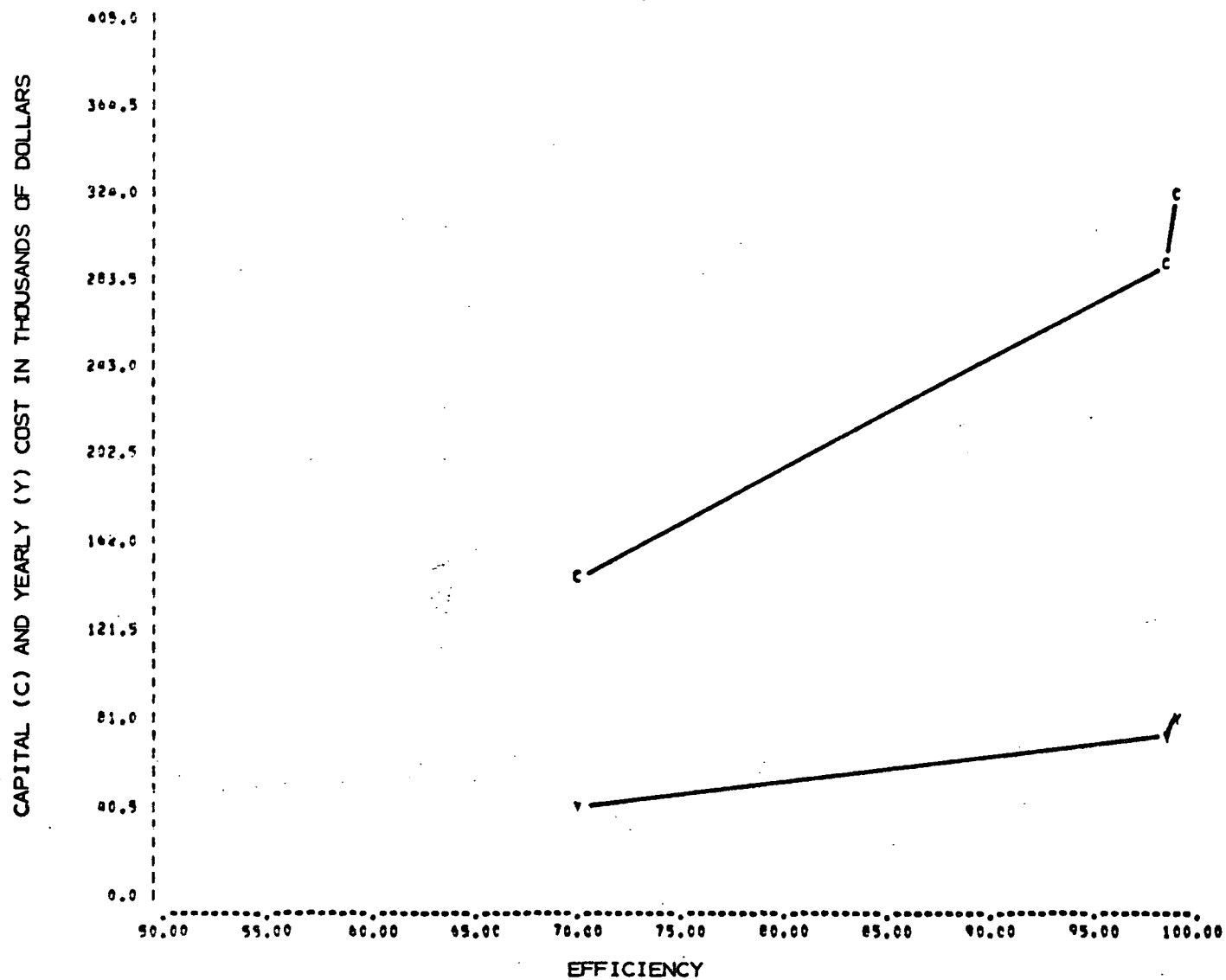


FIGURE 285

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A13, ALTERNATIVES II THRU IV.

TABLE 235

ITEMIZED COST SUMMARY FOR ALTERNATIVE A13- V
(MARGARINE PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1..CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	223910.00
2. LAND	4000.00
3. ENGINEERING	22390.00
4. CONTINGENCY	22390.00
5. PVC LINER	4380.00
TOTAL	277070.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	50100.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	10170.00
5. PVC LINER	230.00
TOTAL	85490.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	85490.00
2. YEARLY INVESTMENT COST RECOVERY	11080.00
3. DEPRECIATION	13650.00
TOTAL	110220.00

TABLE 236

ITEMIZED COST SUMMARY FOR ALTERNATIVE A13-VI
(MARGARINE PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
J...AIR FLOTATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	251170.00
2. LAND	4000.00
3. ENGINEERING	25120.00
4. CONTINGENCY	25120.00
5. PVC LINER	4380.00
TOTAL	309790.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	55520.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	10880.00
5. PVC LINER	230.00
TOTAL	91620.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	91620.00
2. YEARLY INVESTMENT COST RECOVERY	12390.00
3. DEPRECIATION	15290.00
TOTAL	119300.00

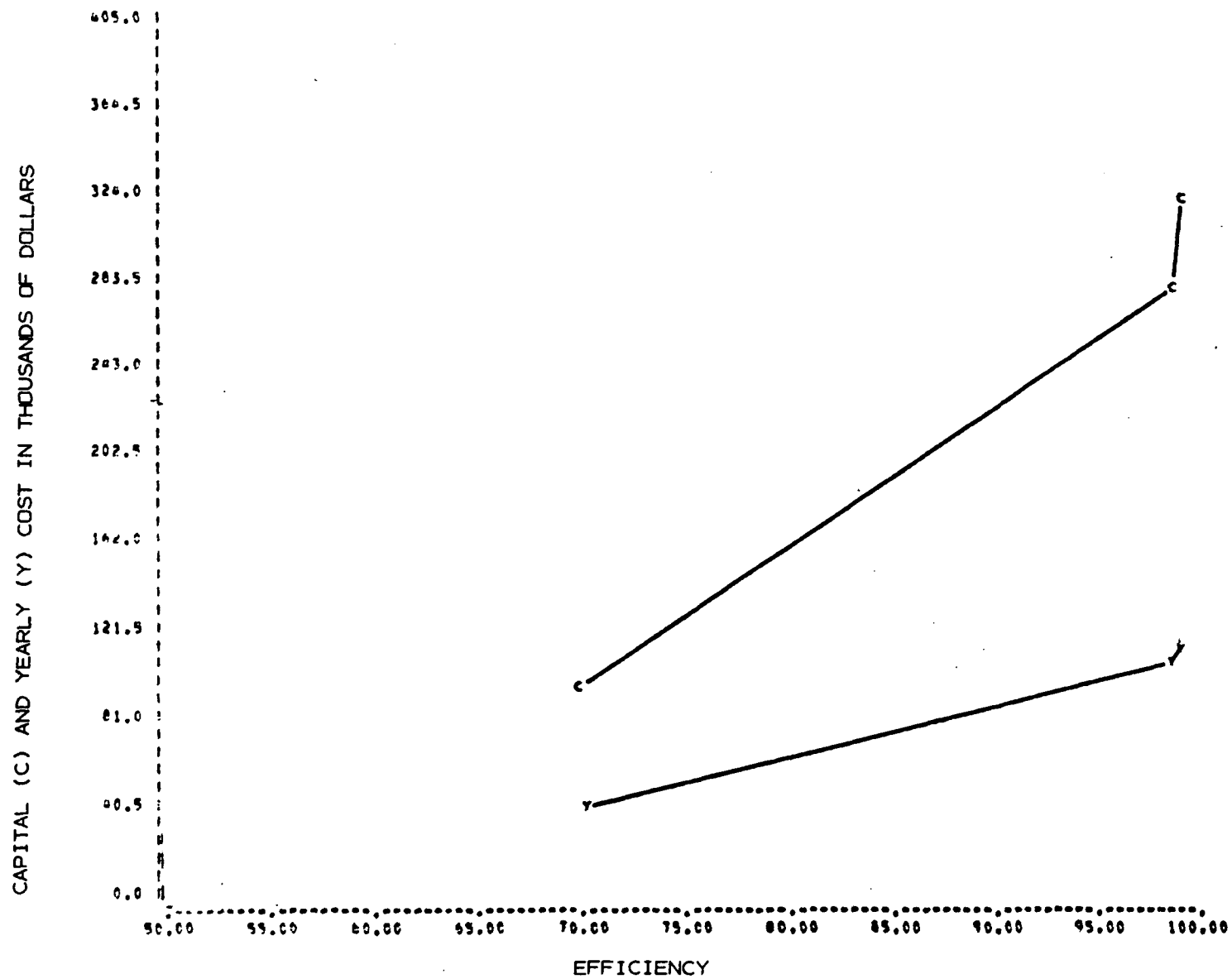


FIGURE 286

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 13, ALTERNATIVES II, V, AND VI

Cost and Reduction Benefits of Alternative Treatment Technologies
for Subcategory A 14, Plasticizing and Packaging Shortening and Table Oils

A model plant representative of Subcategory A 14 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, seven alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which processes 227 kkg (250 ton) of finished edible oil products per day.

Alternative A 14-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 227 kkg per day plant is 87 cu m (0.023 MG) per day. The BOD waste load is 0.56 kg/kkg (1.12 lb/ton), the suspended solids load is 0.42 kg/kkg (0.84 lb/ton), and the oil and grease load is 0.21 kg/kkg (0.42 lb/ton).

The model plant developed for Subcategory A 14 is assumed to have separate discharge of process and non-contact wastewaters, in-plant gravity separation and skimming, pH control, and an oil recovery system for reclamation of waste oil and grease skimmings.

Alternative A 14-II - This alternative provides for the addition of a complete mix activated sludge unit, secondary clarification, sludge recirculating pump, a sludge thickening tank, vacuum filtration, and a sludge holding tank. Sludge is hauled to a landfill facility every 26 days. The activated sludge unit also includes a control house and two full-time operators.

The resulting BOD waste load is 0.029 kg/kkg (0.058 lb/ton), the suspended solids load is 0.038 kg/kkg (0.076 lb/ton), and the oil and grease load is 0.021 kg/kkg (0.042 lb/ton).

Costs:	Total investment cost:	\$201,390
	Total yearly cost:	\$ 39,350

An itemized breakdown of costs is presented in Table 237. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that one operator is required.

Reduction Benefits:	BOD:	94.8 percent
	SS:	90.9 percent
	O&G:	90.0 percent

Alternative A 14-III - This alternative provides in addition to Alternative A 14-II dual media filtration and a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.015 kg/kkg (0.030 lb/ton), the suspended solids load is 0.015 kg/kkg (0.030 lb/ton), and the oil and grease load is 0.008 kg/kkg (0.016 lb/ton).

TABLE 237

ITEMIZED COST SUMMARY FOR ALTERNATIVE A14-II
(SHORTENING AND TABLE OIL PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN 818KQSY
DESIGN EFFICIENCY... 94.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	122710.00
2. LAND	54140.00
3. ENGINEERING	12270.00
4. CONTINGENCY	12270.00
TOTAL	201390.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	6050.00
3. CHEMICALS	1870.00
4. MAINTENANCE&SUPPLIES	3520.00
TOTAL	23930.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	23930.00
2. YEARLY INVESTMENT COST RECOVERY	8060.00
3. DEPRECIATION	7360.00
TOTAL	39350.00

Costs: Total investment cost: \$217,340
Total yearly cost: \$ 44,070

An itemized breakdown of costs is presented in Table 238. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 97.3 percent
SS: 96.4 percent
O&G: 96.2 percent

Alternative A 14-IV - This alternative provides in addition to Alternative A 14-III activated carbon adsorption prior to discharge to navigable waters.

The resulting BOD waste load is 0.008 kg/kkg (0.016 lb/ton), the suspended solids load is 0.008 kg/kkg (0.016 lb/ton), and the oil and grease load is 0.004 kg/kkg (0.008 lb/ton).

Costs: Total investment cost: \$259,260
Total yearly cost: \$ 62,190

An itemized breakdown of costs is presented in Table 239. It is assumed that land costs \$82,040 per hectare (\$33,200 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 98.6 percent
SS: 98.1 percent
O&G: 98.1 percent

A cost efficiency curve is presented in Figure 287.

Alternative A 14-V - This alternative provides in addition to Alternative A 14-I an aerated lagoon system with a settling pond.

The resulting BOD waste load is 0.029 kg/kkg (0.058 lb/ton), the suspended solids load is 0.038 kg/kkg (0.076 lb/ton), and the oil and grease load is 0.021 kg/kkg (0.042 lb/ton).

Costs: Total investment cost: \$147,390
Total yearly cost: \$ 34,810

An itemized breakdown of costs is presented in Table 240. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one-half time operator is required.

Reduction Benefits: BOD: 94.8 percent
SS: 90.9 percent
O&G: 90.0 percent

TABLE 238

ITEMIZED COST SUMMARY FOR ALTERNATIVE A14-III
(SHORTENING AND TABLE OIL PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN (B18KGSY)BN
DESIGN EFFICIENCY... 97.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	136000.00
2. LAND	54140.00
3. ENGINEERING	13600.00
4. CONTINGENCY	13600.00
TOTAL	217340.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	7670.00
3. CHEMICALS	1870.00
4. MAINTENANCE&SUPPLIES	5190.00
TOTAL	27220.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	27220.00
2. YEARLY INVESTMENT	
COST RECOVERY	8690.00
3. DEPRECIATION	8160.00
TOTAL	44070.00

TABLE 239

ITEMIZED COST SUMMARY FOR ALTERNATIVE A14-IV
(SHORTENING AND TABLE OIL PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN (B1BKGSYBN)Z
DESIGN EFFICIENCY... 98.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
R...PUMPING STATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	170940.00
2. LAND	54140.00
3. ENGINEERING	17090.00
4. CONTINGENCY	17090.00
TOTAL	259260.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	10020.00
3. CHEMICALS	1870.00
4. MAINTENANCE & SUPPLIES	17180.00
TOTAL	41560.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	41560.00
2. YEARLY INVESTMENT	
COST RECOVERY	10370.00
3. DEPRECIATION	10260.00
TOTAL	62190.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

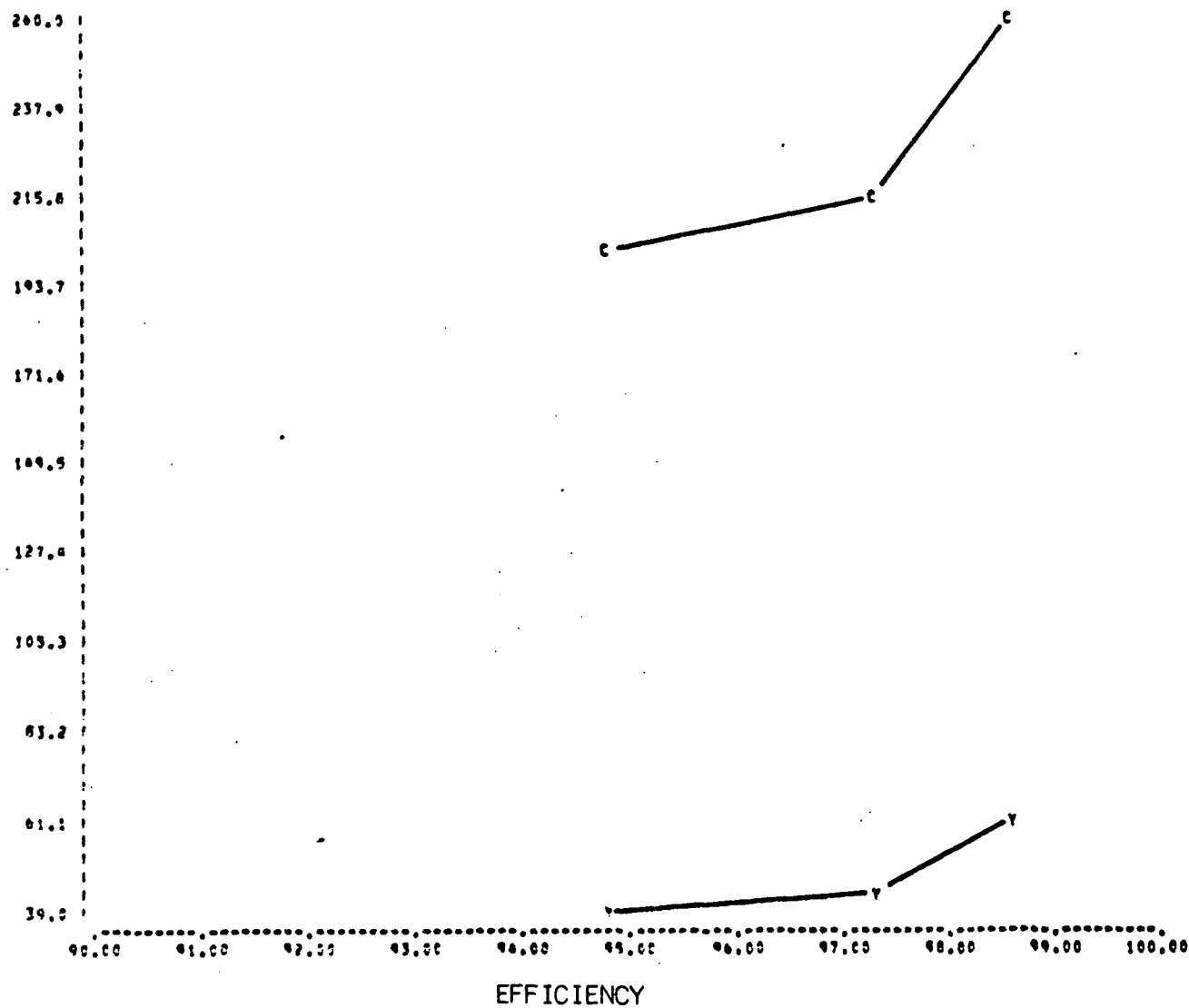


FIGURE 287

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A14, ALTERNATIVES II THROUGH IV

TABLE 240

ITEMIZED COST SUMMARY FOR ALTERNATIVE A14-V
(SHORTENING AND TABLE OIL PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN BL
DESIGN EFFICIENCY... 94.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	116910.00
2. LAND	3330.00
3. ENGINEERING	11690.00
4. CONTINGENCY	11690.00
5. PVC LINER	3770.00
TOTAL	147390.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	13680.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	1640.00
5. PVC LINER	140.00
TOTAL	21710.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	21710.00
2. YEARLY INVESTMENT COST RECOVERY	5900.00
3. DEPRECIATION	7200.00
TOTAL	34810.00

Alternative A 14-VI - This alternative provides in addition to Alternative A 14-V dual media pressure filtration and a pump station to generate sufficient head for filter operation.

The resulting BOD waste load is 0.015 kg/kkg (0.030 lb/ton), the suspended solids load is 0.015 kg/kkg (0.030 lb/ton), and the oil and grease load is 0.008 kg/kkg (0.016 lb/ton).

Costs: Total investment cost: \$163,350
Total yearly cost: \$ 39,520

An itemized breakdown of costs is presented in Table 241. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one-half time operator is required.

Reduction Benefits: BOD: 97.3 percent
SS: 96.4 percent
O&G: 96.2 percent

Alternative A 14-VII - This alternative provides in addition to Alternative A 14-VI activated carbon adsorption before final discharge to navigable waters.

The resulting BOD waste load is 0.008 kg/kkg (0.016 lb/ton), the suspended solids load is 0.008 kg/kkg (0.016 lb/ton), and the oil and grease load is 0.004 kg/kkg (0.008 lb/ton).

Costs: Total investment cost: \$205,260
Total yearly cost: \$ 57,640

An itemized breakdown of costs is presented in Table 242. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that a one-half time operator is required.

Reduction Benefits: BOD: 98.6 percent
SS: 98.1 percent
O&G: 98.1 percent

A cost efficiency curve is presented in Figure 288.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 15 - Olive Oil Refining

A model plant representative of subcategory A 15 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, three alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 7.6 cu m (0.002 MG) of refined olive oil per day.

TABLE 241

ITEMIZED COST SUMMARY FOR ALTERNATIVE A14-VI
(SHORTENING AND TABLE OIL PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN (BL)BN
DESIGN EFFICIENCY,... 97.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	130210.00
2. LAND	3330.00
3. ENGINEERING	13020.00
4. CONTINGENCY	13020.00
5. PVC LINER	3770.00
TOTAL	163350.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	15290.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	3310.00
5. PVC LINER	140.00
TOTAL	24990.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	24990.00
2. YEARLY INVESTMENT COST RECOVERY	6530.00
3. DEPRECIATION	8000.00
TOTAL	39520.00

TABLE 242

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 14-VII
(SHORTENING AND TABLE OIL PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN (BLEND)Z
DESIGN EFFICIENCY... 98.6 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	165140.00
2. LAND	3330.00
3. ENGINEERING	16510.00
4. CONTINGENCY	16510.00
5. PVC LINER	3770.00
TOTAL	205260.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	17650.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	15290.00
5. PVC LINER	140.00
TOTAL	39330.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	39330.00
2. YEARLY INVESTMENT COST RECOVERY	8210.00
3. DEPRECIATION	10100.00
TOTAL	57640.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

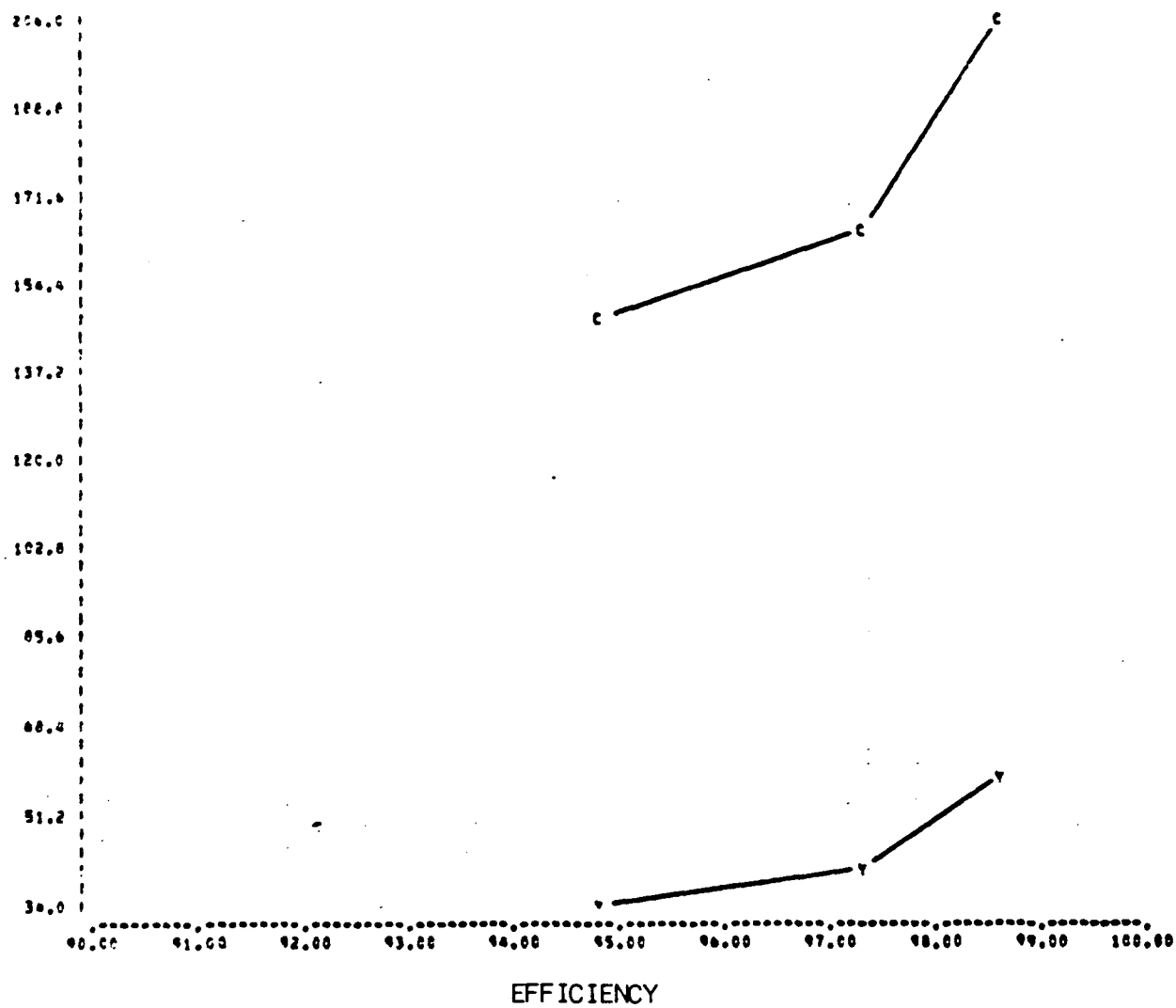


FIGURE 288

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A14, ALTERNATIVE V THROUGH VII

It is estimated that the effluent from a 7.6 cu m (0.002 MG) per day plant is 1.1 cu m (0.0003 MG) per day. The BOD waste load is 0.85 kg/cu m (7.1 lb/1000 gal), the suspended solids load is 0.044 kg/cu m (0.37 lb/1000 gal) and the oil and grease load is 0.029 kg/cu m (0.24 lb/gal).

Alternative A 15-I - This alternative consists of pumping station, a holding tank and spray irrigation of the raw waste effluent. It is assumed that a minimum of 0.65 ha (1.6 acres) of land is required.

The resulting BOD waste load is 0.0 kg/cu m (0.0 lb/1000 gal), the suspended solids load is 0.0 kg/cu m (0.0 lb/1000 gal) and the oil and grease load is 0.0 kg/cu m (0.0 lb/1000 gal).

Costs: Total investment cost: \$37,730
Total yearly cost: \$ 5,170

An itemized breakdown of costs is presented in Table 243. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operator is required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

Alternative A 15-II - This alternative consists of land spreading the raw waste effluent. It is assumed that a minimum of 0.4 ha (one acre) of land is required and that the effluent does not need to be pumped more than 150 m (500 ft).

The resulting BOD waste load is 0.0 kg/cu m (0.0 lb/1000 gal), the suspended solids load is 0.0 kg/cu m (0.0 lb/1000 gal) and the oil and grease load is 0.0 kg/cu m (0.0 lb/1000 gal).

Costs: Total investment cost: \$5,260
Total yearly cost: \$ 540

An itemized breakdown of costs is presented in Table 244. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operator is required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

TABLE 243

ITEMIZED COST SUMMARY FOR ALTERNATIVE A15-I
(OLIVE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	29220.00
2. LAND	2670.00
3. ENGINEERING	2920.00
4. CONTINGENCY	2920.00
TOTAL	37730.00

YEARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	830.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	1080.00
TOTAL	1910.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	1910.00
2. YEARLY INVESTMENT COST RECOVERY	1510.00
3. DEPRECIATION	1750.00
TOTAL	5170.00

TABLE 244

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 15-II
(OLIVE OIL REFINING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 100 PERCENT BOD REDUCTION

TREATMENT MODULES:

LAND SPREADING

INVESTMENT COSTS:

1. CONSTRUCTION	3000.00
2. LAND	1660.00
3. ENGINEERING	300.00
4. CONTINGENCY	300.00
TOTAL	5260.00

YEARLY OPERATING COSTS:

1. LABOR	0.00
2. POWER	0.00
3. CHEMICALS	0.00
4. MAINTENANCE & SUPPLIES	150.00
TOTAL	150.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	150.00
2. YEARLY INVESTMENT COST RECOVERY	210.00
3. DEPRECIATION	180.00
TOTAL	540.00

Alternative A 15-III - This alternative consists of hauling the wastewater to a municipal treatment facility.

The resulting BOD waste load is 0.0 kg/cu m (0.0 lb/1000 gal), the suspended solids load is 0.0 kg/cu m (0.0 lb/1000 gal) and the oil and grease load is 0.0 kg/cu m (0.0 lb/1000 gal).

Costs: Total investment cost: \$0.
Total yearly cost: \$1,200

Reduction Benefits: BOD: 100 percent
SS: 100 percent
O&G: 100 percent

BEVERAGES

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 16 - New Large Breweries

A model plant representative of subcategory A 16 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, thirteen alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 1500 cu m (12,800 bbl) per day.

Alternative A 16-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 1500 cu m (12,800 bbl) per day plant is 8300 cu m (2.2 m) per day. The BOD waste load is 10.55 kg/cu m (2.722 lb/bbl), and the suspended solids load is 3.89 kg/cu m (1.004 lb/bbl).

Costs: 0
Reduction Benefits: None

Alternative A 16-II - This alternative provides screening and a grit chamber, flow equalization, neutralization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load 150.28 kg/cu m (0.072 lb/bbl) and the suspended solids load is 0.39 kg/cu m (0.100 lb/bbl).

Costs: Total investment cost: \$2,355,740
Total yearly cost: \$1,055,530

An itemized breakdown of costs is presented in Table 245. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 97.4 percent
SS: 90.0 percent

TABLE 245

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-II
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

E1...SCREENING & GRIT CHAMBER
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	1879640.00
2. LAND	26410.00
3. ENGINEERING	187960.00
4. CONTINGENCY	187960.00
5. PVC LINER	73770.00
TOTAL	2355740.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	678780.00
3. CHEMICALS	74190.00
4. MAINTENANCE&SUPPLIES	61670.00
5. PVC LINER	5200.00
TOTAL	844830.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	844830.00
2. YEARLY INVESTMENT	
COST RECOVERY	94230.00
3. DEPRECIATION	116470.00
TOTAL	1055530.00

Alternative A 16-III - This alternative provides in addition to Alternative A 16-II dual media filtration.

The resulting BOD waste load is 0.14 kg/cu m (0.036 lb/bbl), and the suspended solids load is 0.19 kg/cu m (0.049 lb/bbl).

Costs: Total investment cost: \$2,495,160
Total yearly cost: \$1,088,090

An itemized breakdown of costs is presented in Table 246. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.7 percent
SS: 95.0 percent

Alternative A 16-IV - This alternative adds activated carbon to Alternative A 16-III.

The resulting BOD waste load is 0.07 kg/cu m (0.018 lb/bbl), and the suspended solids load is 0.09 kg/cu m (0.023 lb/bbl).

Costs: Total investment cost: \$3,798,200
Total yearly cost: \$1,324,820

An itemized breakdown of costs is presented in Table 247. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.4 percent
SS: 97.6 percent

A cost efficiency curve is presented in Figure 239.

Alternative A 16-V - This alternative provides a control house, screening and a grit chamber, flow equalization, neutralization, nutrient addition, a complete-mix activated sludge system, sludge thickening, aerobic digestion, and vacuum filtration.

The resulting BOD waste load is 0.28 kg/cu m (0.072 lb/bbl), and the suspended solids load is 0.39 kg/cu m (0.100 lb/bbl).

Costs: Total investment cost: \$3,730,960
Total yearly cost: \$1,029,500

An itemized breakdown of costs is presented in Table 248. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 97.4 percent
SS: 90.0 percent

TABLE 246

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-III
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

E1..SCREENING & GRIT CHAMBER
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	1995820.00
2. LAND	26410.00
3. ENGINEERING	199580.00
4. CONTINGENCY	199580.00
5. PVC LINER	73770.00
TOTAL	2495160.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	696880.00
3. CHEMICALS	74190.00
4. MAINTENANCE & SUPPLIES	63580.00
5. PVC LINER	5200.00
TOTAL	864840.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	864840.00
2. YEARLY INVESTMENT COST RECOVERY	99810.00
3. DEPRECIATION	123440.00
TOTAL	1088090.00

TABLE 247

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-IV
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

E1...SCREFFING & GRIT CHAMBER
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	3081680.00
2. LAND	26410.00
3. ENGINEERING	308170.00
4. CONTINGENCY	308170.00
5. PVC LINER	73770.00
TOTAL	3798200.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	728220.00
3. CHEMICALS	74190.00
4. MAINTENANCE & SUPPLIES	151700.00
5. PVC LINER	5200.00
TOTAL	984300.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	984300.00
2. YEARLY INVESTMENT	
COST RECOVERY	151930.00
3. DEPRECIATION	188590.00
TOTAL	1324820.00

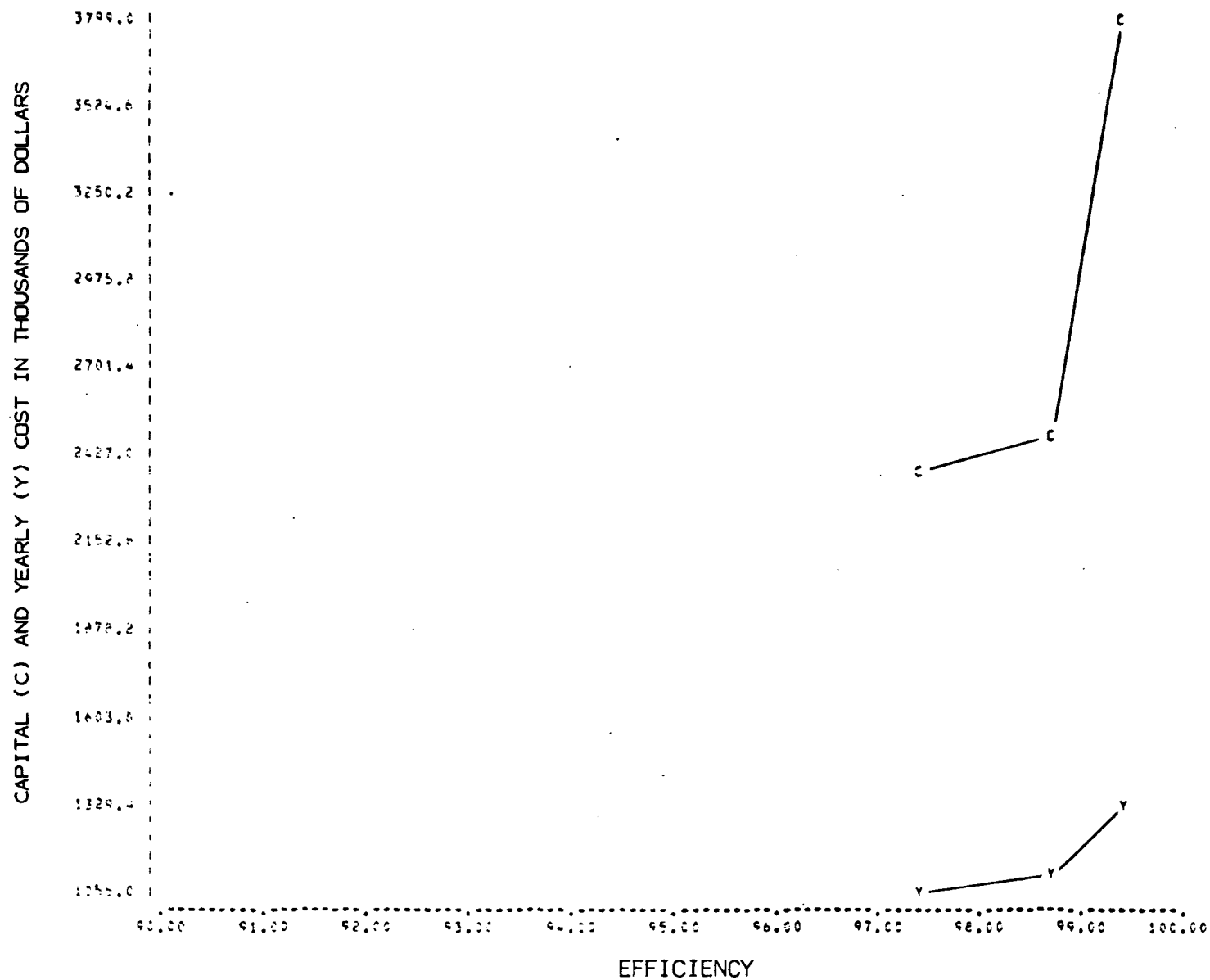


FIGURE 289

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 16, ALTERNATIVE IV

TABLE 248

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-V
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
9...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	3028620.00
2. LAND	96620.00
3. ENGINEERING	302860.00
4. CONTINGENCY	302860.00
TOTAL	3730960.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	458410.00
3. CHEMICALS	113770.00
4. MAINTENANCE&SUPPLIES	51390.00
TOTAL	698540.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	698540.00
2. YEARLY INVESTMENT COST RECOVERY	149240.00
3. DEPRECIATION	181720.00
TOTAL	1029500.00

Alternative A 16-VI - This alternative provides dual media filtration in addition to Alternative A 16-V.

The resulting BOD waste load is 0.14 kg/cu m (0.036 lb/bbl), and the suspended solids load is 0.19 kg/cu m (0.049 lb/bbl).

Costs: Total investment cost: \$3,870,380
Total yearly cost: \$1,062,060

An itemized breakdown of costs is presented in Table 249. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.7 percent
SS: 95.0 percent

Alternative A 16-VII - This alternative adds activated carbon to Alternative A 16-VI.

The resulting BOD waste load is 0.07 kg/cu m (0.018 lb/bbl), and the suspended solids load is 0.09 kg/cu m (0.023 lb/bbl).

Costs: Total investment cost: \$5,173,420
Total yearly cost: \$1,298,800

An itemized breakdown of costs is presented in Table 250. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.4 percent
SS: 97.6 percent

A cost efficiency curve is presented in Figure 290.

Alternative A 16-VIII - This alternative replaces vacuum filtration in A 16-V with sludge storage and spray irrigation.

The resulting BOD waste load is 0.28 kg/cu m (0.072 lb/bbl), and the suspended solids load is 0.39 kg/cu m (0.100 lb/bbl).

Costs: Total investment cost: \$3,652,280
Total yearly cost: \$ 933,750

An itemized breakdown of costs is presented in Table 251. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 97.4 percent
SS: 90.0 percent

Alternative A 16-IX - This alternative adds dual media filtration to Alternative A 16-VIII.

TABLE 249

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-VI
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	3144800.00
2. LAND	96620.00
3. ENGINEERING	314480.00
4. CONTINGENCY	314480.00
TOTAL	3870380.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	476510.00
3. CHEMICALS	113770.00
4. MAINTENANCE & SUPPLIES	53300.00
TOTAL	718550.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	718550.00
2. YEARLY INVESTMENT COST RECOVERY	154820.00
3. DEPRECIATION	188690.00
TOTAL	1062060.00

TABLE 250

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-VII
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
P...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	4230660.00
2. LAND	96620.00
3. ENGINEERING	423070.00
4. CONTINGENCY	423070.00
TOTAL	5173420.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	507850.00
3. CHEMICALS	113770.00
4. MAINTENANCE&SUPPLIES	141430.00
TOTAL	838020.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	838020.00
2. YEARLY INVESTMENT COST RECOVERY	206940.00
3. DEPRECIATION	253840.00
TOTAL	1298800.00

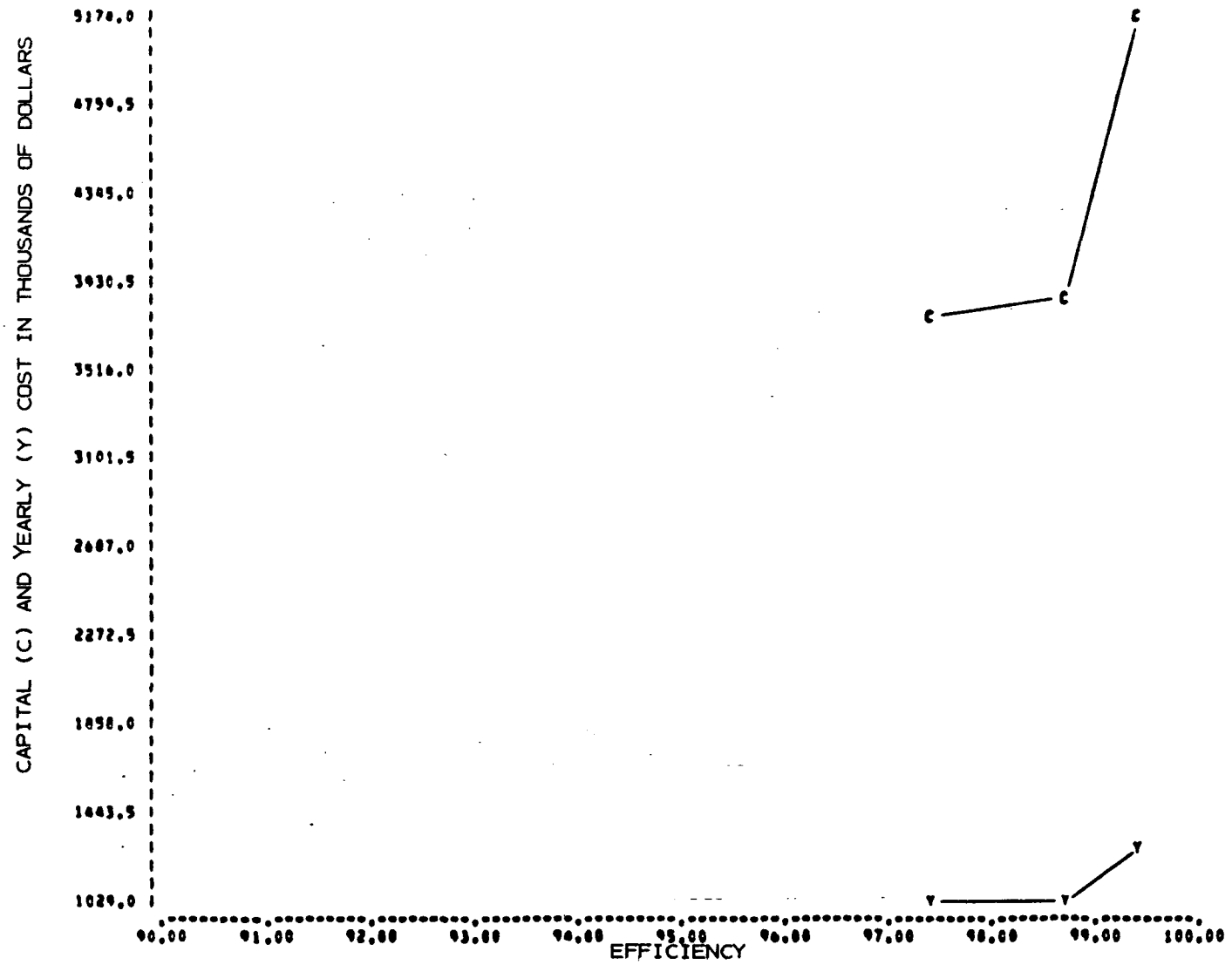


FIGURE 290

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 16, ALTERNATIVE VII

TABLE 251

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-VIII
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	3006770.00
2. LAND	44150.00
3. ENGINEERING	300680.00
4. CONTINGENCY	300680.00
TOTAL	3652280.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	430350.00
3. CHEMICALS	74190.00
4. MAINTENANCE & SUPPLIES	27740.00
TOTAL	607250.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	607250.00
2. YEARLY INVESTMENT COST RECOVERY	146090.00
3. DEPRECIATION	180410.00
TOTAL	933750.00

DRAFT

The resulting BOD waste load is 0.14 kg/cu m (0.036 lb/bbl), and the suspended solids load is 0.19 kg/cu m (0.049 lb/bbl).

Costs: Total investment cost: \$3,791,680
Total yearly cost: \$ 966,310

An itemized breakdown of costs is presented in Table 252. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.7 percent
SS: 95.0 percent

Alternative A 16-X - This alternative adds activated carbon to Alternative A 16-IX.

The resulting BOD waste load is 0.07 kg/cu m (0.018 lb/bbl), and the suspended solids load is 0.09 kg/cu m (0.023 lb/bbl).

Costs: Total investment cost: \$5,094,720
Total yearly cost: \$1,203,040

An itemized breakdown of costs is presented in Table 253. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.4 percent
SS: 97.6 percent

A cost efficiency curve is presented in Figure 291.

Alternative A 16-XI - This alternative replaces vacuum filtration in Alternative A 16V with sand drying.

The resulting BOD waste load is 0.28 kg/cu m (0.072 lb/bbl), and the suspended solids load is 0.39 kg/cum (0.100 lb/bbl).

Costs: Total investment cost: \$6,764,510
Total yearly cost: \$1,527,890

An itemized breakdown of costs is presented in Table 254. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 97.4 percent
SS: 90.0 percent

Alternative A 16-XII - This alternative adds dual media filtration to Alternative A 16-XI.

The resulting BOD waste load is 0.014 kg/cu m (0.036 lb/bbl), and the suspended solids load is 0.019 kg/cu m (0.049 lb/bbl).

TABLE 252

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-IX
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	3122950.00
2. LAND	44150.00
3. ENGINEERING	312290.00
4. CONTINGENCY	312290.00
TOTAL	3791680.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	448450.00
3. CHEMICALS	74190.00
4. MAINTENANCE & SUPPLIES	29650.00
TOTAL	627260.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	627260.00
2. YEARLY INVESTMENT COST RECOVERY	151670.00
3. DEPRECIATION	187380.00
TOTAL	966310.00

TABLE 253

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-X
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	4208810.00
2. LAND	44150.00
3. ENGINEERING	420880.00
4. CONTINGENCY	420880.00
TOTAL	5094720.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	479790.00
3. CHEMICALS	74190.00
4. MAINTENANCE & SUPPLIES	117770.00
TOTAL	746720.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	746720.00
2. YEARLY INVESTMENT	
COST RECOVERY	203790.00
3. DEPRECIATION	252530.00
TOTAL	1203040.00

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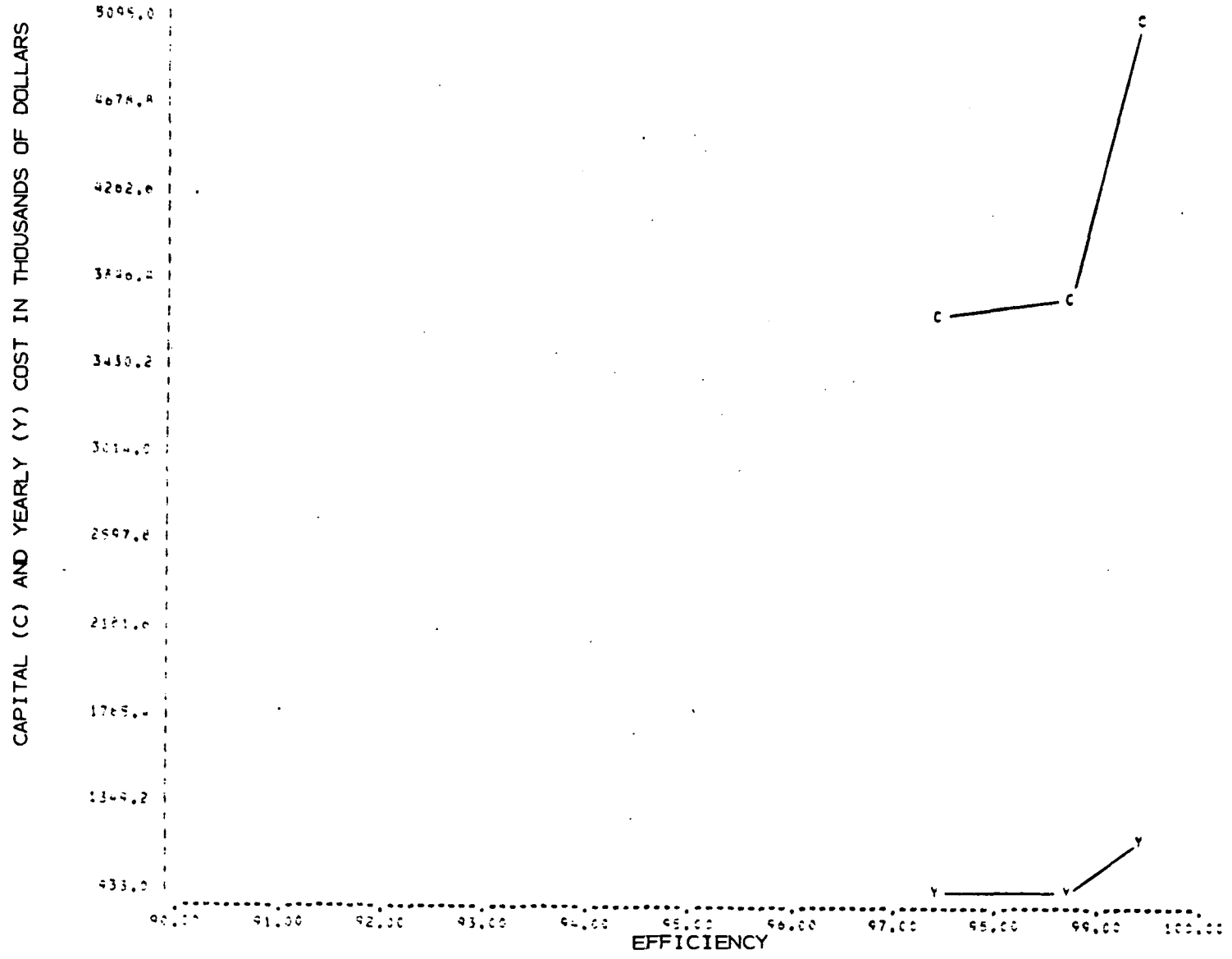


FIGURE 291
INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 16, ALTERNATIVE X

TABLE 254

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-XI
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

H1...CONTROL HOUSE
 E1...SCREENING & GRIT CHAMBER
 R...PUMPING STATION
 C...EQLALIZATION BASIN
 F...ACID NEUTRALIZATION
 H...NITROGEN ADDITION
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 T...SAND DRYING BEDS

INVESTMENT COSTS:

1. CONSTRUCTION	5455920.00
2. LAND	217410.00
3. ENGINEERING	545590.00
4. CONTINGENCY	545590.00
TOTAL	6764510.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	429170.00
3. CHEMICALS	74190.00
4. MAINTENANCE&SUPPLIES	351630.00
TOTAL	929960.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	929960.00
2. YEARLY INVESTMENT	
COST RECOVERY	270580.00
3. DEPRECIATION	327350.00
TOTAL	1527890.00

Costs: Total investment cost: \$6,903,930
Total yearly cost: \$1,560,460

An itemized breakdown of costs is presented in Table 255. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.7 percent
SS: 95.0 percent

Alternative A 16-XIII - This alternative adds activated carbon to Alternative A 16-XII.

The resulting BOD waste load is 0.07 kg/cu m (0.018 lb/bbl), and the suspended solids load is 0.09 kg/cu m (0.023 lb/bbl).

Costs: Total investment cost: \$8,206,970
Total yearly cost: \$1,797,190

An itemized breakdown of costs is presented in Table 256. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.4 percent
SS: 97.6 percent

A cost efficiency curve is presented in Figure 292.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 17 - Old Large Breweries

A model plant representative of subcategory A 17 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, thirteen alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 2600 cu m (22,000 bbl) per day.

Alternative A 17-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 2600 cu m (22,000 bbl) per day plant is 28,000 cu m (7.5 MG) per day. The BOD waste load is 18.56 kg/cu m (4.78 lb/bbl), and the suspended solids load is 7.32 kg/cu m (1.89 lb/bbl).

Costs: 0
Reduction Benefits: None

Alternative A 17-II - This alternative provides screening and a grit chamber, flow equalization, neutralization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load is 0.55 kg/cu m (0.14 lb/bbl), and the suspended solids load is 0.76 kg/cu m (0.20 lb/bbl).

TABLE 255

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-XII
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
 E1...SCREENING & GRIT CHAMBER
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 F...ACID NEUTRALIZATION
 H...NITROGEN ADDITION
 K...ACTIVATED SLUDGE
 Q...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 T...SAND DRYING BEDS
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	5572100.00
2. LAND	217410.00
3. ENGINEERING	557210.00
4. CONTINGENCY	557210.00
TOTAL	6903930.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	447270.00
3. CHEMICALS	74190.00
4. MAINTENANCE & SUPPLIES	353540.00
TOTAL	949970.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	949970.00
2. YEARLY INVESTMENT COST RECOVERY	276160.00
3. DEPRECIATION	334330.00
TOTAL	1560460.00

TABLE 256

ITEMIZED COST SUMMARY FOR ALTERNATIVE A16-XIII
(NEW LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 E1...SCREENING & GRIT CHAMBER
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 F...ACID NEUTRALIZATION
 H...NITROGEN ADDITION
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 T...SAND DRYING BEDS
 N...DUAL MEDIA PRESSURE FILTRATION
 Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	6657960.00
2. LAND	217410.00
3. ENGINEERING	665800.00
4. CONTINGENCY	665800.00
TOTAL	8206970.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	478610.00
3. CHEMICALS	74190.00
4. MAINTENANCE&SUPPLIES	441660.00
TOTAL	1069430.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	1069430.00
2. YEARLY INVESTMENT	
COST RECOVERY	328280.00
3. DEPRECIATION	399480.00
TOTAL	1797190.00

8001

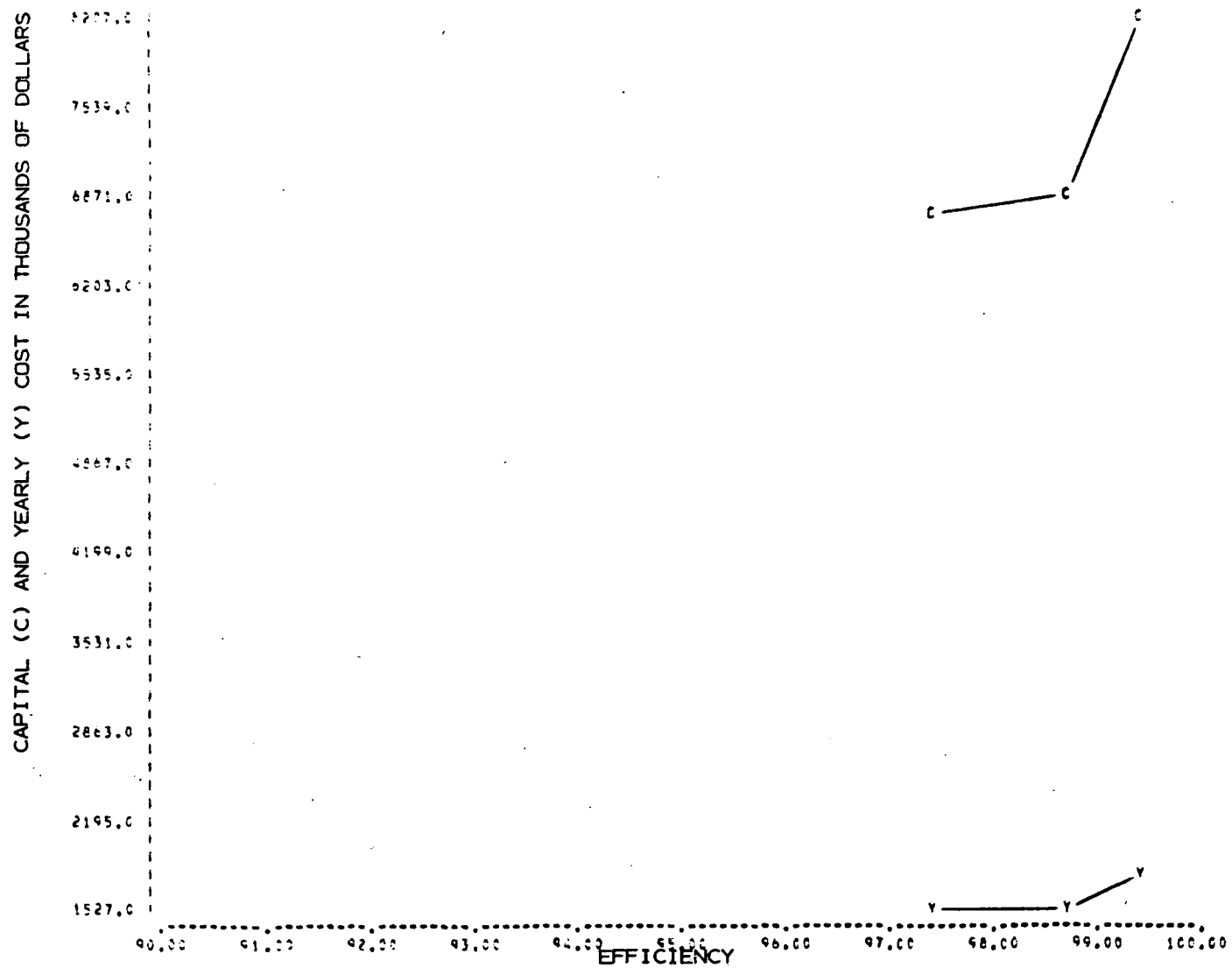


FIGURE 292

INVESTMENT AND YEARLY COST FOR SUBCATEGORY A 16, SUBCATEGORY XIII

Costs: Total investment cost: \$7,125,250
Total yearly cost: \$3,328,060

An itemized breakdown of costs is presented in Table 257. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 97.0 percent
SS: 89.5 percent

Alternative A 17-III - This alternative provides in addition to Alternative A 17-II dual media filtration.

The resulting BOD waste load is 0.27 kg/cu m (0.07 lb/bbl), and the suspended solids load is 0.38 kg/cu m (0.10 lb/bbl).

Costs: Total investment cost: \$7,526,890
Total yearly cost: \$3,422,120

An itemized breakdown of costs is presented in Table 258. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 94.7 percent

Alternative A 17-IV - This alternative adds activated carbon to Alternative A 17-III.

The resulting BOD waste load is 0.13 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.19 kg/cu m (0.05 lb/bbl).

Costs: Total investment cost: \$11,677,060
Total yearly cost: \$ 4,195,440

An itemized breakdown of costs is presented in Table 259. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.3 percent
SS: 97.5 percent

A cost efficiency curve is presented in Figure 293.

Alternative A 17-V - This alternative provides a control house, screening and a grit chamber, flow equalization, neutralization, nutrient addition, a complete mix activated sludge system, sludge thickening, aerobic digestion, and vacuum filtration.

TABLE 257

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-II
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

E1...SCREFFING & GRIT CHAMBER
R...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON
M...SETTLING PCND

INVESTMENT COSTS:

1. CONSTRUCTION	5697460.00
2. LAND	55310.00
3. ENGINEERING	569750.00
4. CONTINGENCY	569750.00
5. PVC LINER	232980.00
TOTAL	7125250.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	2259300.00
3. CHEMICALS	241780.00
4. MAINTENANCE&SUPPLIES	145680.00
5. PVC LINER	17800.00
TOTAL	2689550.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	2689550.00
2. YEARLY INVESTMENT	
COST RECOVERY	285010.00
3. DEPRECIATION	353500.00
TOTAL	3328060.00

TABLE 258

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-III
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON
M...SETTLING POOL
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	6032160.00
2. LAND	55310.00
3. ENGINEERING	603220.00
4. CONTINGENCY	603220.00
5. PVC LINER	232980.00
TOTAL	7526890.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	2311710.00
3. CHEMICALS	241780.00
4. MAINTENANCE&SUPPLIES	151180.00
5. PVC LINER	17800.00
TOTAL	2747460.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	2747460.00
2. YEARLY INVESTMENT COST RECOVERY	301080.00
3. DEPRECIATION	373580.00
TOTAL	3422120.00

TABLE 259

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-IV
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON
M...SETTLING POND
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	9490650.00
2. LAND	55310.00
3. ENGINEERING	949060.00
4. CONTINGENCY	949060.00
5. PVC LINER	232980.00
TOTAL	11677060.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	2412030.00
3. CHEMICALS	241780.00
4. MAINTENANCE & SUPPLIES	450670.00
5. PVC LINER	17800.00
TOTAL	3147270.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	3147270.00
2. YEARLY INVESTMENT COST RECOVERY	467080.00
3. DEPRECIATION	581090.00
TOTAL	4195440.00

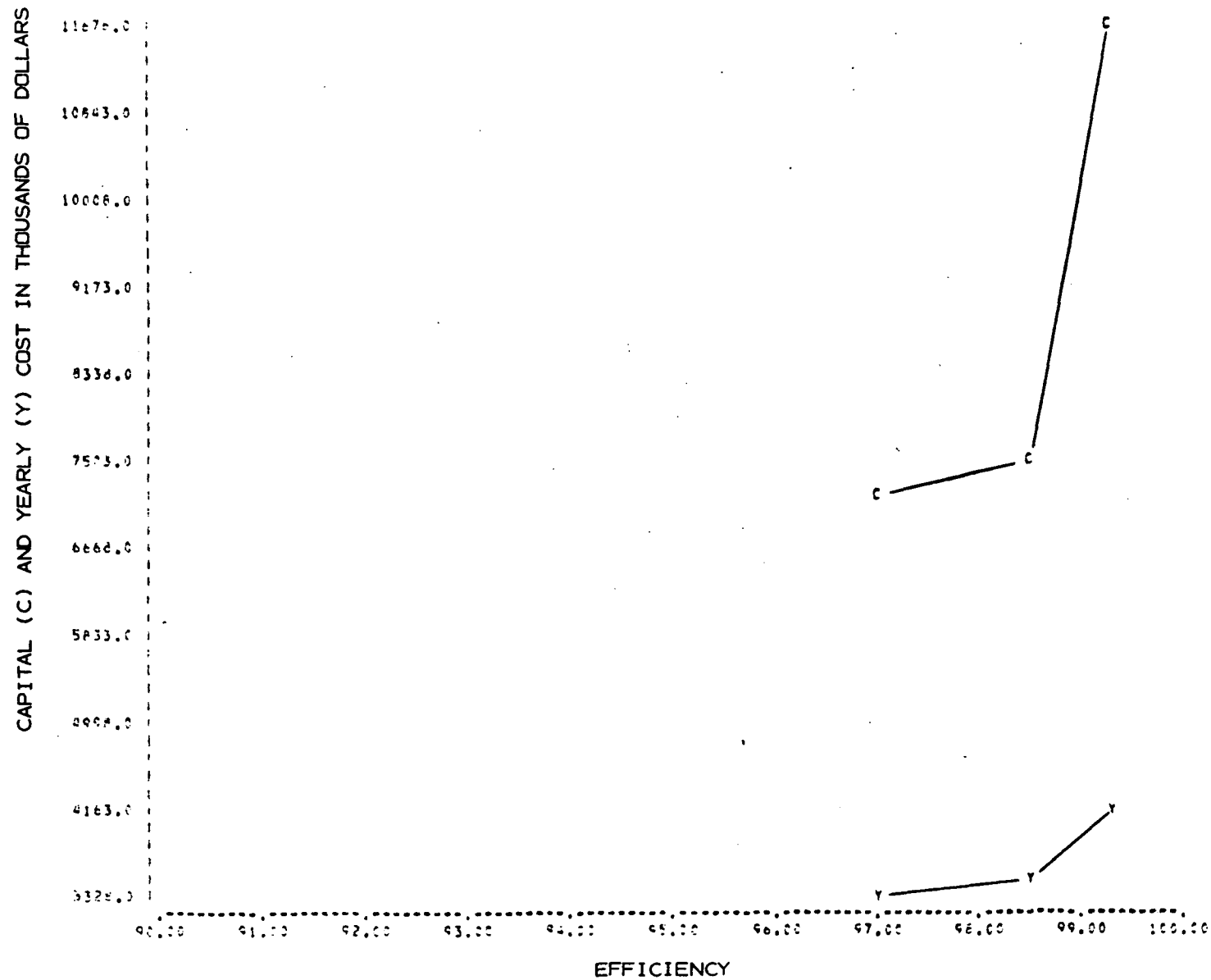


FIGURE 293

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 17, ALTERNATIVE IV

The resulting BOD waste load is 0.55 kg/cu m (0.14 lb/bbl), and the suspended solids load is 0.76 kg/cu m (0.20 lb/bbl).

Costs: Total investment cost: \$11,377,110
Total yearly cost: \$ 3,107,230

An itemized breakdown of costs is presented in Table 260. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 97.0 percent
SS: 89.5 percent

Alternative A 17-VI - This alternative provides dual media filtration in addition to Alternative A 17-V.

The resulting BOD waste load is 0.27 kg/cu m (0.07 lb/bbl), and the suspended solids load is 0.38 kg/cu m (0.10 lb/bbl).

Costs: Total investment cost: \$11,778,750
Total yearly cost: \$ 3,201,290

An itemized breakdown of costs is presented in Table 261. It is assumed that land costs \$41,000 per hectare (16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 94.7 percent

Alternative A 17-VII - This alternative adds activated carbon to Alternative A 17-VI.

The resulting BOD waste load is 0.13 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.19 kg/cu m (0.05 lb/bbl).

Costs: Total investment cost: \$15,928,940
Total yearly cost: \$ 3,974,630

An itemized breakdown of costs is presented in Table 262. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.3 percent
SS: 97.5 percent

A cost efficiency curve is presented in Figure 294.

Alternative A 17-VIII - This alternative replaces vacuum filtration in A 17-V with sludge storage and spray irrigation.

TABLE 260

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-V
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
F...ACID NEUTRALIZATION
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	9260880.00
2. LAND	264050.00
3. ENGINEERING	926090.00
4. CONTINGENCY	926090.00
TOTAL	11377110.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	1518390.00
3. CHEMICALS	481670.00
4. MAINTENANCE&SUPPLIES	21470.00
TOTAL	2096500.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	2096500.00
2. YEARLY INVESTMENT	
COST RECOVERY	455080.00
3. DEPRECIATION	555650.00
TOTAL	3107230.00

TABLE 261

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-VI
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
F...ACID NEUTRALIZATION
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	9595580.00
2.	LAND	264050.00
3.	ENGINEERING	959560.00
4.	CONTINGENCY	959560.00
	TOTAL	11778750.00

YEARLY OPERATING COSTS:

1.	LABOR	74970.00
2.	POWER	1570810.00
3.	CHEMICALS	481670.00
4.	MAINTENANCE SUPPLIES	26960.00
	TOTAL	2154410.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	2154410.00
2.	YEARLY INVESTMENT COST RECOVERY	471150.00
3.	DEPRECIATION	575730.00
	TOTAL	3201290.00

TABLE 262

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-VII
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
F...ACID NEUTRALIZATION
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	13054070.00
2. LAND	264050.00
3. ENGINEERING	1305410.00
4. CONTINGENCY	1305410.00
TOTAL	15928940.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	1671120.00
3. CHEMICALS	481670.00
4. MAINTENANCE & SUPPLIES	326470.00
TOTAL	2554230.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	2554230.00
2. YEARLY INVESTMENT	
COST RECOVERY	637160.00
3. DEPRECIATION	783240.00
TOTAL	3974630.00

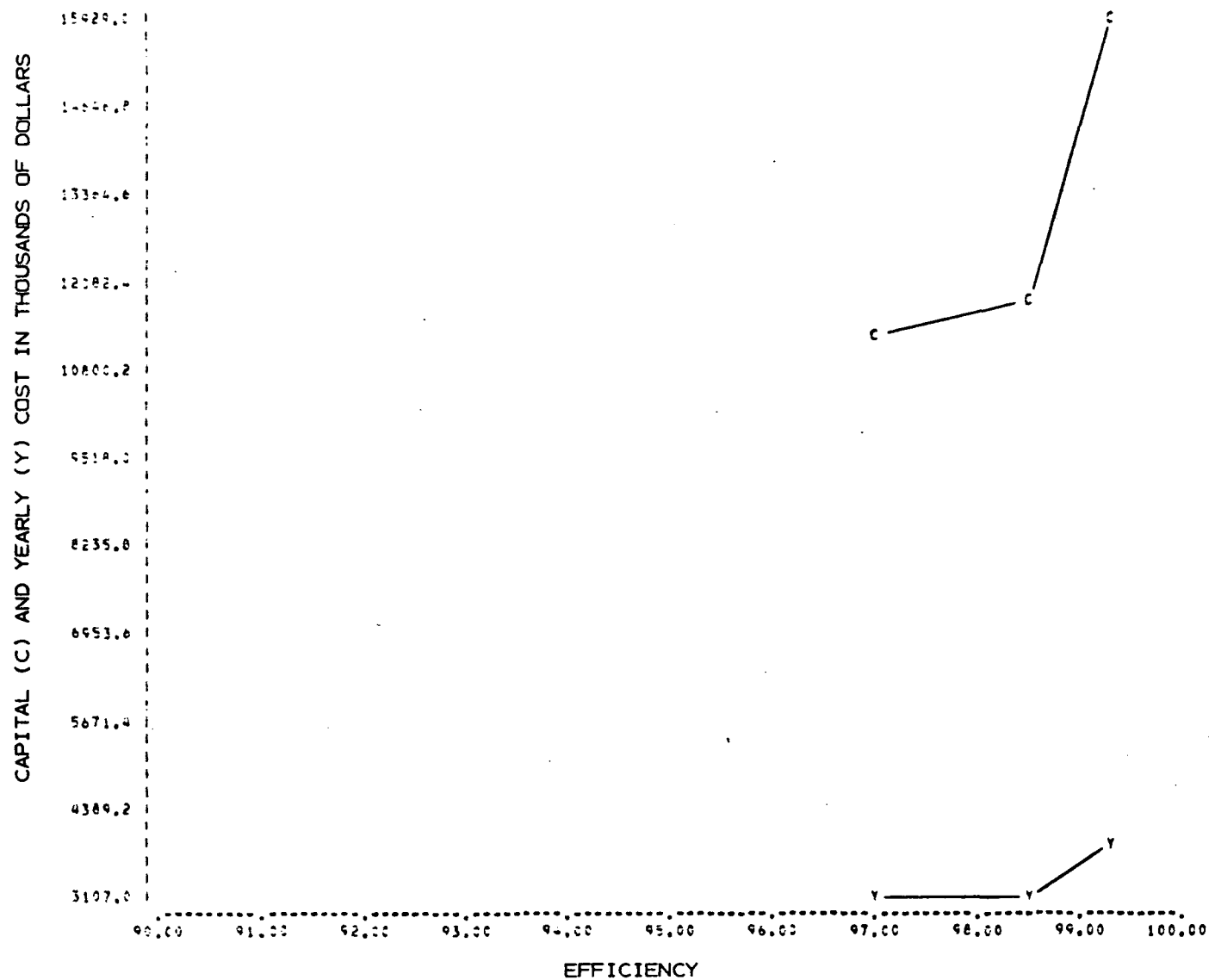


FIGURE 294

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 17, ALTERNATIVE VII

The resulting BOD waste load is 0.55 kg/cu m (0.14 lb/bbl), and the suspended solids load is 0.76 kg/cu m (0.20 lb/bbl).

Costs: Total investment cost: \$11,233,200
Total yearly cost: \$ 2,833,190

An itemized breakdown of costs is presented in Table 263. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 97.0 percent
SS: 89.5 percent

Alternative A 17-IX - This alternative adds dual media filtration to Alternative A 17-VIII.

The resulting BOD waste load is 0.27 kg/cu m (0.07 lb/bbl), and the suspended solids load is 0.38 kg/cu m (0.10 lb/bbl).

Costs: Total investment cost: \$11,634,840
Total yearly cost: \$ 2,927,240

An itemized breakdown of costs is presented in Table 264. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.5 percent
SS: 94.7 percent

Alternative A 17-X - This alternative adds activated carbon to Alternative A 17-IX.

The resulting BOD waste load is 0.13 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.19 kg/cu m (0.05 lb/bbl).

Costs: Total investment cost: \$15,785,030
Total yearly cost: \$ 3,700,570

An itemized breakdown of costs is presented in Table 265. It is assumed that land costs assumed that six operators are required.

Reduction Benefits: BOD: 99.3 percent
SS: 97.5 percent

A cost efficiency curve is presented in Figure 295.

Alternative A 17-XI - This alternative replaces vacuum filtration in Alternative A 17-V with sand drying beds. This alternative was not deemed economically viable and therefore was not costed.

TABLE 263

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-VIII
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	9252610.00
2. LAND	130070.00
3. ENGINEERING	925260.00
4. CONTINGENCY	925260.00
TOTAL	11233200.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	1430180.00
3. CHEMICALS	241780.00
4. MAINTENANCE&SUPPLIES	81770.00
TOTAL	1828700.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	1828700.00
2. YEARLY INVESTMENT COST RECOVERY	449330.00
3. DEPRECIATION	555160.00
TOTAL	2833190.00

TABLE 264

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-IX
(OLD LARGE BREWERIES)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 E1...SCREENING & GRIT CHAMBER
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 F...ACID NEUTRALIZATION
 H...NITROGEN ADDITION
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 Y...HOLDING TANK
 U...SPRAY IRRIGATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	9587310.00
2. LAND	130070.00
3. ENGINEERING	958730.00
4. CONTINGENCY	958730.00
TOTAL	11634840.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	1482600.00
3. CHEMICALS	241780.00
4. MAINTENANCE & SUPPLIES	87260.00
TOTAL	1886610.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	1886610.00
2. YEARLY INVESTMENT	
COST RECOVERY	465390.00
3. DEPRECIATION	575240.00
TOTAL	2927240.00

TABLE 265

ITEMIZED COST SUMMARY FOR ALTERNATIVE A17-X
(OLD LARGE BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1..CONTROL HOUSE
E1..SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1.	CONSTRUCTION	13045800.00
2.	LAND	130070.00
3.	ENGINEERING	1304580.00
4.	CONTINGENCY	1304580.00
TOTAL		15785030.00

YEARLY OPERATING COSTS:

1.	LABOR	74970.00
2.	POWER	1582910.00
3.	CHEMICALS	241780.00
4.	MAINTENANCE&SUPPLIES	386760.00
TOTAL		2286420.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	2286420.00
2.	YEARLY INVESTMENT COST RECOVERY	631400.00
3.	DEPRECIATION	782750.00
TOTAL		3700570.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

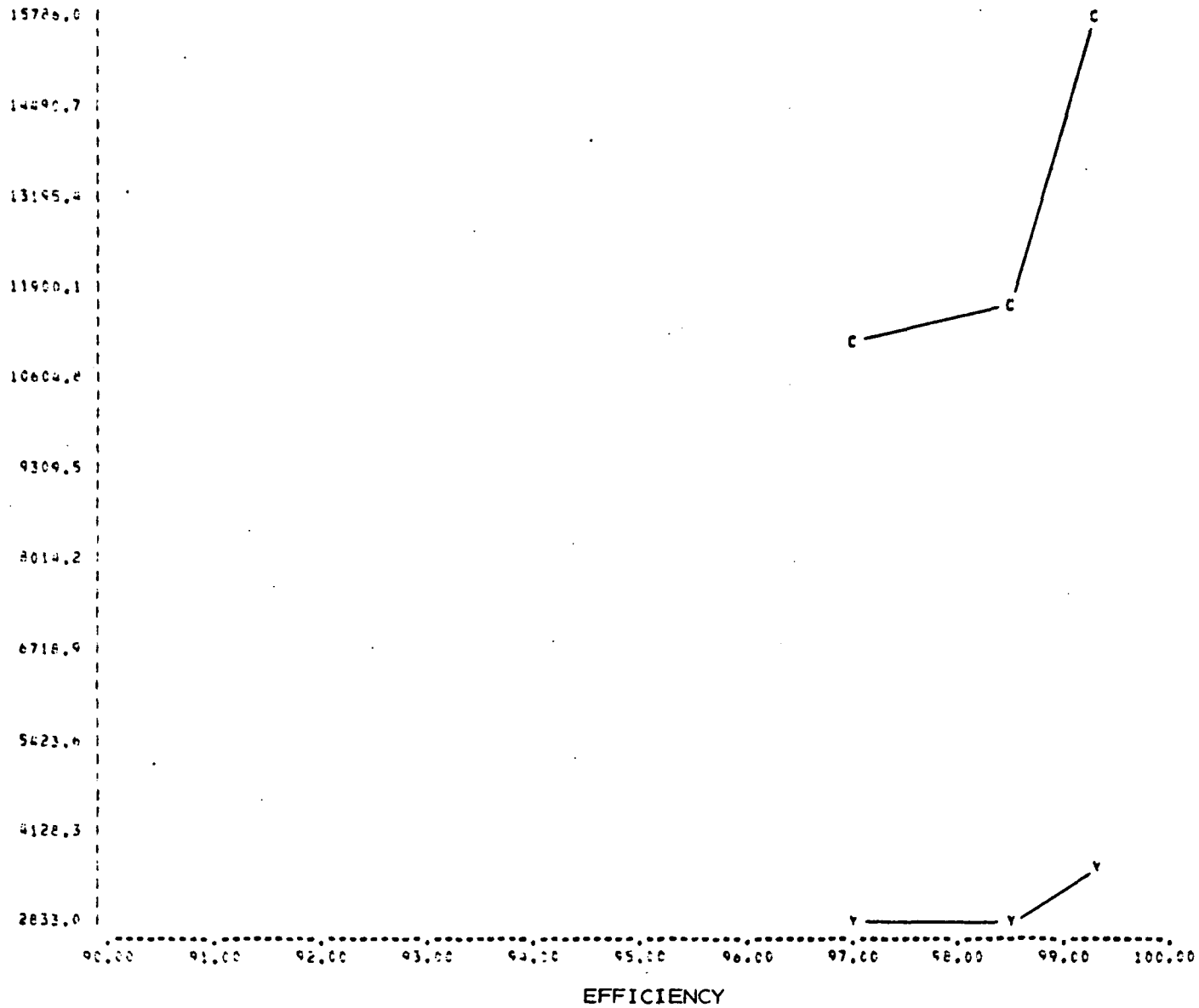


FIGURE 295

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 17, ALTERNATIVE X

The resulting BOD waste load is 0.55 kg/cu m (0.14 lb/bbl), and the suspended solids load is 0.76 kg/cu m (0.20 lb/bbl).

Reduction Benefits: BOD: 97.0 percent
SS: 89.5 percent

Alternative A 17-XII - This alternative adds dual media filtration to Alternative A 17-XI. This alternative was not deemed economically viable and therefore was not costed.

The resulting BOD waste load is 0.27 kg/cu m (0.07 lb/bbl), and the suspended solids load is 0.38 kg/cu m (0.10 lb/bbl).

Reduction Benefits: BOD: 98.5 percent
SS: 94.7 percent

Alternative A 17-XIII - This alternative adds activated carbon to Alternative A 17-XII. This alternative was not deemed economically viable and therefore was not costed.

The resulting BOD waste load is 0.13 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.19 kg/cu m (0.05 lb/bbl).

Reduction Benefits: BOD: 99.3 percent
SS: 97.5 percent

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 18 - All Other Breweries

A model plant representative of subcategory A 18 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, thirteen alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 470 cu m (4000 bbl) per day.

Alternative A 18-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 470 cu m (4000 bbl) per day plant is 4500 cu m (1.2 MG) per day. The BOD waste load is 13.53 kg/cu m (3.491 lb/bbl), and the suspended solids load is 6.19 kg/cu m (1.60 lb/bbl).

Costs: 0
Reduction Benefits: None

Alternative A 18-II - This alternative provides screening and a grit chamber, flow equalization, neutralization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load is 0.48 kg/cu m (0.12 lb/bbl), and the suspended solids load is 0.68 kg/cu m (0.18 lb/bbl).

Costs: Total investment cost: \$1,344,140
Total yearly cost: \$ 530,240

An itemized breakdown of costs is presented in Table 266. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 96.4 percent
SS: 89.1 percent

Alternative A 18-III - This alternative provides in addition to Alternative A 18-II dual media filtration.

The resulting BOD waste load is 0.24 kg/cu m (0.06 lb/bbl), and the suspended solids load is 0.34 kg/cu m (0.09 lb/bbl).

Costs: Total investment cost: \$1,432,200
Total yearly cost: \$ 551,760

An itemized breakdown of costs is presented in Table 267. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 98.2 percent
SS: 94.5 percent

Alternative A 18-IV - This alternative adds activated carbon to Alternative A 18-III.

The resulting BOD waste load is 0.12 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.17 kg/cu m (0.04 lb/bbl).

Costs: Total investment cost: \$2,337,000
Total yearly cost: \$ 706,630

An itemized breakdown of costs is presented in Table 268. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 99.0 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 296.

Alternative A 18-V - This alternative provides a control house, screening and a grit chamber, flow equalization, neutralization, nutrient addition, a complete mix activated sludge system, sludge thickening, aerobic digestion, and vacuum filtration.

TABLE 266

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-II
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 96.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
E1...SCREENING & GRIT CHAMBER
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	1073410.00
2. LAND	17950.00
3. ENGINEERING	107340.00
4. CONTINGENCY	107340.00
5. PVC LINER	38100.00
TOTAL	1344140.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	322080.00
3. CHEMICALS	34400.00
4. MAINTENANCE&SUPPLIES	25800.00
5. PVC LINER	2890.00
TOTAL	410160.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	410160.00
2. YEARLY INVESTMENT	
COST RECOVERY	53770.00
3. DEPRECIATION	66310.00
TOTAL	530240.00

TABLE 267

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-III
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
E1...SCREENING & GRIT CHAMBER
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	1146790.00
2. LAND	17950.00
3. ENGINEERING	114680.00
4. CONTINGENCY	114680.00
5. PVC LINER	38100.00
TOTAL	1432200.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	333470.00
3. CHEMICALS	34400.00
4. MAINTENANCE&SUPPLIES	28010.00
5. PVC LINER	2890.00
TOTAL	423760.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	423760.00
2. YEARLY INVESTMENT COST RECOVERY	57290.00
3. DEPRECIATION	70710.00
TOTAL	551760.00

TABLE 268

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-IV
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
E1...SCREENING & GRIT CHAMBER
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
L...AERATED LAGOON
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1.	CONSTRUCTION	1900790.00
2.	LAND	17950.00
3.	ENGINEERING	190080.00
4.	CONTINGENCY	190080.00
5.	PVC LINER	38100.00
	TOTAL	2337000.00

YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	357830.00
3.	CHEMICALS	34400.00
4.	MAINTENANCE&SUPPLIES	77090.00
5.	PVC LINER	2890.00
	TOTAL	497200.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	497200.00
2.	YEARLY INVESTMENT COST RECOVERY	93480.00
3.	DEPRECIATION	115950.00
	TOTAL	706630.00

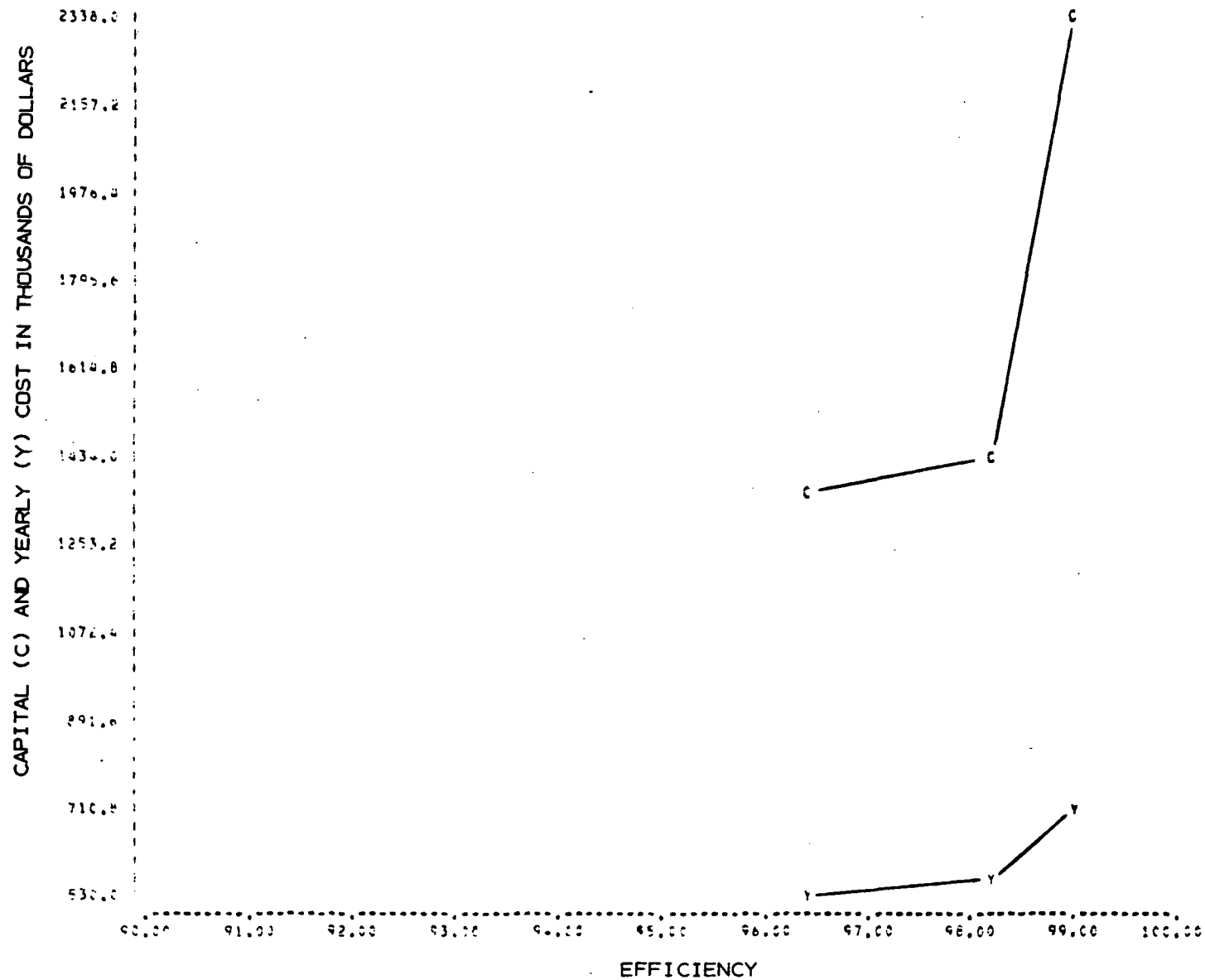


FIGURE 296

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 18, ALTERNATIVE IV

The resulting BOD waste load is 0.48 kg/cu m (0.12 lb/bbl), and the suspended solids load is 0.68 kg/cu m (0.18 lb/bbl).

Costs: Total investment cost: \$1,506,780
Total yearly cost: \$ 440,710

An itemized breakdown of costs is presented in Table 269. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 96.4 percent
SS: 89.1 percent

Alternative A 18-VI - This alternative provides dual media filtration in addition to Alternative A 18-V.

The resulting BOD waste load is 0.24 kg/cu m (0.06 lb/bbl), and the suspended solids load is 0.34 kg/cu m (0.09 lb/bbl).

Costs: Total investment cost: \$1,594,850
Total yearly cost: \$ 461,230

An itemized breakdown of costs is presented in Table 270. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.2 percent
SS: 94.5 percent

Alternative A 18-VII - This alternative adds activated carbon to Alternative A 18-VI.

The resulting BOD waste load is 0.12 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.17 kg/cu m (0.04 lb/bbl).

Costs: Total investment cost: \$2,499,660
Total yearly cost: \$ 616,110

An itemized breakdown of costs is presented in Table 271. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.0 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 297.

Alternative A 18-VIII - This alternative replaces vacuum filtration in A 18-V with sludge storage and spray irrigation.

TABLE 269

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-V
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 96.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1..CONTROL HOUSE
E1..SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
N...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
P...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	1201780.00
2. LAND	64640.00
3. ENGINEERING	120180.00
4. CONTINGENCY	120180.00
TOTAL	1506780.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	165870.00
3. CHEMICALS	50320.00
4. MAINTENANCE&SUPPLIES	17170.00
TOTAL	308330.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	308330.00
2. YEARLY INVESTMENT COST RECOVERY	60270.00
3. DEPRECIATION	72110.00
TOTAL	440710.00

TABLE 270

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-VI
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	1275170.00
2. LAND	64640.00
3. ENGINEERING	127520.00
4. CONTINGENCY	127520.00
TOTAL	1594850.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	177250.00
3. CHEMICALS	50320.00
4. MAINTENANCE&SUPPLIES	18390.00
TOTAL	320930.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	320930.00
2. YEARLY INVESTMENT COST RECOVERY	63790.00
3. DEPRECIATION	76510.00
TOTAL	461230.00

TABLE 271

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-VII
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	2029180.00
2. LAND	64640.00
3. ENGINEERING	202920.00
4. CONTINGENCY	202920.00
TOTAL	2499660.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	201610.00
3. CHEMICALS	50320.00
4. MAINTENANCE&SUPPLIES	67470.00
TOTAL	394370.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	394370.00
2. YEARLY INVESTMENT COST RECOVERY	99990.00
3. DEPRECIATION	121750.00
TOTAL	616110.00

1034

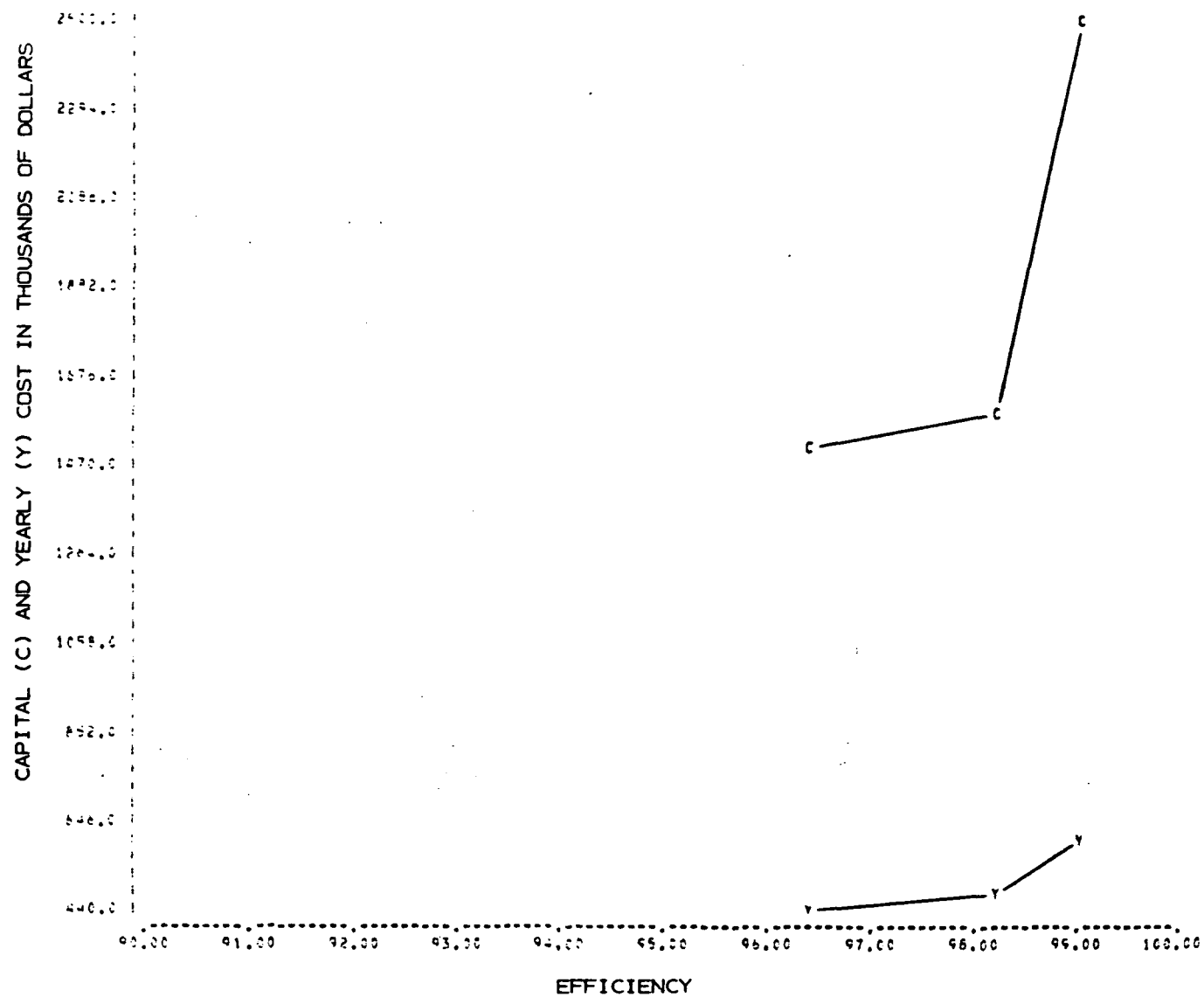


FIGURE 297

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 18, ALTERNATIVE VII

The resulting BOD waste load is 0.48 kg/cu m (0.12 lb/bbl), and the suspended solids load is 0.68 kg/cu m (0.18 lb/bbl).

Costs: Total investment cost: \$1,473,950
Total yearly cost: \$ 405,140

An itemized breakdown of costs is presented in Table 272. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 96.4 percent
SS: 89.1 percent

Alternative A 18-IX - This alternative adds dual media filtration to Alternative A 18-VIII.

The resulting BOD waste load is 0.24 kg/cu m (0.06 lb/bbl), and the suspended solids load is 0.34 kg/cu m (0.09 lb/bbl).

Costs: Total investment cost: \$1,562,010
Total yearly cost: \$ 425,670

An itemized breakdown of costs is presented in Table 273. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.2 percent
SS: 94.5 percent

Alternative A 18-X - This alternative adds activated carbon to Alternative A 18-IX.

The resulting BOD waste load is 0.12 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.17 kg/cu m (0.04 lb/bbl).

Costs: Total investment cost: \$2,466,820
Total yearly cost: \$ 580,540

An itemized breakdown of costs is presented in Table 274. It is assumed that land costs \$6150 per hectare (\$2490 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.0 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 298.

Alternative A 18-XI - This alternative replaces vacuum filtration in Alternative A 18-V with sand drying beds.

TABLE 272

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-VIII
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 96.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
N...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	1210250.00
2. LAND	21660.00
3. ENGINEERING	121020.00
4. CONTINGENCY	121020.00
TOTAL	1473950.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	155730.00
3. CHEMICALS	34400.00
4. MAINTENANCE & SUPPLIES	8470.00
TOTAL	273570.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	273570.00
2. YEARLY INVESTMENT COST RECOVERY	58960.00
3. DEPRECIATION	72610.00
TOTAL	405140.00

TABLE 273

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-IX
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	1283630.00
2. LAND	21660.00
3. ENGINEERING	128360.00
4. CONTINGENCY	128360.00
TOTAL	1562010.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	167120.00
3. CHEMICALS	34400.00
4. MAINTENANCE & SUPPLIES	9680.00
TOTAL	286170.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	286170.00
2. YEARLY INVESTMENT COST RECOVERY	62480.00
3. DEPRECIATION	77020.00
TOTAL	425670.00

TABLE 274

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-X
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	2037640.00
2. LAND	21660.00
3. ENGINEERING	203760.00
4. CONTINGENCY	203760.00
TOTAL	2466820.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	191480.00
3. CHEMICALS	34400.00
4. MAINTENANCE&SUPPLIES	58760.00
TOTAL	359610.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	359610.00
2. YEARLY INVESTMENT COST RECOVERY	98670.00
3. DEPRECIATION	122260.00
TOTAL	580540.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

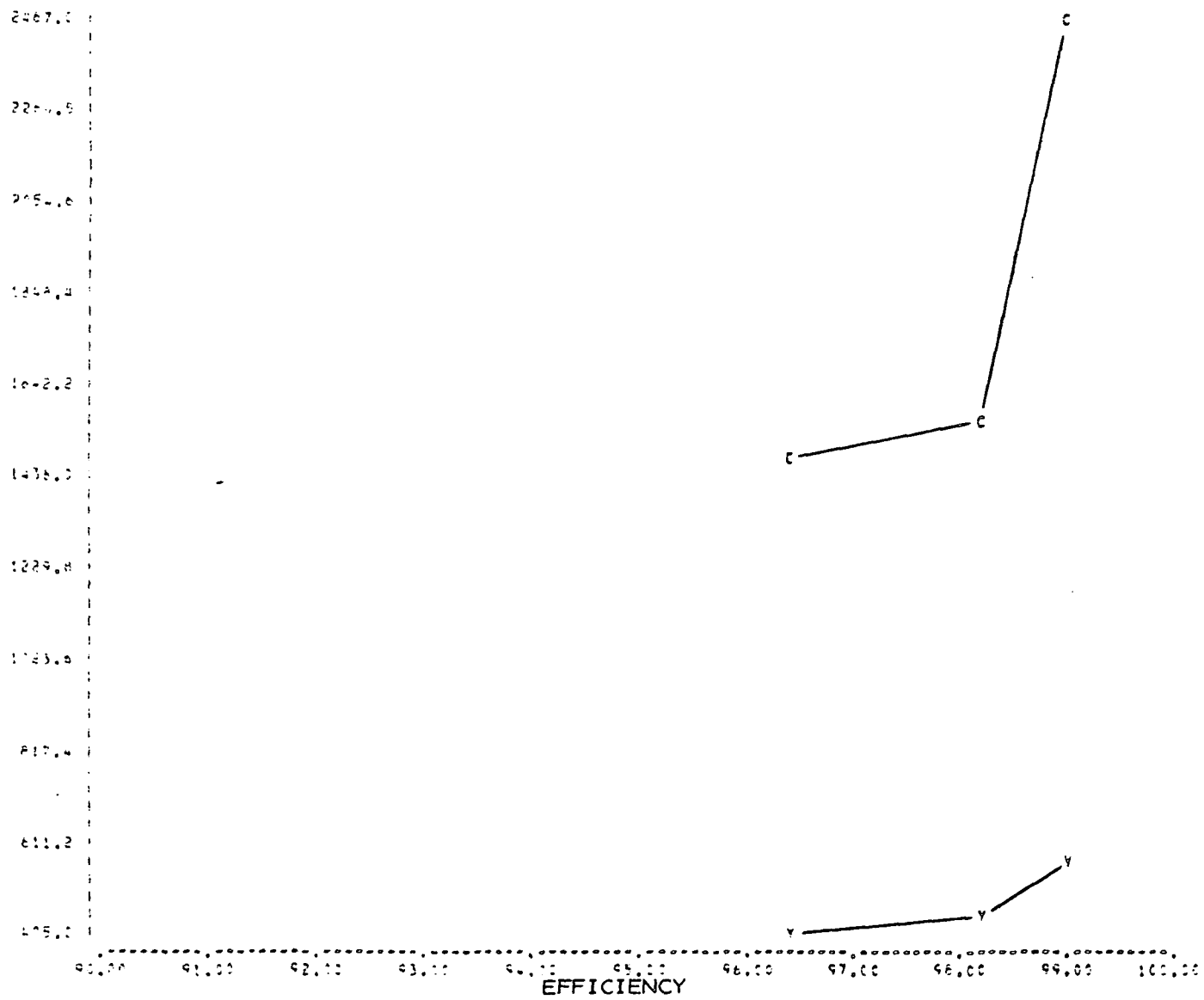


FIGURE 298

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 18, ALTERNATIVE X

DRAFT

The resulting BOD waste load is 0.48 kg/cu m (0.12 lb/bbl), and the suspended solids load is 0.68 kg/cu m (0.18 lb/bbl).

Costs: Total investment cost: \$2,694,560
Total yearly cost: \$ 638,610

An itemized breakdown of costs is presented in Table 275. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 96.4 percent
SS: 89.1 percent

Alternative A 18-XII - This alternative adds dual media filtration to Alternative A 18-XI.

The resulting BOD waste load is 0.24 kg/cu m (0.06 lb/bbl), and the suspended solids load is 0.34 kg/cu m (0.09 lb/bbl).

Costs: Total investment cost: \$2,782,630
Total yearly cost: \$ 659,140

An itemized breakdown of costs is presented in Table 276. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 98.2 percent
SS: 94.5 percent

Alternative A 18-XIII - This alternative adds activated carbon to Alternative A 18-XII.

The resulting BOD waste load is 0.12 kg/cu m (0.03 lb/bbl), and the suspended solids load is 0.17 kg/cu m (0.04 lb/bbl).

Costs: Total investment cost: \$3,687,440
Total yearly cost: \$ 814,010

An itemized breakdown of costs is presented in Table 277. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.0 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 299.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 19 - Malt

A model plant representative of subcategory A 18 was developed in Section V for the purpose of applying control and treatment alter-

TABLE 275

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-XI
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 96.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS

INVESTMENT COSTS:

1. CONSTRUCTION	2162100.00
2. LAND	100040.00
3. ENGINEERING	216210.00
4. CONTINGENCY	216210.00
TOTAL	2694560.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	154780.00
3. CHEMICALS	34400.00
4. MAINTENANCE&SUPPLIES	136950.00
TOTAL	401100.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	401100.00
2. YEARLY INVESTMENT COST RECOVERY	107780.00
3. DEPRECIATION	129730.00
TOTAL	638610.00

DRAFT

TABLE 276

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-XII
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.2 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
E1...SCREENING & GRIT CHAMBER
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	2235490.00
2.	LAND	100040.00
3.	ENGINEERING	223550.00
4.	CONTINGENCY	223550.00
TOTAL		2782630.00

YEARLY OPERATING COSTS:

1.	LABOR	74970.00
2.	POWER	166170.00
3.	CHEMICALS	34400.00
4.	MAINTENANCE & SUPPLIES	138160.00
TOTAL		413700.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	413700.00
2.	YEARLY INVESTMENT COST RECOVERY	111310.00
3.	DEPRECIATION	134130.00
TOTAL		659140.00

TABLE 277

ITEMIZED COST SUMMARY FOR ALTERNATIVE A18-XIII
(OTHER BREWERIES)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1..CONTROL HOUSE
E1..SCREENING & GRIT CHAMBER
P...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	2989500.00
2. LAND	100040.00
3. ENGINEERING	298950.00
4. CONTINGENCY	298950.00
TOTAL	3687440.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	190530.00
3. CHEMICALS	34400.00
4. MAINTENANCE&SUPPLIES	187240.00
TOTAL	487140.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	487140.00
2. YEARLY INVESTMENT	
COST RECOVERY	147500.00
3. DEPRECIATION	179370.00
TOTAL	814010.00

1044

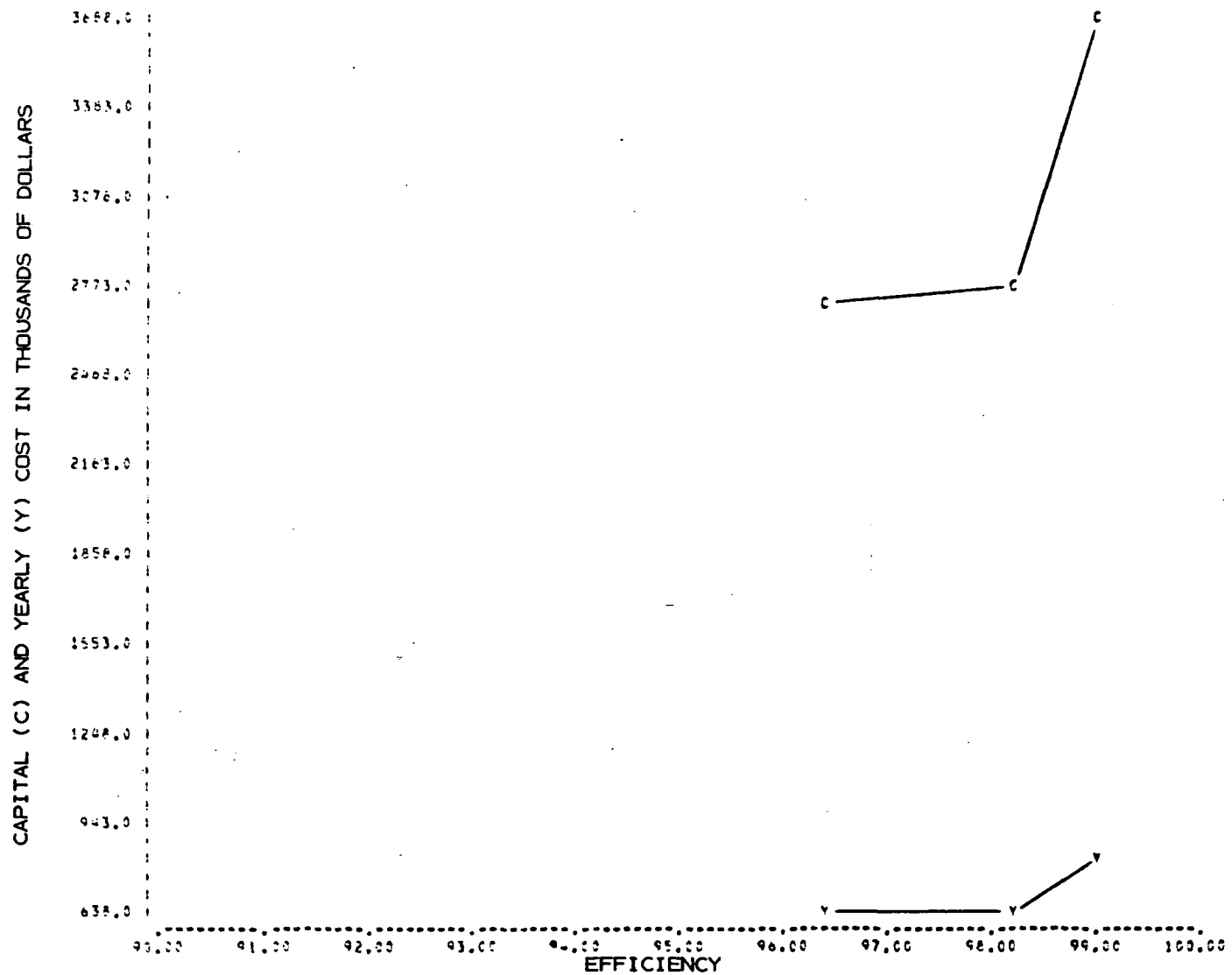


FIGURE 299

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 18, ALTERNATIVE XIII

natives. In Section VII, seven alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 350 kkg (16,000 bu) per day.

Alternative A 19-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 350 kkg (16,000 bu) per day plant is 2590 cu m (0.685 MG) per day. The BOD waste load is 4.55 kg/kkg (0.218 lb/bu), and the suspended solids load is 0.77 kg/kkg (0.037 lb/bu).

Suspended solids in the waste, consisting mostly of grain and sprouts, are assumed to be removed by screening prior to discharge.

Costs: 0
Reduction Benefits: None

Alternative A 19-II - This alternative provides a control house, flow equalization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load is 0.22 kg/kkg (0.011 lb/bu), and the suspended solids load is 0.13 kg/kkg (0.0062 lb/bu).

Costs: Total investment cost: \$1,200,150
Total yearly cost: \$ 572,660

An itemized breakdown of costs is presented in Table 278. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Suspended solids in the waste, consisting mostly of grain and sprouts, is assumed to be removed by screening prior to discharge.

Reduction Benefits: BOD: 95.2 percent
SS: 83.1 percent

Alternative A 19-III - This alternative provides in addition to Alternative A 19-II dual media filtration.

The resulting BOD waste load is 0.11 kg/kkg (0.0053 lb/bu), and the suspended solids load is 0.06 kg/kkg (0.0029 lb/bu).

Costs: Total investment cost: \$1,245,740
Total yearly cost: \$ 583,300

An itemized breakdown of costs is presented in Table 279. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Suspended solids in the waste, consisting mostly of grain and sprouts, is assumed to be removed by screening prior to discharge.

TABLE 278

ITEMIZED COST SUMMARY FOR ALTERNATIVE A19-II
(MALT)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	959690.00
2. LAND	12740.00
3. ENGINEERING	95970.00
4. CONTINGENCY	95970.00
5. PVC LINER	35780.00
TOTAL	1200150.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	401540.00
3. CHEMICALS	3030.00
4. MAINTENANCE&SUPPLIES	34080.00
5. PVC LINER	1640.00
TOTAL	465280.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	465280.00
2. YEARLY INVESTMENT COST RECOVERY	48010.00
3. DEPRECIATION	59370.00
TOTAL	572660.00

TABLE 279

ITEMIZED COST SUMMARY FOR ALTERNATIVE A19-III
(MALT)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 H...NITROGEN ADDITION
 L...AERATED LAGOON
 B...PUMPING STATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	997680.00
2. LAND	12740.00
3. ENGINEERING	99770.00
4. CONTINGENCY	99770.00
5. PVC LINER	35780.00
TOTAL	1245740.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	407450.00
3. CHEMICALS	3030.00
4. MAINTENANCE&SUPPLIES	34710.00
5. PVC LINER	1640.00
TOTAL	471820.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	471820.00
2. YEARLY INVESTMENT	
COST RECOVERY	49830.00
3. DEPRECIATION	61650.00
TOTAL	583300.00

Reduction Benefits: BOD: 97.6 percent
SS: 92.2 percent

A cost efficiency curve is presented in Figure 300.

Alternative A 19-IV - This alternative provides a control house, flow equalization, nutrient addition, a complete mix activated sludge system, sludge thickening, aerobic digestion, and spray irrigation.

The resulting BOD waste load is 0.22 kg/kkg (0.011 lb/bu), and the suspended solids load is 0.13 kg/kkg (0.0062 lb/bu).

Costs: Total investment cost: \$709,240
Total yearly cost: \$176,410

An itemized breakdown of costs is presented in Table 280. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Suspended solids in the waste, consisting mostly of grain and sprouts, is assumed to be removed by screening prior to discharge.

Reduction Benefits: BOD: 95.2 percent
SS: 83.1 percent

Alternative A 19-V - This alternative adds dual media filtration to Alternative A 19-IV.

The resulting BOD waste load is 0.11 kg/kkg (0.0053 lb/bu), and the suspended solids load is 0.06 kg/kkg (0.0029 lb/bu).

Costs: Total investment cost: \$761,830
Total yearly cost: \$187,330

An itemized breakdown of costs is presented in Table 281. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Suspended solids in the waste, consisting mostly of grain and sprouts, is assumed to be removed by screening prior to discharge.

Reduction Benefits: BOD: 97.6 percent
SS: 92.2 percent

A cost efficiency curve is presented in Figure 301.

Alternative A 19-VI - This alternative replaces spray irrigation of sludge in Alternative A 19-IV with sand bed drying.

The resulting BOD waste load is 0.22 kg/kkg (0.011 lb/bu), and the suspended solids load is 0.13 kg/kkg (0.0062 lb/bu).

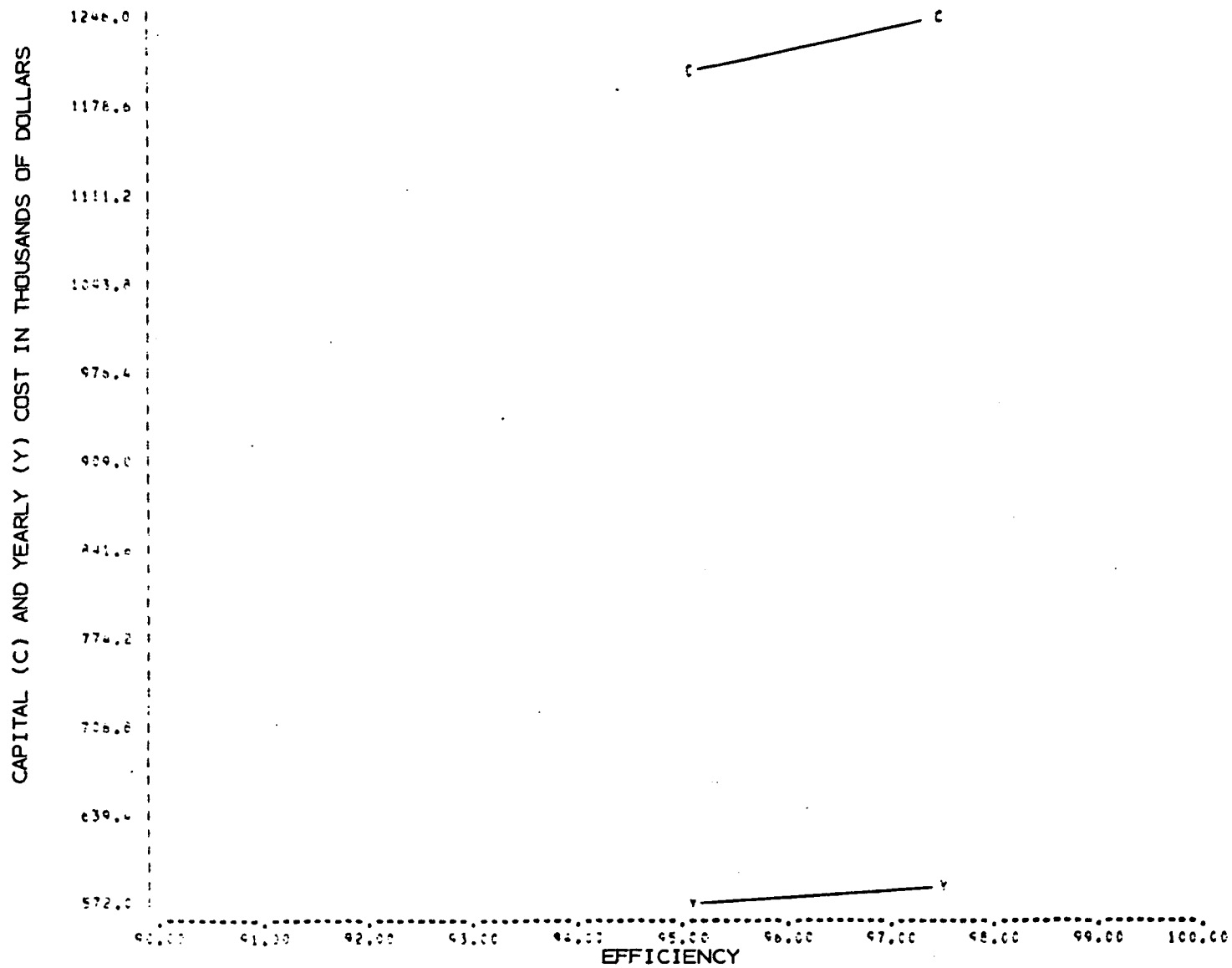


FIGURE 300

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 19, ALTERNATIVE III

TABLE 280

ITEMIZED COST SUMMARY FOR ALTERNATIVE A19-IV
(MALT)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 P...PUMPING STATION
 C...EQUALIZATION BASIN
 H...NITROGEN ADDITION
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 Y...HOLDING TANK
 U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	562570.00
2. LAND	34150.00
3. ENGINEERING	56260.00
4. CONTINGENCY	56260.00
TOTAL	709240.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	62790.00
3. CHEMICALS	3030.00
4. MAINTENANCE&SUPPLIES	10990.00
TOTAL	114290.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	114290.00
2. YEARLY INVESTMENT	
COST RECOVERY	28370.00
3. DEPRECIATION	33750.00
TOTAL	176410.00

TABLE 281

ITEMIZED COST SUMMARY FOR ALTERNATIVE A19-V
(MALT)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 H...NITROGEN ADDITION
 K...ACTIVATED SLUDGE
 Q...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 Y...HOLDING TANK
 U...SPRAY IRRIGATION
 B...PUMPING STATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	600560.00
2. LAND	41150.00
3. ENGINEERING	60060.00
4. CONTINGENCY	60060.00
TOTAL	761830.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	68700.00
3. CHEMICALS	3030.00
4. MAINTENANCE&SUPPLIES	11620.00
TOTAL	120830.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	120830.00
2. YEARLY INVESTMENT	
COST RECOVERY	30470.00
3. DEPRECIATION	36030.00
TOTAL	187330.00

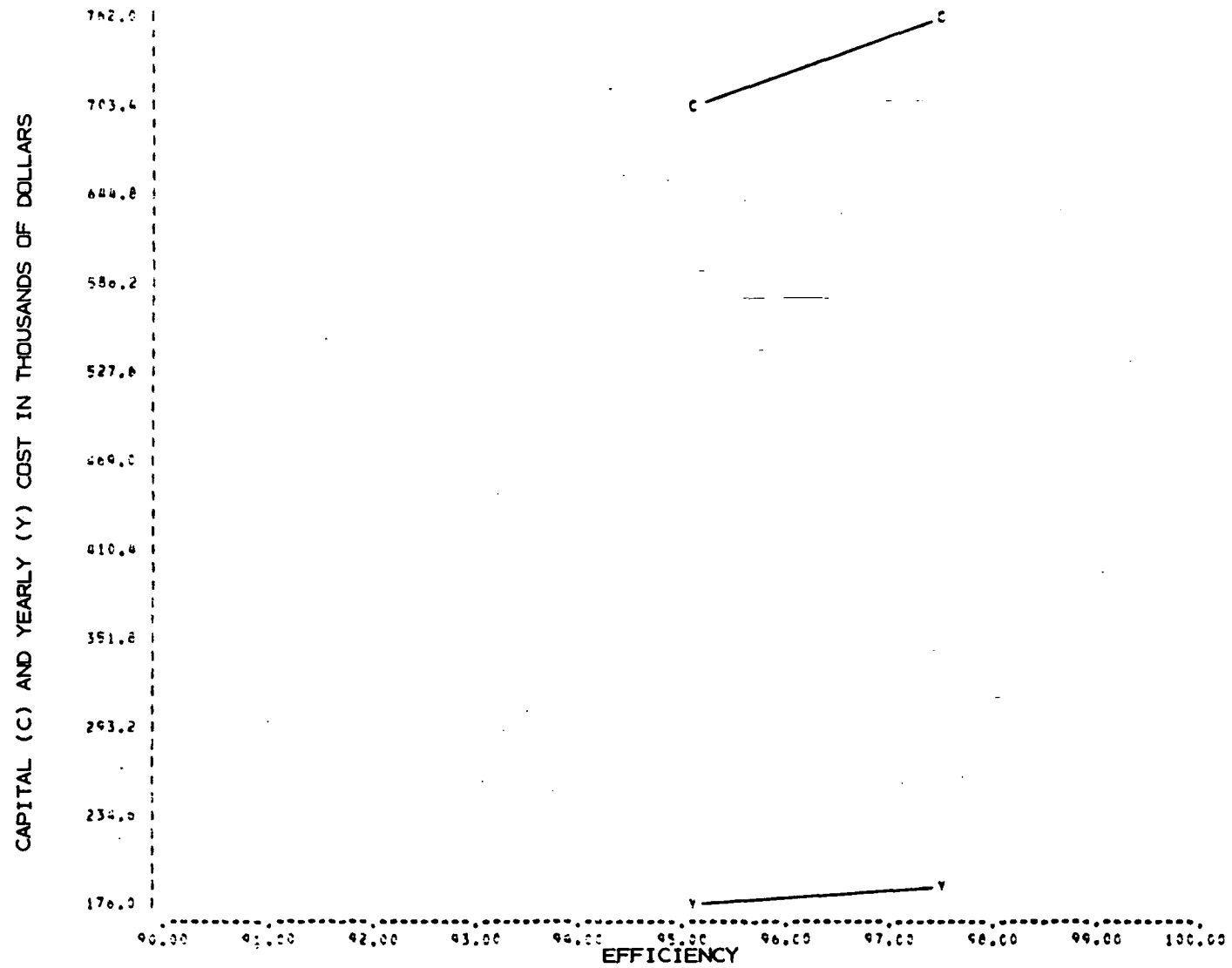


FIGURE 301

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 19, ALTERNATIVE V

DRAFT

Costs: Total investment cost: \$971,480
Total yearly cost: \$229,830

An itemized breakdown of costs is presented in Table 282. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Suspended solids in the waste, consisting mostly of grain and sprouts, is assumed to be removed by screening prior to discharge.

Reduction Benefits: BOD: 95.2 percent
SS: 83.1 percent

Alternative A 19-VII - This alternative adds dual media filtration to Alternative A 19-VI.

The resulting BOD waste load is 0.11 kg/kkg (0.0053 lb/bu), and the suspended solids load is 0.06 kg/kkg (0.0029 lb/bu).

Costs: Total investment cost: \$1,017,070
Total yearly cost: \$ 240,470

An itemized breakdown of costs is presented in Table 283. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Suspended solids in the waste, consisting mostly of grain and sprouts, is assumed to be removed by screening prior to discharge.

Reduction Benefits: BOD: 97.6 percent
SS: 92.2 percent

A cost efficiency curve is presented in Figure 302.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 20 - Wineries Without Stills

A model plant representative of subcategory A 20 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, ten alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which processes 180 kkg (200 tons) of grapes per day during crushing, and produces 41 cu m (10,800 gal) per day during processing. Since the treatment system was sized on crushing season design values, those are the costs which will be presented.

The following process operations are assumed for the model plant:
(1) stems are considered a solid waste to be spread on vineyard property, (2) pressed pomace may be used for distilling material,

TABLE 282

ITEMIZED COST SUMMARY FOR ALTERNATIVE A19-VI
(MALT)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.1 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
T...SAND DRYING BEDS

INVESTMENT COSTS:

1. CONSTRUCTION	775270.00
2. LAND	41150.00
3. ENGINEERING	77530.00
4. CONTINGENCY	77530.00
TOTAL	971480.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	61920.00
3. CHEMICALS	3030.00
4. MAINTENANCE&SUPPLIES	42020.00
TOTAL	144450.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	144450.00
2. YEARLY INVESTMENT COST RECOVERY	38860.00
3. DEPRECIATION	46520.00
TOTAL	229830.00

TABLE 283

ITEMIZED COST SUMMARY FOR ALTERNATIVE A19-VII
(MALT)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
T...SAND DRYING BEDS
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	813260.00
2. LAND	41150.00
3. ENGINEERING	81330.00
4. CONTINGENCY	81330.00
TOTAL	1017070.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	67830.00
3. CHEMICALS	3030.00
4. MAINTENANCE&SUPPLIES	42650.00
TOTAL	150990.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	150990.00
2. YEARLY INVESTMENT COST RECOVERY	40680.00
3. DEPRECIATION	48800.00
TOTAL	240470.00

1056

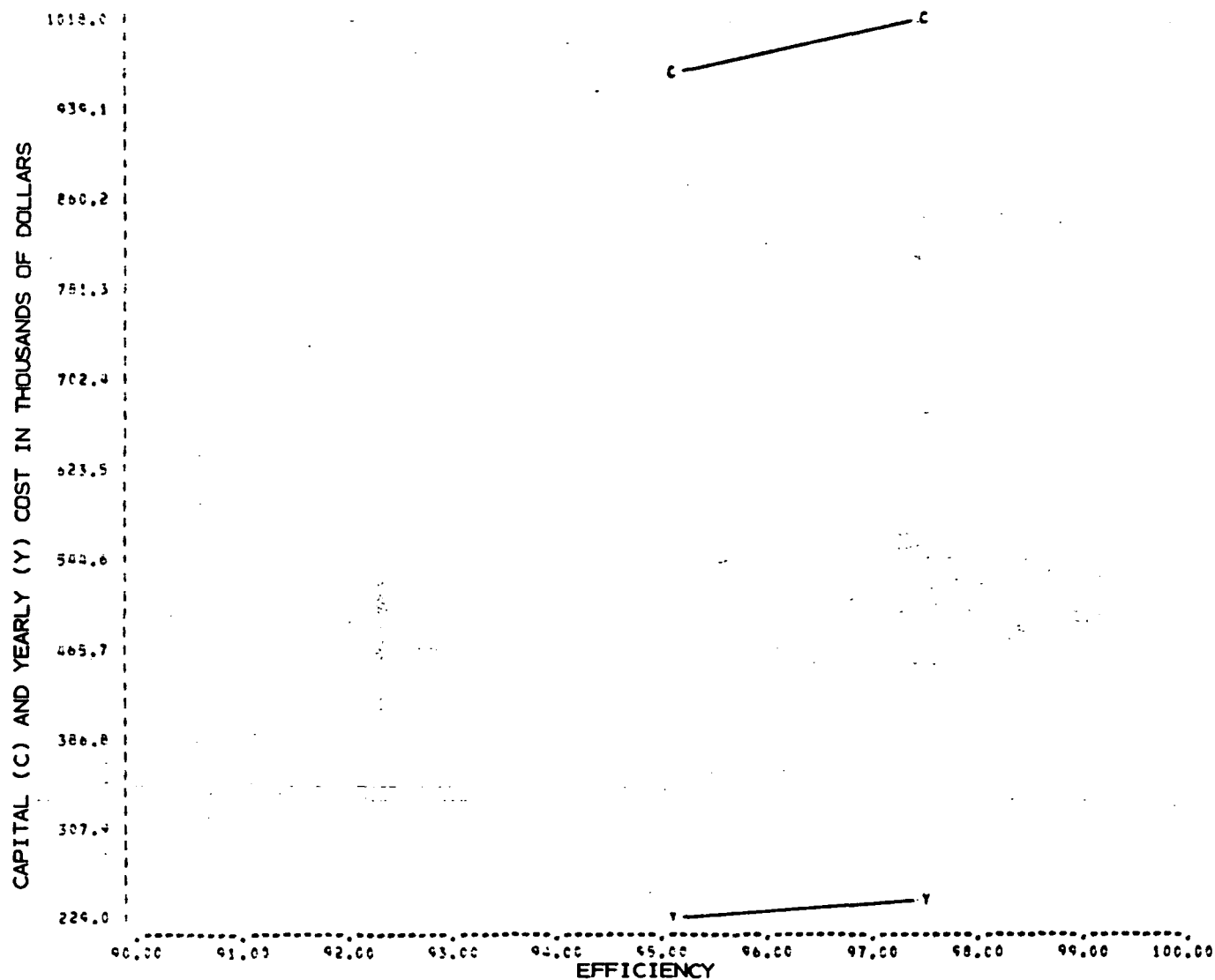


FIGURE 302

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 19, ALTERNATIVE VII

may be spread on vineyard property, or may be recovered as a by-product (3) diatomaceous earth (spent filter aid) is considered to be a solid waste to be spread on vineyard property, (4) no distillation is done on the premises, and (5) wastewater is screened prior to discharge.

Alternative A 20-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 180 kkg (200.0 ton) per day plant is 276 cu m (0.073 MG) per day. The BOD waste load is 3.57 kg/kkg (7.14 lb/ton), and the suspended solids load is 1.16 kg/kkg (2.32 lb/ton).

Costs: 0
Reduction Benefits: None

Alternative A 20-II - This alternative provides a control house, flow equalization, nutrient addition, neutralization, a complete mix activated sludge system, sludge thickening, aerobic digestion, dual media filtration, and spray irrigation of sludge.

The resulting BOD waste load is 0.77 kg/kkg (1.54 lb/ton), and the suspended solids load is 0.115 kg/kkg (0.230 lb/ton).

Costs: Total investment cost: \$414,130
Total yearly cost: \$116,400

An itemized breakdown of costs is presented in Table 284. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 97.8 percent
SS: 90.1 percent

Alternative A 20-III - This alternative adds dual media filtration to Alternative A 20-II.

The resulting BOD waste load is 0.38 kg/kkg (0.76 lb/ton), and the suspended solids load is 0.0540 kg/kkg (0.108 lb/ton).

Costs: Total investment cost: \$434,350
Total yearly cost: \$122,300

An itemized breakdown of costs is presented in Table 285. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits BOD: 98.9 percent
SS: 95.3 percent

TABLE 284

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-II
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY,... 97.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	331230.00
2. LAND	16660.00
3. ENGINEERING	33120.00
4. CONTINGENCY	33120.00
TOTAL	414130.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	25510.00
3. CHEMICALS	7530.00
4. MAINTENANCE&SUPPLIES	9440.00
TOTAL	79960.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	79960.00
2. YEARLY INVESTMENT COST RECOVERY	16570.00
3. DEPRECIATION	19870.00
TOTAL	116400.00

TABLE 285

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-III
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	348070.00
2. LAND	16660.00
3. ENGINEERING	34810.00
4. CONTINGENCY	34810.00
TOTAL	434350.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	28830.00
3. CHEMICALS	7530.00
4. MAINTENANCE&SUPPLIES	10210.00
TOTAL	84050.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	84050.00
2. YEARLY INVESTMENT	
COST RECOVERY	17370.00
3. DEPRECIATION	20880.00
TOTAL	122300.00

Alternative A 20-IV - This alternative provides in addition to Alternative A 20-III activated carbon.

The resulting BOD waste load is 0.23 kg/kkg (0.46 lb/ton), and the suspended solids load is 0.031 kg/kkg (0.062 lb/ton).

Costs: Total investment cost: \$502,200
Total yearly cost: \$146,770

An itemized breakdown of costs is presented in Table 286. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits BOD: 99.4 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 303.

Alternative A 20-V - This alternative replaces spray irrigation of sludge in Alternative A 20-II with sand drying beds.

The resulting BOD waste load is 0.77 kg/kkg (1.54 lb/ton), and the suspended solids load is 0.115 kg/kkg (0.230 lb/ton).

Costs: Total investment cost: \$492,450
Total yearly cost: \$134,160

An itemized breakdown of costs is presented in Table 287. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits BOD: 97.8 percent
SS: 90.1 percent

Alternative A 20-VI - This alternative provides in addition to Alternative A 20-V dual media filtration.

The resulting BOD waste load is 0.38 kg/kkg (0.76 lb/ton), and the suspended solids load is 0.054 kg/kkg (0.108 lb/ton).

Costs: Total investment cost: \$512,680
Total yearly cost: \$140,070

An itemized breakdown of costs is presented in Table 288. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits BOD: 98.9 percent
SS: 95.3 percent

TABLE 286

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-IV
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	404620.00
2. LAND	16660.00
3. ENGINEERING	40460.00
4. CONTINGENCY	40460.00
TOTAL	502200.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	31770.00
3. CHEMICALS	7530.00
4. MAINTENANCE & SUPPLIES	25620.00
TOTAL	102400.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	102400.00
2. YEARLY INVESTMENT COST RECOVERY	20090.00
3. DEPRECIATION	24280.00
TOTAL	146770.00

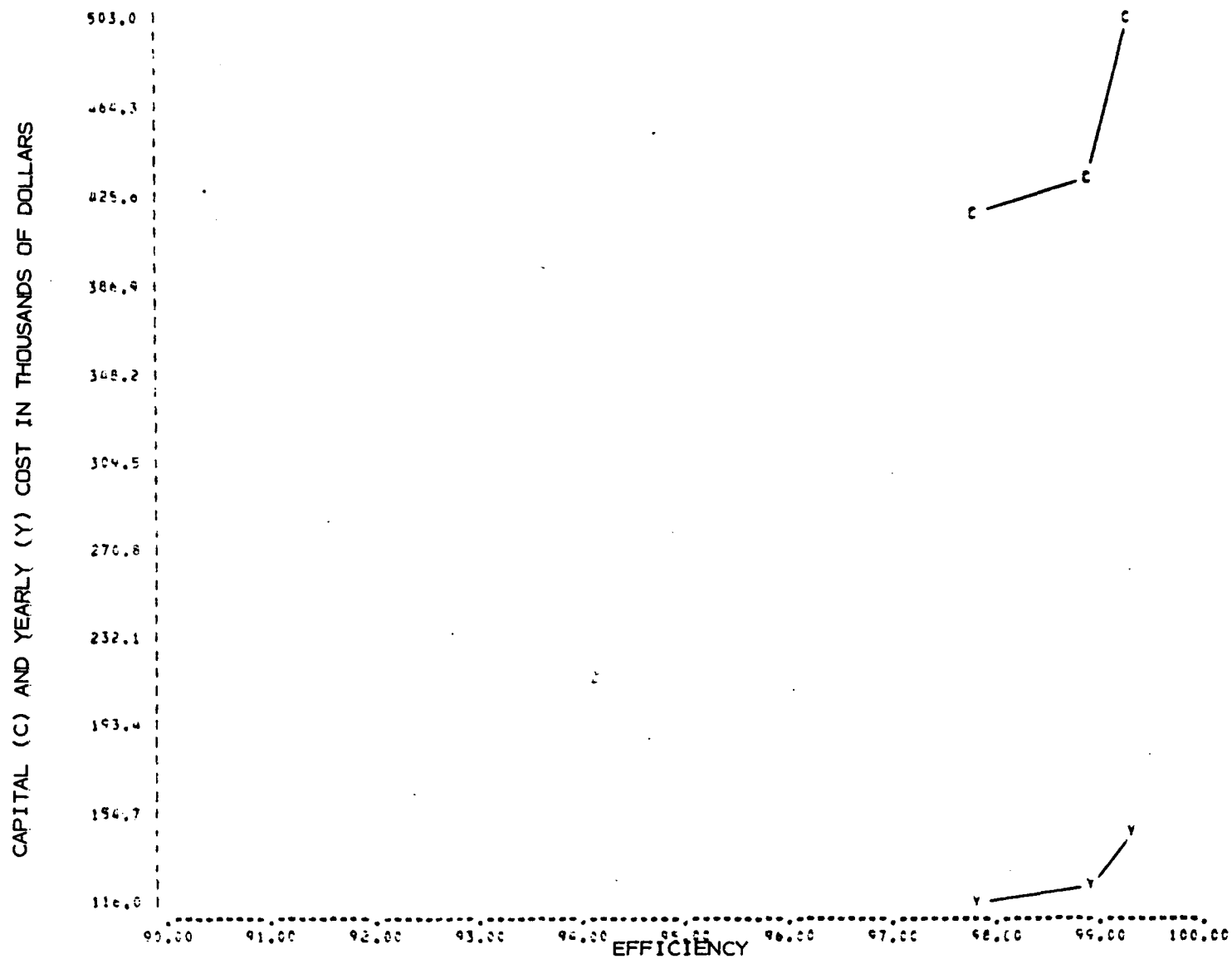


FIGURE 303

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 20, ALTERNATIVE IV

TABLE 287

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-V
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
F...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	393720.00
2.	LAND	19990.00
3.	ENGINEERING	39370.00
4.	CONTINGENCY	39370.00
	TOTAL	492450.00

YEARLY OPERATING COSTS:

1.	LABOR	37480.00
2.	POWER	24660.00
3.	CHEMICALS	7530.00
4.	MAINTENANCE & SUPPLIES	21170.00
	TOTAL	90840.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	90840.00
2.	YEARLY INVESTMENT COST RECOVERY	19700.00
3.	DEPRECIATION	23620.00
	TOTAL	134160.00

TABLE 288

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-VI
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
P...AEROBIC DIGESTOR
T...SAND DRYING BEDS
N...DUAL MEDIA PRESSURE FILTRATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	410570.00
2. LAND	19990.00
3. ENGINEERING	41060.00
4. CONTINGENCY	41060.00
TOTAL	512680.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	27980.00
3. CHEMICALS	7530.00
4. MAINTENANCE & SUPPLIES	21940.00
TOTAL	94930.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	94930.00
2. YEARLY INVESTMENT COST RECOVERY	20510.00
3. DEPRECIATION	24630.00
TOTAL	140070.00

Alternative A 20-VII - This alternative adds activated carbon to Alternative A 20-VI.

The resulting BOD waste load is 0.23 kg/kkg (0.46 lb/ton), and the suspended solids load is 0.031 kg/kkg (0.062 lb/ton).

Costs: Total investment cost: \$580,520
Total yearly cost: \$164,530

An itemized breakdown of costs is presented in Table 289. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits BOD: 99.4 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 304.

Alternative A 20-VIII - This alternative provides flow equalization, nutrient addition, neutralization, an aerated lagoon system, and dual media filtration.

The resulting BOD waste load is 0.77 kg/kkg (1.54 lb/ton), and the suspended solids load is 0.115 kg/kkg (0.230 lb/ton).

Costs: Total investment cost: \$413,090
Total yearly cost: \$172,300

An itemized breakdown of costs is presented in Table 290. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits BOD: 97.8 percent
SS: 90.1 percent

Alternative A 20-IX - This alternative provides in addition to Alternative A 20-VIII dual media filtration.

The resulting BOD waste load is 0.38 kg/kkg (0.76 lb/ton), and the suspended solids load is 0.054 kg/kkg (0.108 lb/ton).

Costs: Total investment cost: \$433,290
Total yearly cost: \$178,210

An itemized breakdown of costs is presented in Table 291. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits BOD: 98.9 percent
SS: 95.3 percent

TABLE 289

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-VII
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
N...DUAL MEDIA PRESSURE FILTRATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

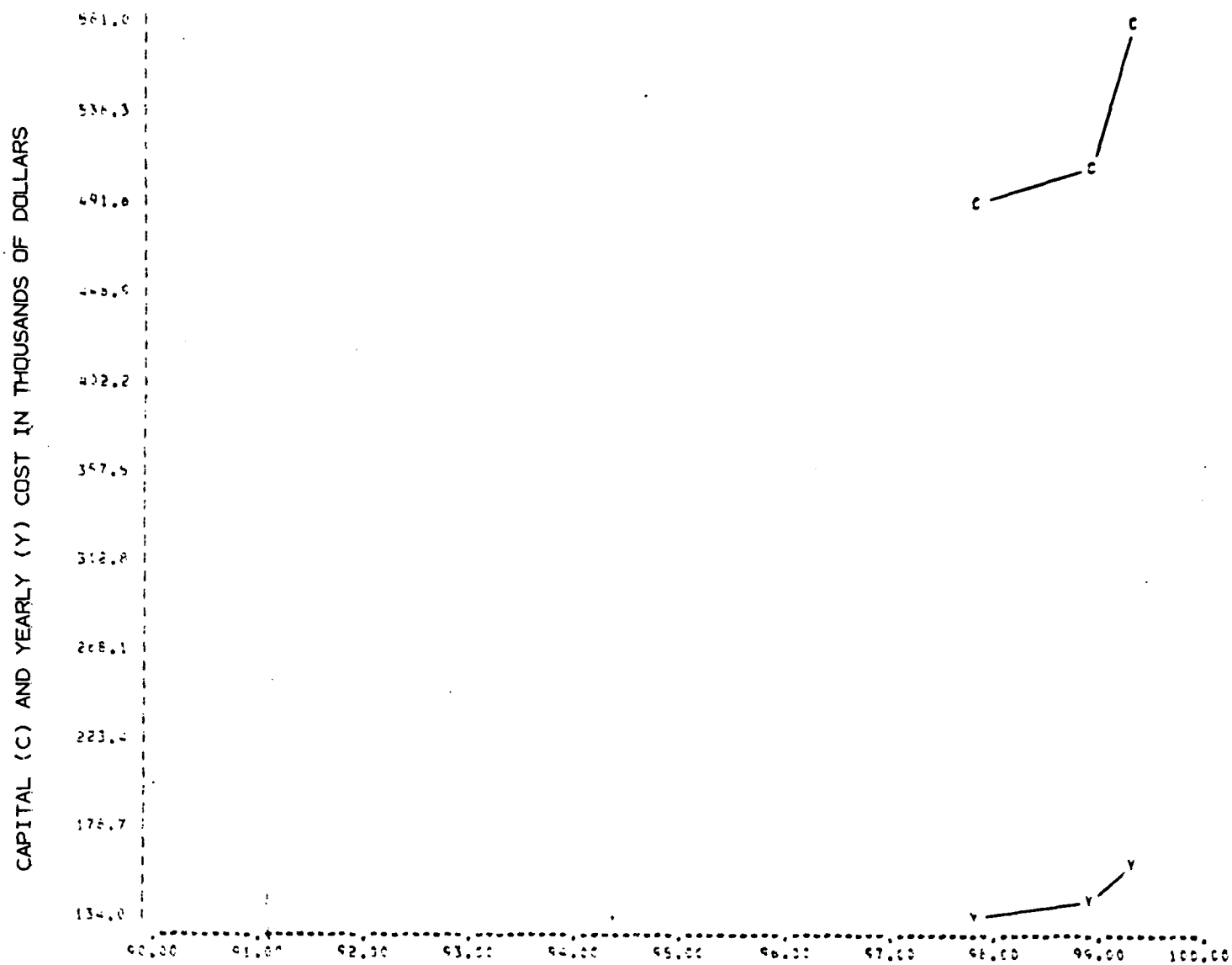
1. CONSTRUCTION	467110.00
2. LAND	19990.00
3. ENGINEERING	46710.00
4. CONTINGENCY	46710.00
TOTAL	580520.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	30930.00
3. CHEMICALS	7530.00
4. MAINTENANCE & SUPPLIES	37340.00
TOTAL	113280.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	113280.00
2. YEARLY INVESTMENT COST RECOVERY	23220.00
3. DEPRECIATION	28030.00
TOTAL	164530.00



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FIGURE 304

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 20, ALTERNATIVE VII

TABLE 290

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-VIII
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
L...AERATED LAGOON
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	333480.00
2. LAND	4330.00
3. ENGINEERING	33350.00
4. CONTINGENCY	33350.00
5. PVC LINER	8580.00
TOTAL	413090.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	102900.00
3. CHEMICALS	7530.00
4. MAINTENANCE & SUPPLIES	12230.00
5. PVC LINER	190.00
TOTAL	135340.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	135340.00
2. YEARLY INVESTMENT	
COST RECOVERY	16520.00
3. DEPRECIATION	20440.00
TOTAL	172300.00

TABLE 291

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-IX
(WINERIES WITHOUT STILLS)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 98.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
 C...EQLALIZATION BASIN
 H...NITROGEN ADDITION
 I...PHOSPHORUS ADDITION
 F...ACID NEUTRALIZATION
 G...CALSTIC NEUTRALIZATION
 L...AERATED LAGOON
 N...DUAL MEDIA PRESSURE FILTRATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	350320.00
2.	LAND	4330.00
3.	ENGINEERING	35030.00
4.	CONTINGENCY	35030.00
5.	PVC LINER	8580.00
	TOTAL	433290.00

YEARLY OPERATING COSTS:

1.	LABOR	12490.00
2.	POWER	106220.00
3.	CHEMICALS	7530.00
4.	MAINTENANCE&SUPPLIES	13000.00
5.	PVC LINER	190.00
	TOTAL	139430.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	139430.00
2.	YEARLY INVESTMENT	
	COST RECOVERY	17330.00
3.	DEPRECIATION	21450.00
	TOTAL	178210.00

Alternative A 20-X - This alternative provides in addition to Alternative A 20-IX activated carbon.

The resulting BOD waste load is 0.23 kg/kkg (0.46 lb/ton), and the suspended solids load is 0.031 kg/kkg (0.062 lb/ton).

Costs: Total investment cost: \$501,160
Total yearly cost: \$202,670

An itemized breakdown of costs is presented in Table 292. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 99.4 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 305.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 21 - Wineries with Stills

A model plant representative of Subcategory A 21 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, two alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which processes 700 kkg (760 ton) of grapes per day.

Alternative A 21-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 700 kkg (760 ton) per day plant is 1700 cu m (0.442 MG) per day. The BOD waste load is 13.9 kg/kkg (27.7 lb/ton), and the suspended solids load is 13.6 kg/kkg (27.3 lb/ton).

Costs: 0
Reduction Benefits: None

Alternative A 21-II - This alternative consists of a holding tank, pumping station, pipeline, and land spreading.

The resulting BOD waste load is zero, and the suspended solids load is zero.

Costs: Total investment cost: \$381,640
Total yearly cost: \$ 52,310

TABLE 292

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 20-X
(WINERIES WITHOUT STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
F...ACID NEUTRALIZATION
G...CAUSTIC NEUTRALIZATION
L...AERATED LAGOON
N...DUAL MEDIA PRESSURE FILTRATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	406870.00
2. LAND	4330.00
3. ENGINEERING	40690.00
4. CONTINGENCY	40690.00
5. PVC LINER	8580.00
TOTAL	501160.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	109170.00
3. CHEMICALS	7530.00
4. MAINTENANCE & SUPPLIES	28400.00
5. PVC LINER	190.00
TOTAL	157780.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	157780.00
2. YEARLY INVESTMENT COST RECOVERY	20050.00
3. DEPRECIATION	24840.00
TOTAL	202670.00

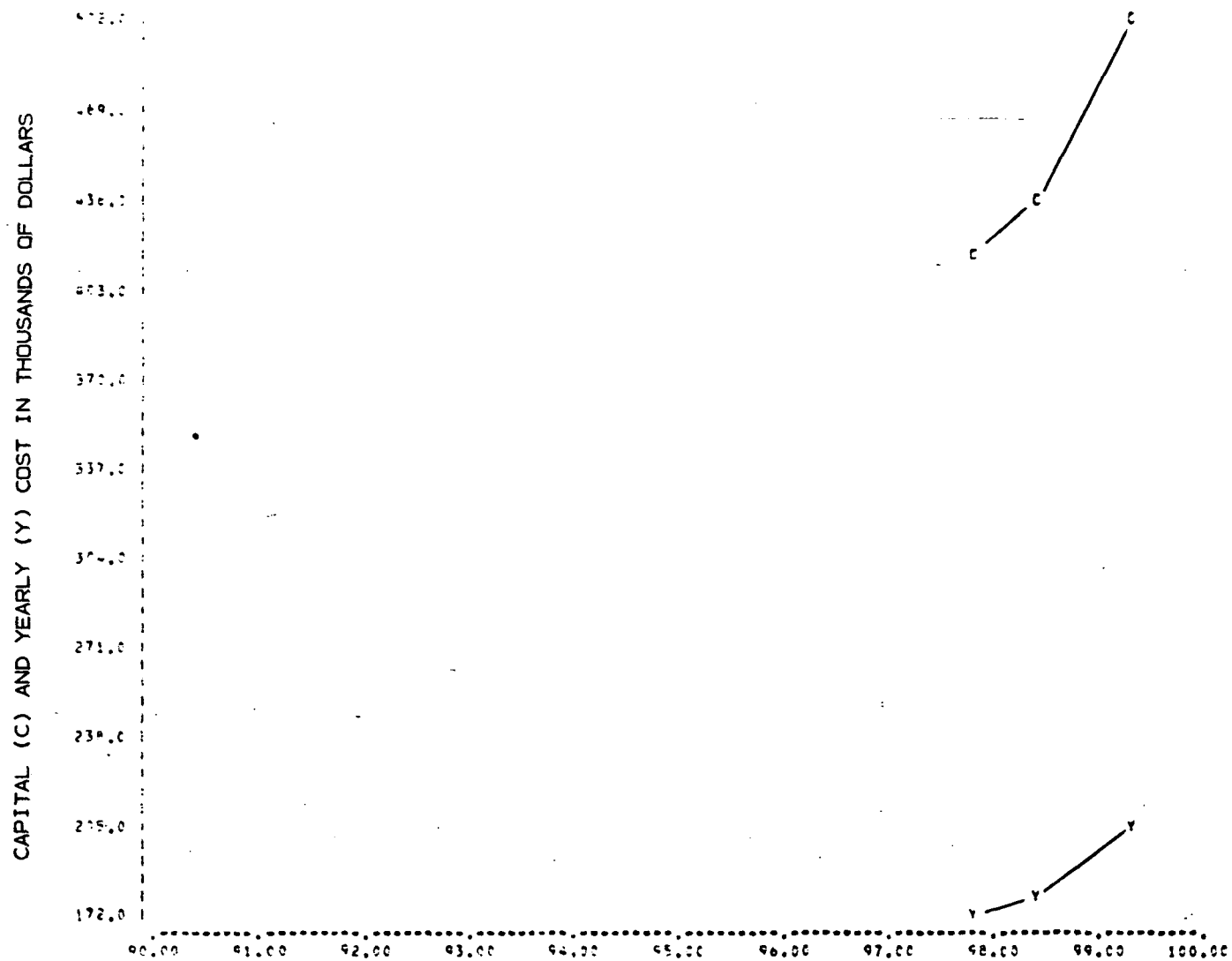


FIGURE 305

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 20, ALTERNATIVE X

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An itemized breakdown of costs is presented in Table 293. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

Cost and Reduction Benefits of Alternative Treatment Technologies
for Subcategory A 22 - Grain Distillers Operating Stillage
Recovery Systems

Two model plants representative of Subcategory A 22 were developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, nine alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for model plant A 22-A which produces 380 kkg (15,000 bu) per day.

Alternative A 22-A-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 380 kkg (15,000 bu) per day plant is 2500 cu m (0.650 MG) per day. The BOD waste load is 6.02 kg/kkg (0.336 lb/bu), and the suspended solids load is 4.21 kg/kkg (0.236 lb/bu).

The model plant assumes screening of the effluent prior to discharge.

Costs: 0
Reduction Benefits: None

Alternative A 22-A-II - This alternative provides flow equalization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load is 0.26 kg/kkg (0.015 lb/bu), and the suspended solids load is 0.32 kg/kkg (0.018 lb/bu).

Costs: Total investment cost: \$1,231,320
Total yearly cost: \$ 602,940

An itemized breakdown of costs is presented in Table 294. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.7 percent
SS: 92.3 percent

Alternative A 22-A-III - This alternative provides in addition to Alternative A 22-A-II dual media filtration.

TABLE 293

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 21-II
(WINERIES WITH STILL)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
B...PUMPING STATION
W...PIPELINE

INVESTMENT COSTS:

1. CONSTRUCTION	275000.00
2. LAND	51640.00
3. ENGINEERING	27500.00
4. CONTINGENCY	27500.00
TOTAL	381640.00

YEARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	4960.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	15580.00
TOTAL	20540.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	20540.00
2. YEARLY INVESTMENT COST RECOVERY	15270.00
3. DEPRECIATION	16500.00
TOTAL	52310.00

TABLE 294

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-II
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	983780.00
2. LAND	12990.00
3. ENGINEERING	98380.00
4. CONTINGENCY	98380.00
5. PVC LINER	37790.00
TOTAL	1231320.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	433320.00
3. CHEMICALS	6950.00
4. MAINTENANCE&SUPPLIES	38420.00
5. PVC LINER	1590.00
TOTAL	492770.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	492770.00
2. YEARLY INVESTMENT	
COST RECOVERY	49250.00
3. DEPRECIATION	60920.00
TOTAL	602940.00

DRAFT

The resulting BOD waste load is 0.13 kg/kkg (0.0073 lb/bu), and the suspended solids load is 0.016 kg/kkg (0.0090 lb/bu).

Costs: Total investment cost: \$1,276,250
Total yearly cost: \$ 613,420

An itemized breakdown of costs is presented in Table 295. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 97.8 percent
SS: 96.9 percent

A cost efficiency curve is presented in Figure 306.

Alternative A 22-A-IV - This alternative provides a control house, flow equalization, a complete mix activated sludge system, sludge thickening, aerobic digestion, and sand drying beds.

The resulting BOD waste load is 0.26 kg/kkg (0.015 lb/bu), and the suspended solids load is 0.32 kg/kkg (0.018 lb/bu).

Costs: Total investment cost: \$1,230,170
Total yearly cost: \$ 289,080

An itemized breakdown of costs is presented in Table 296. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.7 percent
SS: 92.3 percent

Alternative A 22-A-V - This alternative provides in addition to Alternative A 22-A-IV dual media filtration.

The resulting BOD waste load is 0.13 kg/kkg (0.0073 lb/bu), and the suspended solids load is 0.16 kg/kkg (0.0090 lb/bu).

Costs: Total investment cost: \$1,275,110
Total yearly cost: \$ 299,560

An itemized breakdown of costs is presented in Table 297. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

TABLE 295

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-III
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	1021230.00
2. LAND	12990.00
3. ENGINEERING	102120.00
4. CONTINGENCY	102120.00
5. PVC LINER	37790.00
TOTAL	1276250.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	439140.00
3. CHEMICALS	6950.00
4. MAINTENANCE&SUPPLIES	39040.00
5. PVC LINER	1590.00
TOTAL	499210.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	499210.00
2. YEARLY INVESTMENT COST RECOVERY	51050.00
3. DEPRECIATION	63160.00
TOTAL	613420.00

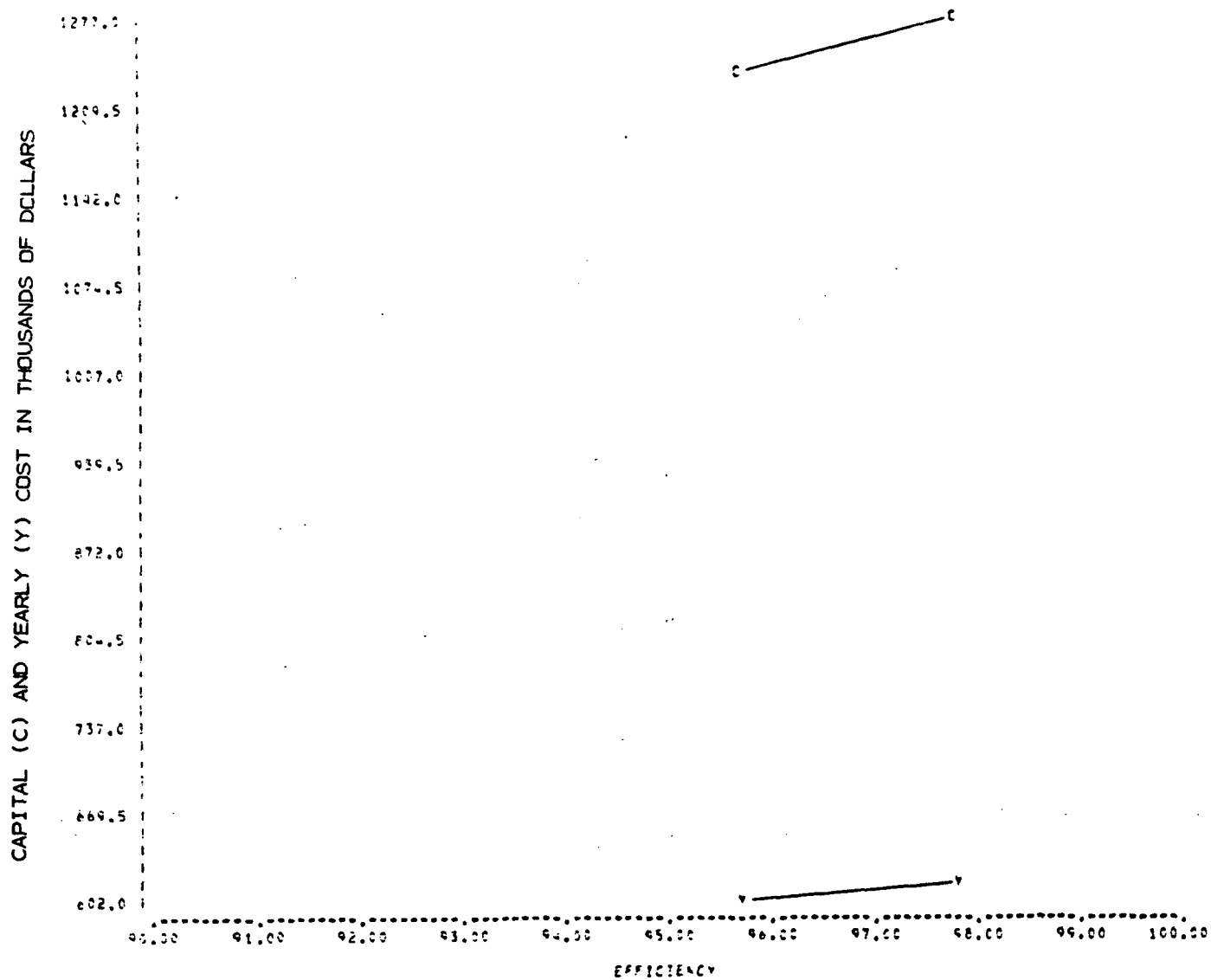


FIGURE 306

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-A-III

TABLE 296

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-IV
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
F...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS

INVESTMENT COSTS:

1.	CONSTRUCTION	985360.00
2.	LAND	47730.00
3.	ENGINEERING	98540.00
4.	CONTINGENCY	98540.00
	TOTAL	1230170.00

YEARLY OPERATING COSTS:

1.	LABOR	37480.00
2.	POWER	78450.00
3.	CHEMICALS	6950.00
4.	MAINTENANCE&SUPPLIES	57870.00
	TOTAL	180750.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	180750.00
2.	YEARLY INVESTMENT COST RECOVERY	49210.00
3.	DEPRECIATION	59120.00
	TOTAL	289080.00

TABLE 297

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-V
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

H1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
O...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	1022820.00
2. LAND	47730.00
3. ENGINEERING	102280.00
4. CONTINGENCY	102280.00
TOTAL	1275110.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	84270.00
3. CHEMICALS	6950.00
4. MAINTENANCE&SUPPLIES	58490.00
TOTAL	187190.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	187190.00
2. YEARLY INVESTMENT COST RECOVERY	51000.00
3. DEPRECIATION	61370.00
TOTAL	299560.00

Reduction Benefits: BOD: 97.8 percent
SS: 96.9 percent

A cost efficiency curve is presented in Figure 307.

Alternative A 22-A-VI - This alternative replaces sand drying beds in Alternative A 22-A-IV with vacuum filtration.

The resulting BOD waste load is 0.26 kg/kg (0.015 lb/bu), and the suspended solids load is 0.32 kg/kg (0.018 lb/bu).

Costs: Total investment cost: \$839,260
Total yearly cost: \$221,570

An itemized breakdown of costs is presented in Table 298. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.7 percent
SS: 92.3 percent

Alternative A 22-A-VII - This alternative provides in addition to Alternative A 22-A-VI dual media filtration.

The resulting BOD waste load is 0.13 kg/kg (0.0073 lb/bu), and the suspended solids load is 0.16 kg/kg (0.0090 lb/bu).

Costs: Total investment cost: \$884,220
Total yearly cost: \$232,060

An itemized breakdown of costs is presented in Table 299. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 97.8 percent
SS: 96.9 percent

A cost efficiency curve is presented in Figure 308.

Alternative A 22-A-VIII - This alternative replaces the sand drying beds in Alternative A 22-A-IV with spray irrigation.

The resulting BOD waste load is 0.26 kg/kg (0.015 lb/bu), and the suspended solids load is 0.32 kg/kg (0.018 lb/bu).

Costs: Total investment cost: \$838,600
Total yearly cost: \$212,850

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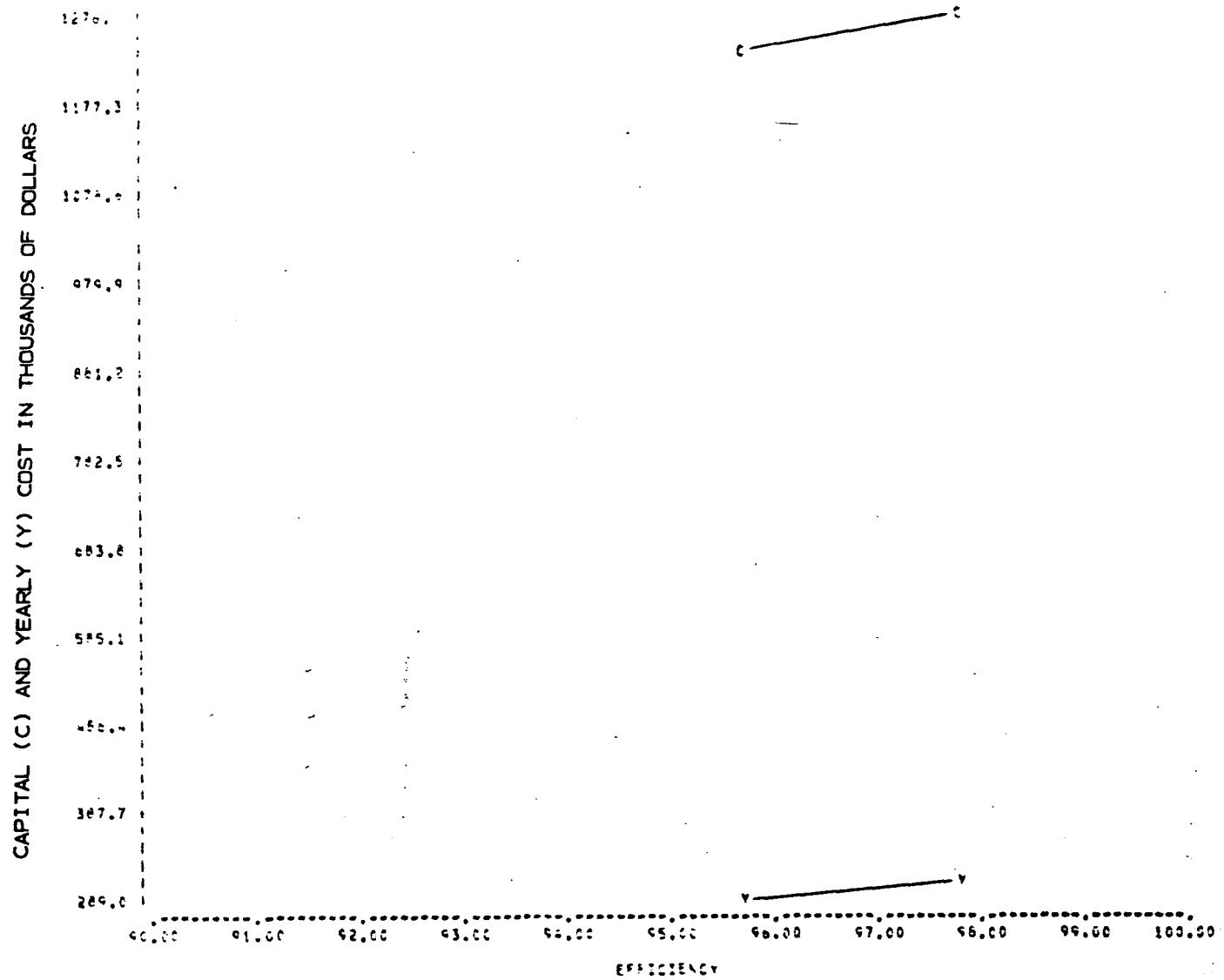


FIGURE 307

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-A-V

TABLE 298

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-VI
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EGLALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	660510.00
2. LAND	46650.00
3. ENGINEERING	66050.00
4. CONTINGENCY	66050.00
TOTAL	839260.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	83060.00
3. CHEMICALS	12700.00
4. MAINTENANCE&SUPPLIES	15130.00
TOTAL	148370.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	148370.00
2. YEARLY INVESTMENT	
COST RECOVERY	33570.00
3. DEPRECIATION	39630.00
TOTAL	221570.00

TABLE 299

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-VII
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
P...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	697970.00
2. LAND	46650.00
3. ENGINEERING	69800.00
4. CONTINGENCY	69800.00
TOTAL	884220.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	88880.00
3. CHEMICALS	12700.00
4. MAINTENANCE&SUPPLIES	15750.00
TOTAL	154810.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	154810.00
2. YEARLY INVESTMENT COST RECOVERY	35370.00
3. DEPRECIATION	41880.00
TOTAL	232060.00

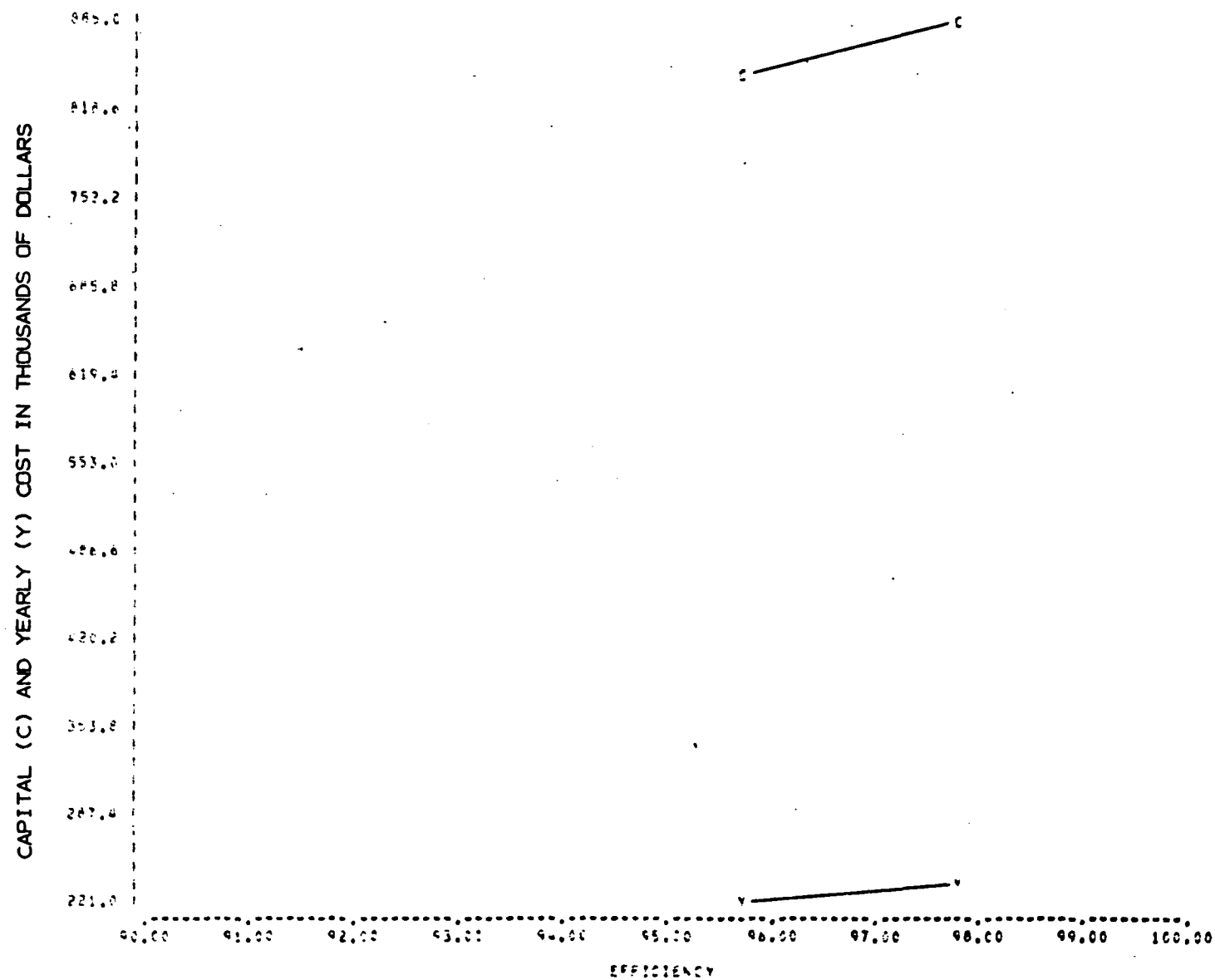


FIGURE 308

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-A-VII

An itemized breakdown of costs is presented in Table 300. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.7 percent
SS: 92.3 percent

Alternative A 22-A-IX - This alternative provides in addition to Alternative A 22-A-VIII dual media filtration.

The resulting BOD waste load is 0.13 kg/kg (0.0073 lb/bu), and the suspended solids load is 0.16 kg/kg (0.0090 lb/bu).

Costs: Total investment cost: \$863,810
Total yearly cost: \$219,710

An itemized breakdown of costs is presented in Table 301. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 97.8 percent
SS: 96.9 percent

A cost efficiency curve is presented in Figure 309.

Model plant B produces 90 kkg (3500 bu) per day.

Alternative A 22-B-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 90 kkg (3500 bu) per day plant is 570 cu m (0.15 MG) per day. The BOD waste load is 5.99 kg/kg (0.335 lb/bu), and the suspended solids load is 4.23 kg/kg (0.237 lb/bu).

The model plant assumes screening of the effluent prior to discharge.

Costs: 0
Reduction Benefits: None

TABLE 300

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-VIII
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	667600.00
2. LAND	37480.00
3. ENGINEERING	66760.00
4. CONTINGENCY	66760.00
TOTAL	838600.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	79330.00
3. CHEMICALS	6950.00
4. MAINTENANCE & SUPPLIES	15490.00
TOTAL	139250.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	139250.00
2. YEARLY INVESTMENT COST RECOVERY	33540.00
3. DEPRECIATION	40060.00
TOTAL	212850.00

TABLE 301

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-A-IX
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY SYSTEMS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQLALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
V...HOLDING TANK
U...SPRAY IRRIGATION
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	688610.00
2. LAND	37480.00
3. ENGINEERING	68860.00
4. CONTINGENCY	68860.00
TOTAL	863810.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	83590.00
3. CHEMICALS	6950.00
4. MAINTENANCE&SUPPLIES	15820.00
TOTAL	143840.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	143840.00
2. YEARLY INVESTMENT	
COST RECOVERY	34550.00
3. DEPRECIATION	41320.00
TOTAL	219710.00

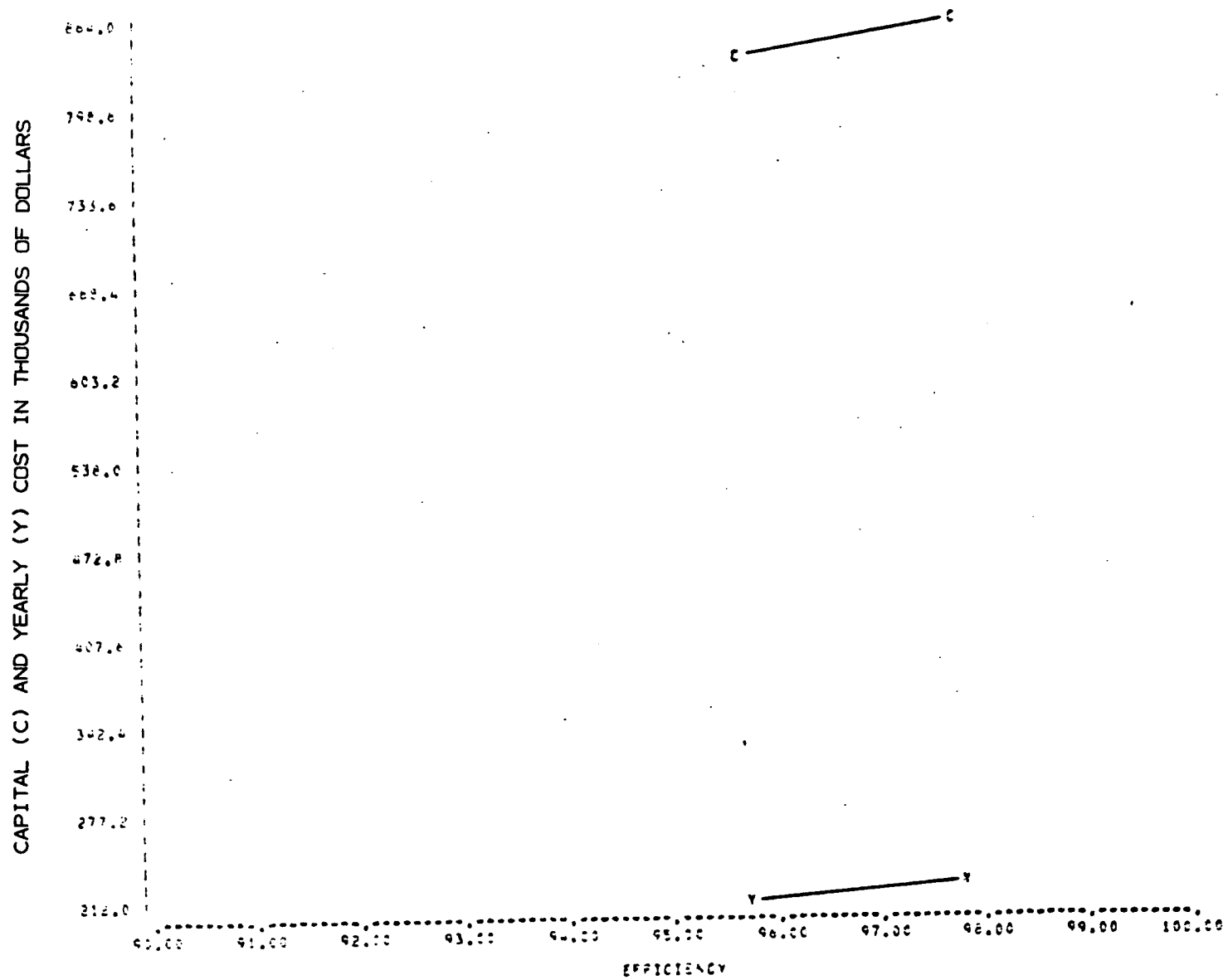


FIGURE 309
INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-A-IX

Alternative A 22-B-II - This alternative provides flow equalization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load is 0.25 kg/kg (0.014 lb/bu), and the suspended solids load is 0.32 kg/kg (0.018 lb/bu).

Costs: Total investment cost: \$348,170
Total yearly cost: \$132,190

An itemized breakdown of costs is presented in Table 302. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.8 percent
SS: 92.5 percent

Alternative A 22-B-III - This alternative provides in addition to Alternative A 22-B-II dual media filtration.

The resulting BOD waste load is 0.13 kg/kg (0.0073 lb/bu), and the suspended solids load is 0.16 kg/kg (0.0090 lb/bu).

Costs: Total investment cost: \$373,380
Total yearly cost: \$139,050

An itemized breakdown of costs is presented in Table 303. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 97.9 percent
SS: 96.3 percent

A cost efficiency curve is presented in Figure 310.

Alternative A 22-B-IV - This alternative provides a control house, flow equalization, a complete mix activated sludge system, sludge thickening, aerobic digestion, and sand drying beds.

The resulting BOD waste load is 0.25 kg/kg (0.014 lb/bu), and the suspended solids load is 0.32 kg/kg (0.018 lb/bu).

Costs: Total investment cost: \$332,290
Total yearly cost: \$ 97,130

An itemized breakdown of costs is presented in Table 304. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

TABLE 302

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-II
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	279500.00
2. LAND	4830.00
3. ENGINEERING	27950.00
4. CONTINGENCY	27950.00
5. PVC LINER	7940.00
TOTAL	348170.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	82700.00
3. CHEMICALS	1860.00
4. MAINTENANCE&SUPPLIES	9900.00
5. PVC LINER	380.00
TOTAL	101090.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	101090.00
2. YEARLY INVESTMENT COST RECOVERY	13930.00
3. DEPRECIATION	17170.00
TOTAL	132190.00

TABLE 303

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-III
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON
S...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	300510.00
2. LAND	4830.00
3. ENGINEERING	30050.00
4. CONTINGENCY	30050.00
5. PVC LINER	7940.00
TOTAL	373380.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	86960.00
3. CHEMICALS	1860.00
4. MAINTENANCE&SUPPLIES	10230.00
5. PVC LINER	380.00
TOTAL	105680.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	105680.00
2. YEARLY INVESTMENT COST RECOVERY	14940.00
3. DEPRECIATION	18430.00
TOTAL	139050.00

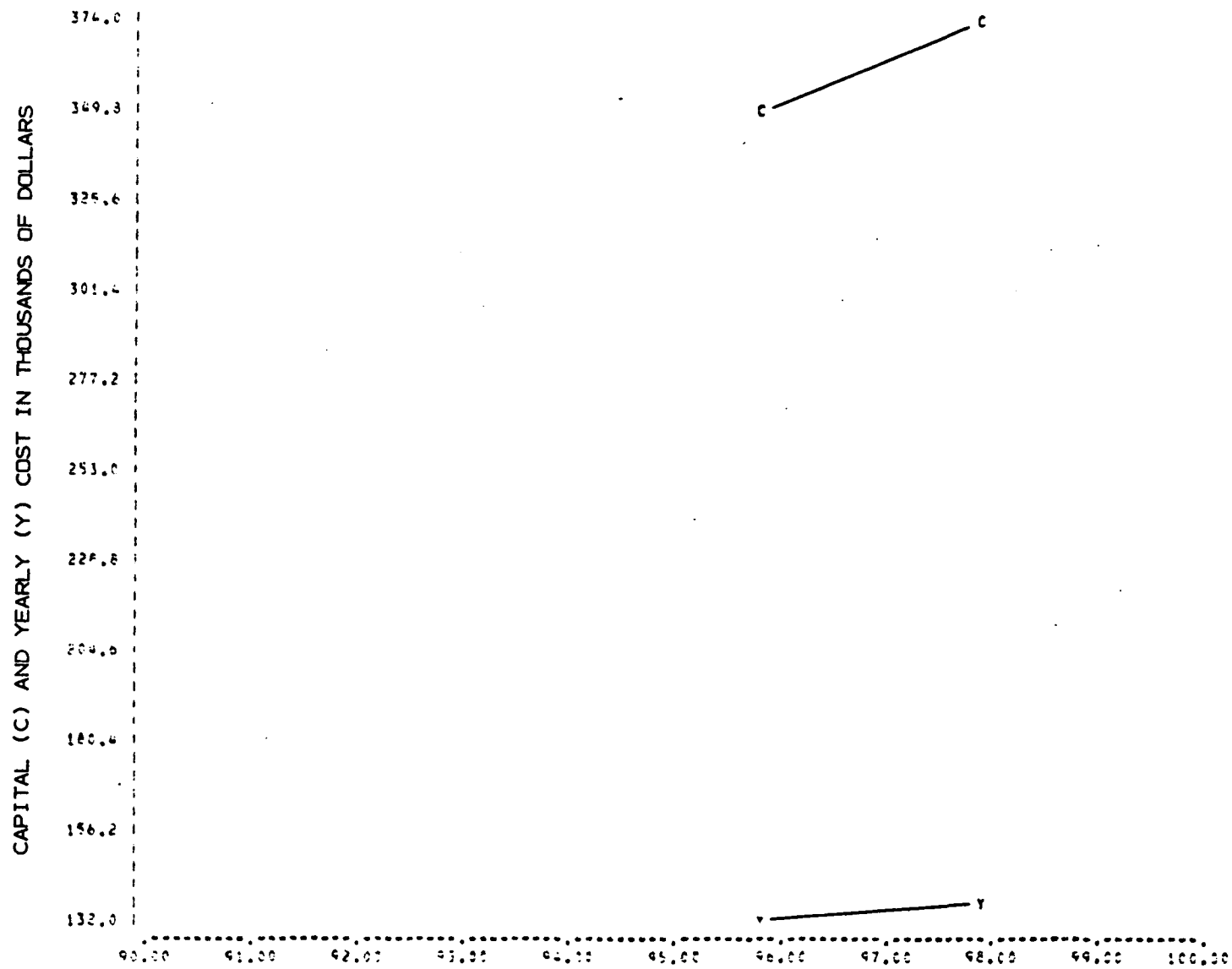


FIGURE 310

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-B-III

TABLE 304

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-IV
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
M...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS

INVESTMENT COSTS:

1. CONSTRUCTION	263720.00
2. LAND	15830.00
3. ENGINEERING	26370.00
4. CONTINGENCY	26370.00
TOTAL	332290.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	19760.00
3. CHEMICALS	1860.00
4. MAINTENANCE&SUPPLIES	8920.00
TOTAL	68020.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	68020.00
2. YEARLY INVESTMENT COST RECOVERY	13290.00
3. DEPRECIATION	15820.00
TOTAL	97130.00

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.8 percent
SS: 92.5 percent

Alternative A 22-B-V - This alternative provides dual media filtration in addition to the treatment chain in Alternative A 22-B-IV.

The resulting BOD waste load is 0.13 kg/kkg (0.0073 lb/bu), and the suspended solids load is 0.16 kg/kkg (0.0090 lb/bu).

Costs: Total investment cost: \$357,500
Total yearly cost: \$103,990

An itemized breakdown of costs is presented in Table 305. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 97.9 percent
SS: 96.3 percent

A cost efficiency curve is presented in Figure 311.

Alternative A 22-B-VI - This alternative replaces sand drying beds in Alternative A 22-B-IV with vacuum filtration.

The resulting BOD waste load is 0.25 kg/kkg (0.014 lb/bu), and the suspended solids load is 0.32 kg/kkg (0.018 lb/bu).

Costs: Total investment cost: \$387,710
Total yearly cost: \$106,650

An itemized breakdown of costs is presented in Table 306. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.8 percent
SS: 92.5 percent

Alternative A 22-B-VII - This alternative adds dual media filtration to Alternative A 22-B-VI.

The resulting BOD waste load is 0.13 kg/kkg (0.0073 lb/bu), and the suspended solids load is 0.16 kg/kkg (0.0090 lb/bu).

Costs: Total investment cost: \$412,920
Total yearly cost: \$113,510

TABLE 305

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-V
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

P1...CONTROL HOUSE
 P...PUMPING STATION
 C...EQUALIZATION BASIN
 H...NITROGEN ADDITION
 I...PHOSPHORUS ADDITION
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 P...AEROBIC DIGESTOR
 T...SAND DRYING BEDS
 B...PUMPING STATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	284730.00
2. LAND	15830.00
3. ENGINEERING	28470.00
4. CONTINGENCY	28470.00
TOTAL	357500.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	24020.00
3. CHEMICALS	1860.00
4. MAINTENANCE&SUPPLIES	9250.00
TOTAL	72610.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	72610.00
2. YEARLY INVESTMENT COST RECOVERY	14300.00
3. DEPRECIATION	17080.00
TOTAL	103990.00

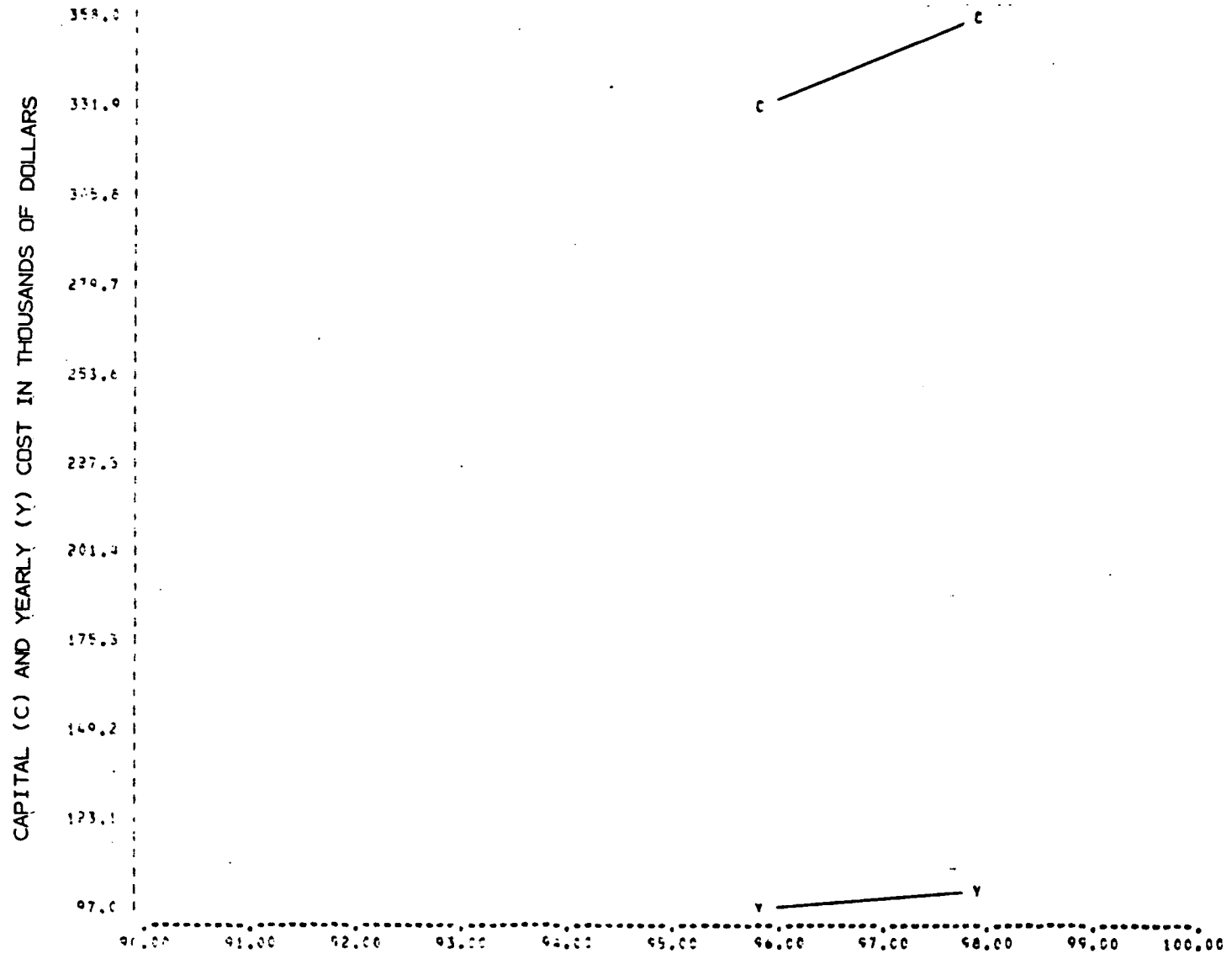


FIGURE 311

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-B-IV-V

TABLE 306

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-VI
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	296720.00
2. LAND	31650.00
3. ENGINEERING	29670.00
4. CONTINGENCY	29670.00
TOTAL	387710.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	22000.00
3. CHEMICALS	4350.00
4. MAINTENANCE&SUPPLIES	9510.00
TOTAL	73340.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	73340.00
2. YEARLY INVESTMENT COST RECOVERY	15510.00
3. DEPRECIATION	17800.00
TOTAL	106650.00

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An itemized breakdown of costs is presented in Table 307. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 97.9 percent
SS: 96.3 percent

A cost efficiency curve is presented in Figure 312.

Alternative A 22-B-VIII - This alternative replaces the sand drying beds in Alternative A 22-B-IV with spray irrigation.

The resulting BOD waste load is 0.25 kg/kkg (0.014 lb/bu), and the suspended solids load is 0.32 kg/kkg (0.018 lb/bu).

Costs: Total investment cost: \$388,320
Total yearly cost: \$102,870

An itemized breakdown of costs is presented in Table 308. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 95.8 percent
SS: 92.5 percent

Alternative A 22-B-IX - This alternative adds dual media filtration to Alternative A 22-B-VIII.

The resulting BOD waste load is 0.13 kg/kkg (0.0073 lb/bu), and the suspended solids load is 0.16 kg/kkg (0.0090 lb/bu).

Costs: Total investment cost: \$404,360
Total yearly cost: \$107,620

An itemized breakdown of costs is presented in Table 309. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

The model plant assumes screening of the effluent prior to discharge.

Reduction Benefits: BOD: 97.9 percent
SS: 96.3 percent

A cost efficiency curve is presented in Figure 313.

TABLE 307

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-VII
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 H...NITROGEN ADDITION
 I...PHOSPHORUS ADDITION
 K...ACTIVATED SLUDGE
 Q...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 S...VACUUM FILTRATION
 Y...HOLDING TANK
 B...PUMPING STATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	317730.00
2. LAND	31650.00
3. ENGINEERING	31770.00
4. CONTINGENCY	31770.00
TOTAL	412920.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	26260.00
3. CHEMICALS	4350.00
4. MAINTENANCE&SUPPLIES	9840.00
TOTAL	77930.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	77930.00
2. YEARLY INVESTMENT COST RECOVERY	16520.00
3. DEPRECIATION	19060.00
TOTAL	113510.00

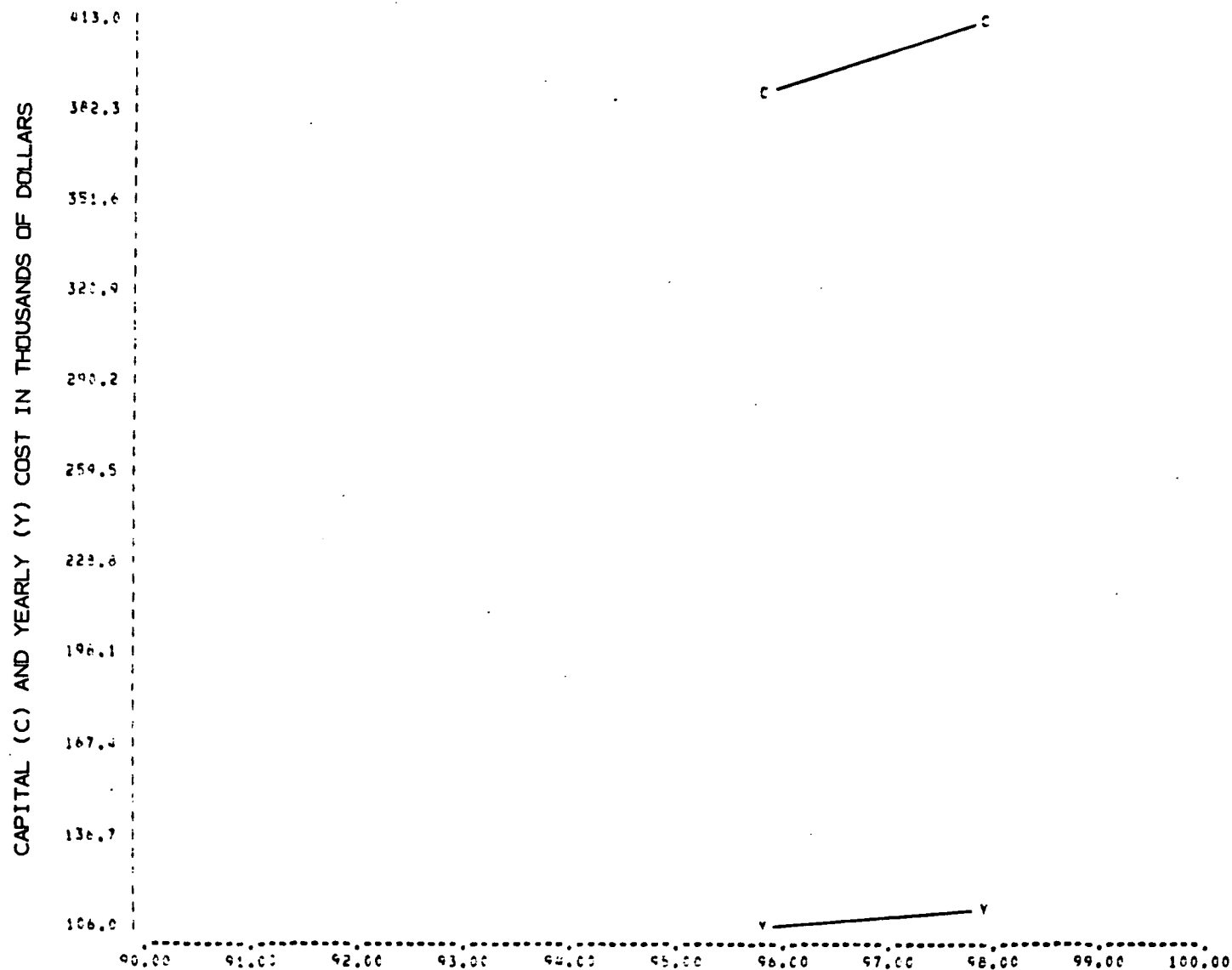


FIGURE 312

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-B-VI-VII

TABLE 308

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-VIII
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1..CONTROL HOUSE
B...PUMPING STATION
C...EQLALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1.	CONSTRUCTION	307640.00
2.	LAND	19160.00
3.	ENGINEERING	30760.00
4.	CONTINGENCY	30760.00
	TOTAL	388320.00

YEARLY OPERATING COSTS:

1.	LABOR	37480.00
2.	POWER	20600.00
3.	CHEMICALS	1860.00
4.	MAINTENANCE&SUPPLIES	8940.00
	TOTAL	68880.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	68880.00
2.	YEARLY INVESTMENT COST RECOVERY	15530.00
3.	DEPRECIATION	18460.00
	TOTAL	102870.00

TABLE 309

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 22-B-IX
(GRAIN DISTILLERS OPERATING STILLAGE RECOVERY)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
P...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	321000.00
2. LAND	19160.00
3. ENGINEERING	32100.00
4. CONTINGENCY	32100.00
TOTAL	404360.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	22250.00
3. CHEMICALS	1860.00
4. MAINTENANCE&SUPPLIES	10600.00
TOTAL	72190.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	72190.00
2. YEARLY INVESTMENT COST RECOVERY	16170.00
3. DEPRECIATION	19260.00
TOTAL	107620.00

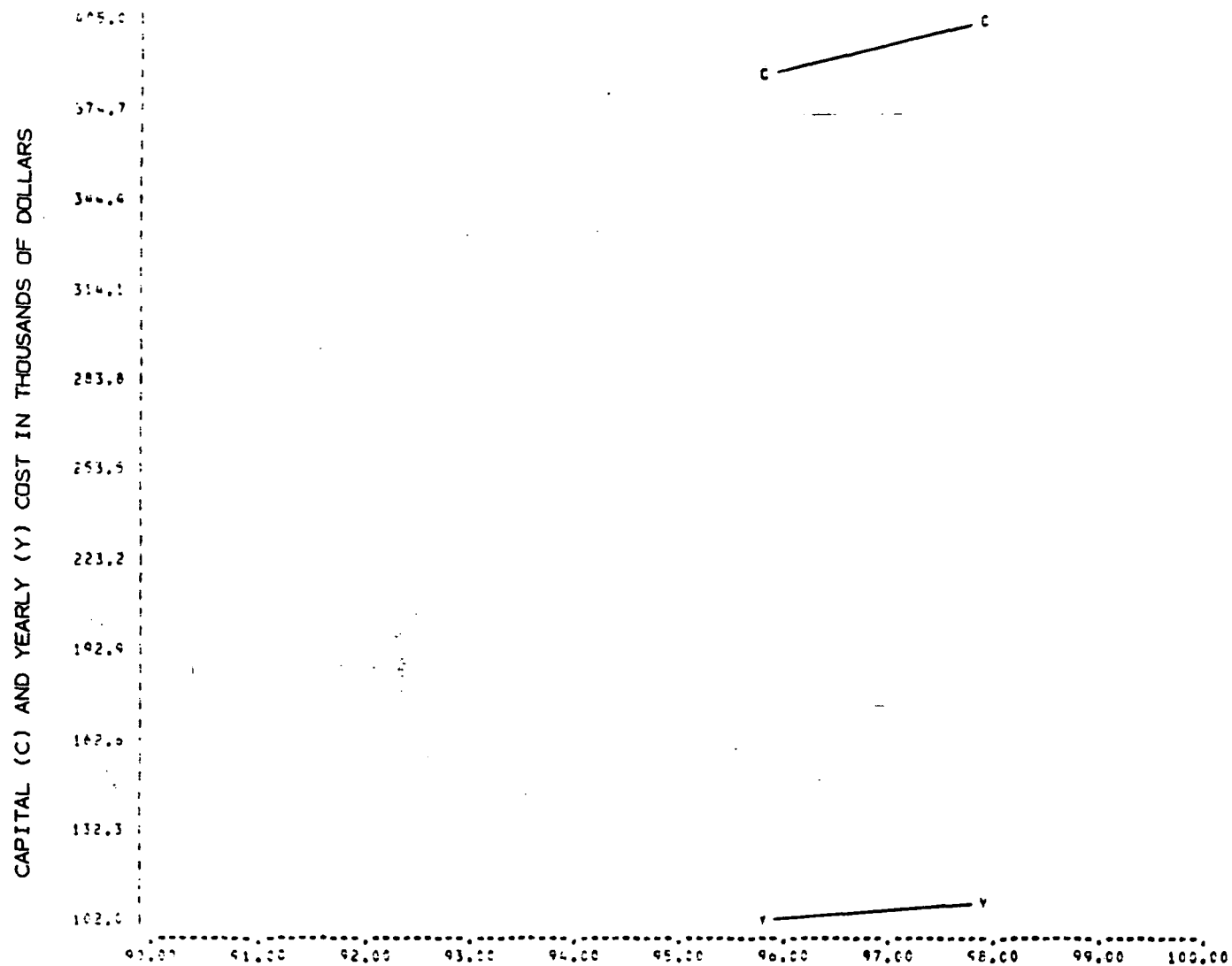


FIGURE 313

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 22-B-VII-IX

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 23 - Grain Distillers Not Operating Stills

A model plant representative of Subcategory A 23 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, five alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 50 kkg (2000 bu) per day.

Alternative A 23-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 50 kkg (2000 bu) per day plant is 91 cu m (0.024 MG) per day. The BOD waste load is 0.38 kg/kkg (0.021 lb/bu), and the suspended solids load is 0.29 kg/kkg (0.016 lb/bu).

Costs: 0
Reduction Benefits: None

Alternative A 23-II - This alternative provides a pumping station and aerated lagoon system.

The resulting BOD waste load is 0.06 kg/kkg (0.0034 lb/bu), and the suspended solids load is 0.07 kg/kkg (0.0039 lb/bu).

Costs: Total investment cost: \$133,720
Total yearly cost: \$ 28,200

An itemized breakdown of costs is presented in Table 310. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 85.7 percent
SS: 75.0 percent

Alternative A 23-III - This alternative provides in addition to Alternative A 23-II dual media filtration.

The resulting BOD waste load is 0.03 kg/kkg (0.0017 lb/bu), and the suspended solids load is 0.04 kg/kkg (0.0022 lb/bu).

Costs: Total investment cost: \$149,750
Total yearly cost: \$ 32,940

An itemized breakdown of costs is presented in Table 311. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 92.9 percent
SS: 87.5 percent

A cost efficiency curve is presented in Figure 314.

TABLE 310

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 23-II
(GRAIN DISTILLERS NOT OPERATING STILL)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 85.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	105670.00
2. LAND	3330.00
3. ENGINEERING	10570.00
4. CONTINGENCY	10570.00
5. PVC LINER	3580.00
TOTAL	133720.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	5170.00
3. CHEMICALS	60.00
4. MAINTENANCE&SUPPLIES	4790.00
5. PVC LINER	60.00
TOTAL	16330.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	16330.00
2. YEARLY INVESTMENT COST RECOVERY	5350.00
3. DEPRECIATION	6520.00
TOTAL	28200.00

TABLE 311

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 23-III
(GRAIN DISTILLERS NOT OPERATING STILLS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 92.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
F...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON
P...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	119040.00
2. LAND	3330.00
3. ENGINEERING	11900.00
4. CONTINGENCY	11900.00
5. PVC LINER	3580.00
TOTAL	149750.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	6820.00
3. CHEMICALS	60.00
4. MAINTENANCE & SUPPLIES	6440.00
5. PVC LINER	60.00
TOTAL	19630.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	19630.00
2. YEARLY INVESTMENT COST RECOVERY	5990.00
3. DEPRECIATION	7320.00
TOTAL	32940.00

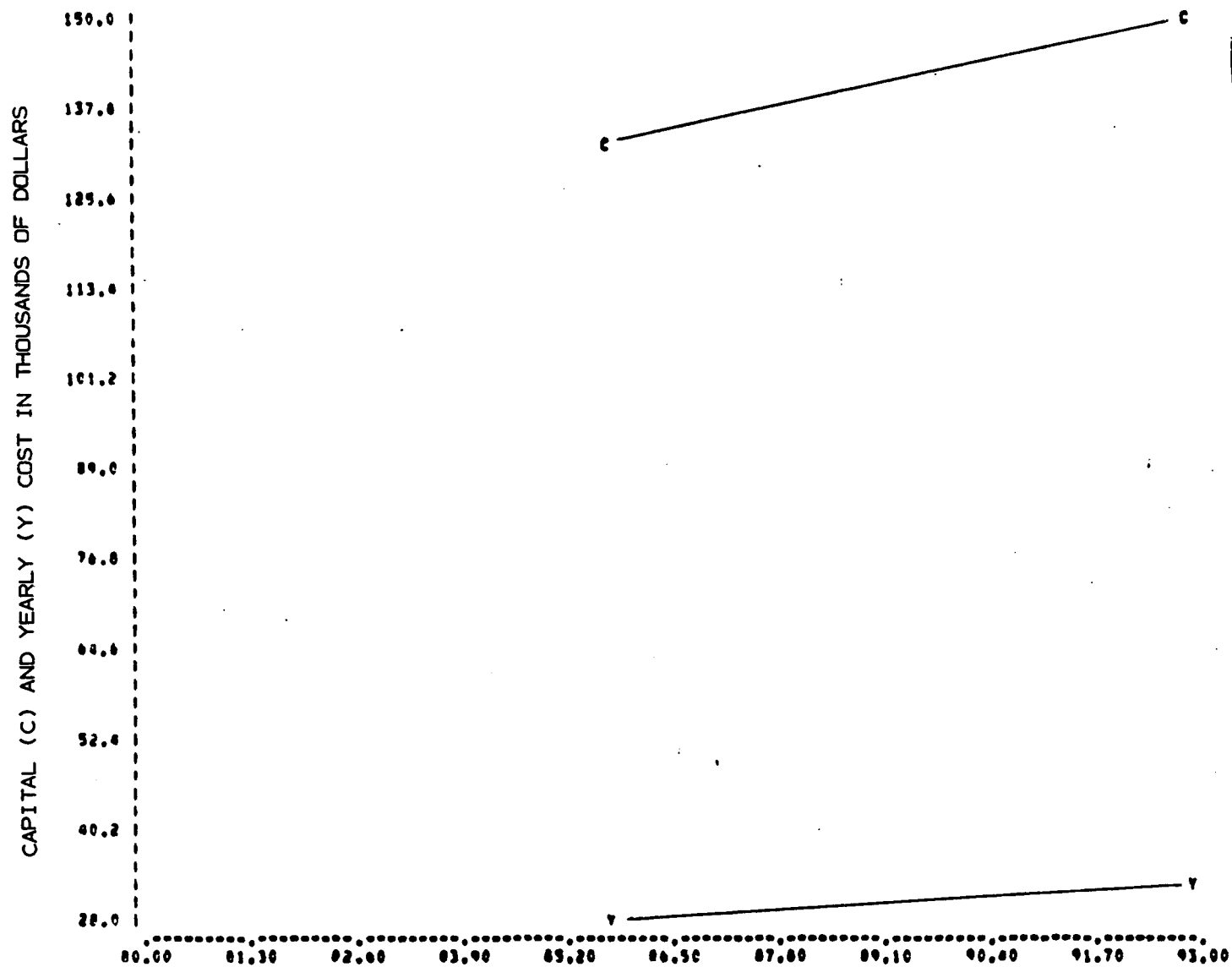


FIGURE 314

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 23-III

Alternative A 23-IV - This alternative provides in addition to Alternative A 23-II spray irrigation.

The resulting BOD waste load is zero, and the suspended solids load is zero.

Costs: Total investment cost: \$224,040
Total yearly cost: \$ 70,590

An itemized breakdown of costs is presented in Table 312. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

A cost efficiency curve is presented in Figure 315.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 24 - Molasses Distillers

A model plant representative of Subcategory A 24 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, nine alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 30,000 pg per day.

Alternative A 24-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 30,000 pg per day plant is 818 cu m (0.216 MG) per day. The BOD waste load is 969 kg/1000 pg (2140 lb/1000 pg), and the suspended solids load is 183 kg/1000 pg (403 lb/1000 pg).

Costs: 0
Reduction Benefits: None

Alternative A 24-II - This alternative consists of concentrating high strength molasses slops (stillage) by multi-effect evaporation, and then treating evaporator condensate and all other wastes with a treatment chain consisting of a control house, a pumping station, flow equalization, nutrient addition, a complete mix activated sludge system, sludge thickening, aerobic digestion, vacuum filtration, sludge storage and truck hauling. Evaporation is predicted to have an investment cost of \$2,193,310 and a yearly cost of \$609,620. Evaporation is assumed to remove 97 percent of the BOD and 99 percent of the suspended solids from high strength wastes. Two day storage of distilling slops and seven day storage of molasses by-product is provided, and all necessary pumping equipment is included.

TABLE 312

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 23-IV
(GRAIN DISTILLERS NOT OPERATING STILL)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

R...PUMPING STATION
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	174270.00
2. LAND	11330.00
3. ENGINEERING	17430.00
4. CONTINGENCY	17430.00
5. PVC LINER	3580.00
TOTAL	224040.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	6130.00
3. CHEMICALS	60.00
4. MAINTENANCE & SUPPLIES	7260.00
5. PVC LINER	60.00
TOTAL	50990.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	50990.00
2. YEARLY INVESTMENT COST RECOVERY	8960.00
3. DEPRECIATION	10640.00
TOTAL	70590.00

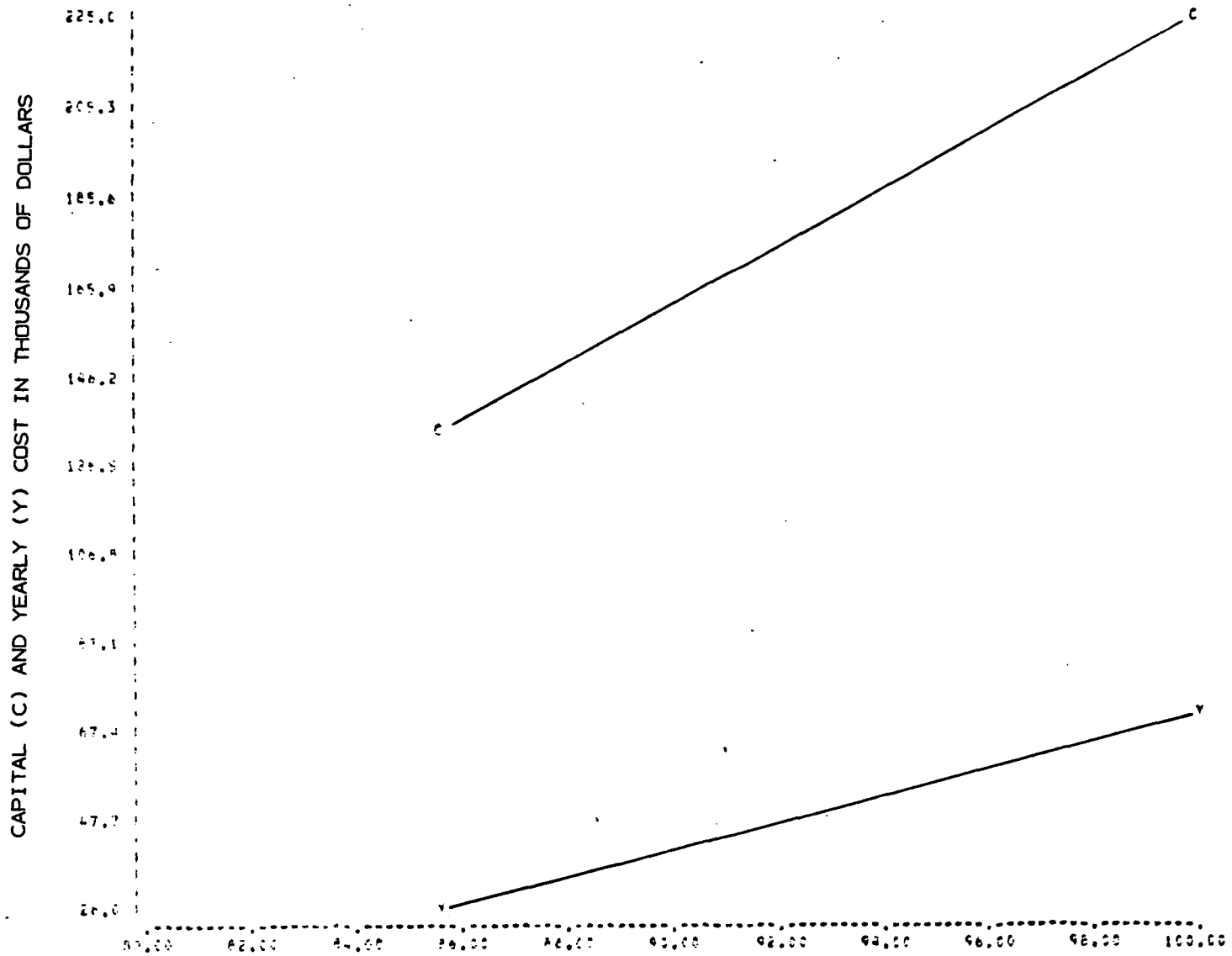


FIGURE 315

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 23-IV

The resulting BOD waste load is 1.16 kg/1000 pg (2.56 lb/1000 pg), and the suspended solids load is 0.69 kg/1000 pg (1.52 lb/1000 pg).

Costs: Total investment cost: \$2,644,060
Total yearly cost: \$ 698,640

An itemized breakdown of costs is presented in Table 313. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

It is recognized that, although not included in the above costs, additional boiler and cooling capacity may be required for evaporation. Cost recovery from saleable by-products is not reflected in the costs.

Reduction Benefits: BOD: 99.9 percent
SS: 99.6 percent

Alternative A 24-III - This alternative consists of adding dual media filtration to the treatment chain in Alternative A 24-II.

The resulting BOD waste load is 0.58 kg/1000 pg (1.28 lb/1000 pg), and the suspended solids load is 0.35 kg/1000 pg (0.77 lb/1000 pg).

Costs: Total investment cost: \$2,671,130
Total yearly cost: \$ 705,710

An itemized breakdown of costs is presented in Table 314. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.9 percent
SS: 99.8 percent

A cost efficiency curve is presented in Figure 316.

Alternative A 24-IV - This alternative replaces vacuum filtration in Alternative A 24-II with spray irrigation of sludge.

The resulting BOD waste load is 1.16 kg/1000 pg (2.56 lb/1000 pg), and the suspended solids load is 0.69 kg/1000 pg (1.52 lb/1000 pg).

Costs: Total investment cost: \$2,638,610
Total yearly cost: \$ 692,540

An itemized breakdown of costs is presented in Table 315. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.9 percent
SS: 99.6 percent

TABLE 313

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-II
(MOLASSES DISTILLERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
F1...MULTIPLE EFFECT EVAPORATOR
Y...HOLDING TANK
B...PUMPING STATION
Y...HOLDING TANK
B...PUMPING STATION
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	2181160.00
2. LAND	26660.00
3. ENGINEERING	218120.00
4. CONTINGENCY	218120.00
TOTAL	2644060.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	339170.00
3. CHEMICALS	7350.00
4. MAINTENANCE & SUPPLIES	40520.00
TOTAL	462010.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	462010.00
2. YEARLY INVESTMENT COST RECOVERY	105760.00
3. DEPRECIATION	130870.00
TOTAL	698640.00

TABLE 314

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-III
(MOLASSES DISTILLERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
F1...MULTIPLE EFFECT EVAPORATOR
Y...HOLDING TANK
B...PUMPING STATION
Y...HOLDING TANK
B...PUMPING STATION
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
S...VACUUM FILTRATION
Y...HOLDING TANK
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	2203730.00
2. LAND	26660.00
3. ENGINEERING	220370.00
4. CONTINGENCY	220370.00
TOTAL	2671130.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	343450.00
3. CHEMICALS	7350.00
4. MAINTENANCE&SUPPLIES	40870.00
TOTAL	466640.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	466640.00
2. YEARLY INVESTMENT	
COST RECOVERY	106850.00
3. DEPRECIATION	132220.00
TOTAL	705710.00

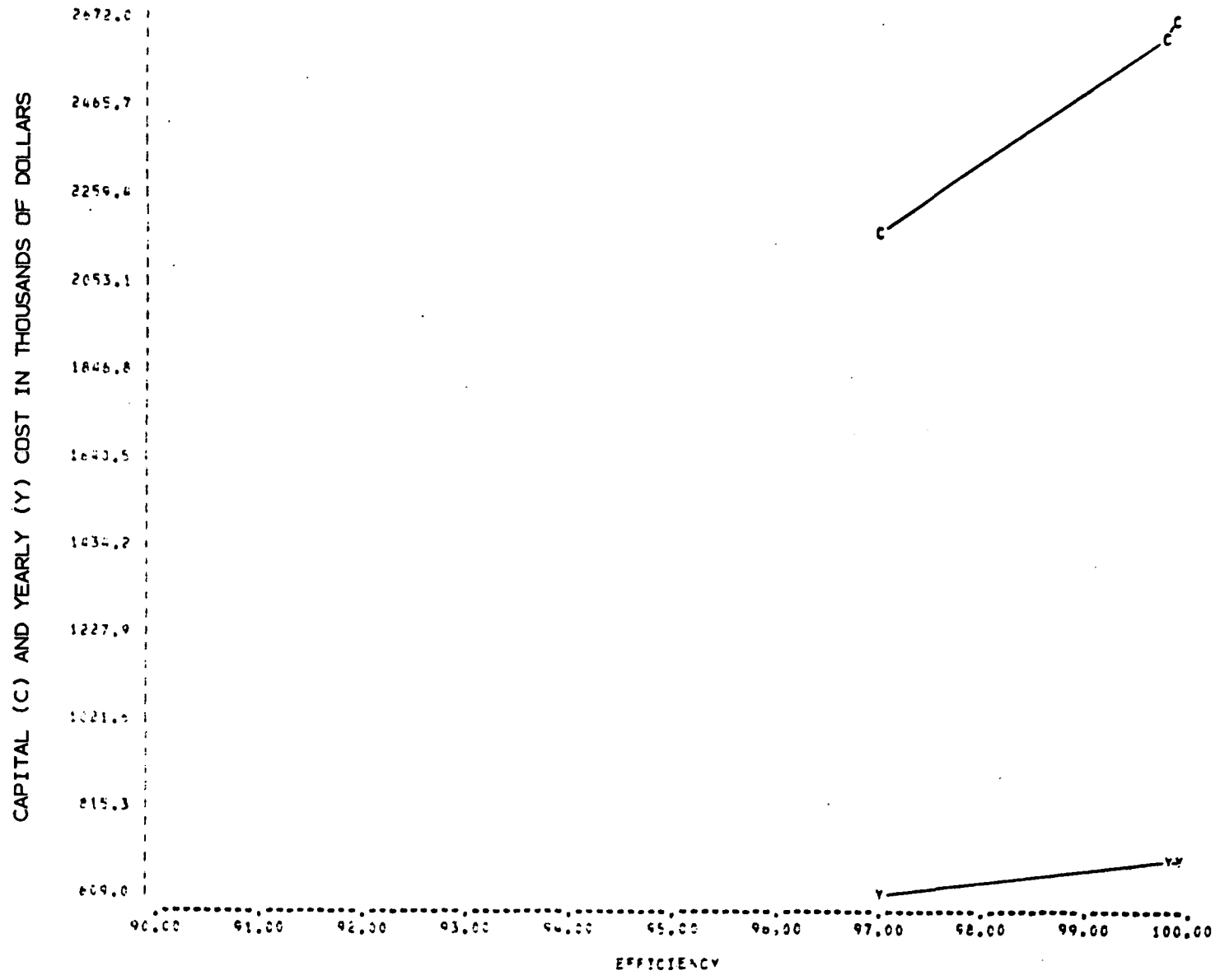


FIGURE 316

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 24-III

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TABLE 315

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-IV
(MOLASSES DISTILLERS)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 F1...MULTIPLE EFFECT EVAPORATOR
 Y...HOLDING TANK
 B...PUMPING STATION
 Y...HOLDING TANK
 B...PUMPING STATION
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 h...NITROGEN ADDITION
 I...PHOSPHORUS ADDITION
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 Y...HOLDING TANK
 U...SPRAY IRRIGATION

INVESTMENT COSTS:

1.	CONSTRUCTION	2183560.00
2.	LAND	18330.00
3.	ENGINEERING	218360.00
4.	CONTINGENCY	218360.00
	TOTAL	2638610.00

YEARLY OPERATING COSTS:

1.	LABOR	74970.00
2.	POWER	337450.00
3.	CHEMICALS	4390.00
4.	MAINTENANCE&SUPPLIES	39180.00
	TOTAL	455990.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	455990.00
2.	YEARLY INVESTMENT	
	COST RECOVERY	105540.00
3.	DEPRECIATION	131010.00
	TOTAL	692540.00

Alternative A 24-V - This alternative provides in addition to Alternative A 24-IV dual media filtration.

The resulting BOD waste load is 0.58 kg/1000 pg (1.28 lb/1000 pg), and the suspended solids load is 0.35 kg/1000 pg (0.77 lb/1000 pg).

Costs: Total investment cost: \$2,665,690
Total yearly cost: \$ 699,620

An itemized breakdown of costs is presented in Table 316. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.9 percent
SS: 99.8 percent

A cost efficiency curve is presented in Figure 317.

Alternative A 24-VI - This alternative replaces vacuum filtration in Alternative A 24-II with sand drying beds.

The resulting BOD waste load is 1.16 kg/1000 pg (2.56 lb/1000 pg), and the suspended solids load is 0.69 kg/1000 pg (1.52 lb/1000 pg).

Costs: Total investment cost: \$2,759,100
Total yearly cost: \$ 718,490

An itemized breakdown of costs is presented in Table 317. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.9 percent
SS: 99.6 percent

Alternative A 24-VII - This alternative adds dual media filtration to Alternative A 24-VI.

The resulting BOD waste load is 0.58 kg/1000 pg (1.28 lb/1000 pg), and the suspended solids load is 0.35 kg/1000 pg (0.77 lb/1000 pg).

Costs: Total investment cost: \$2,786,170
Total yearly cost: \$ 725,560

An itemized breakdown of costs is presented in Table 318. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.9 percent
SS: 99.8 percent

A cost efficiency curve is presented in Figure 318.

TABLE 316

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-V
(MOLASSES DISTILLERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
F1...MULTIPLE EFFECT EVAPORATOR
Y...HOLDING TANK
B...PUMPING STATION
Y...HOLDING TANK
B...PUMPING STATION
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
U...SPRAY IRRIGATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	2206140.00
2. LAND	18330.00
3. ENGINEERING	220610.00
4. CONTINGENCY	220610.00
TOTAL	2665690.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	341730.00
3. CHEMICALS	4390.00
4. MAINTENANCE&SUPPLIES	39530.00
TOTAL	460620.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	460620.00
2. YEARLY INVESTMENT COST RECOVERY	106630.00
3. DEPRECIATION	132370.00
TOTAL	699620.00

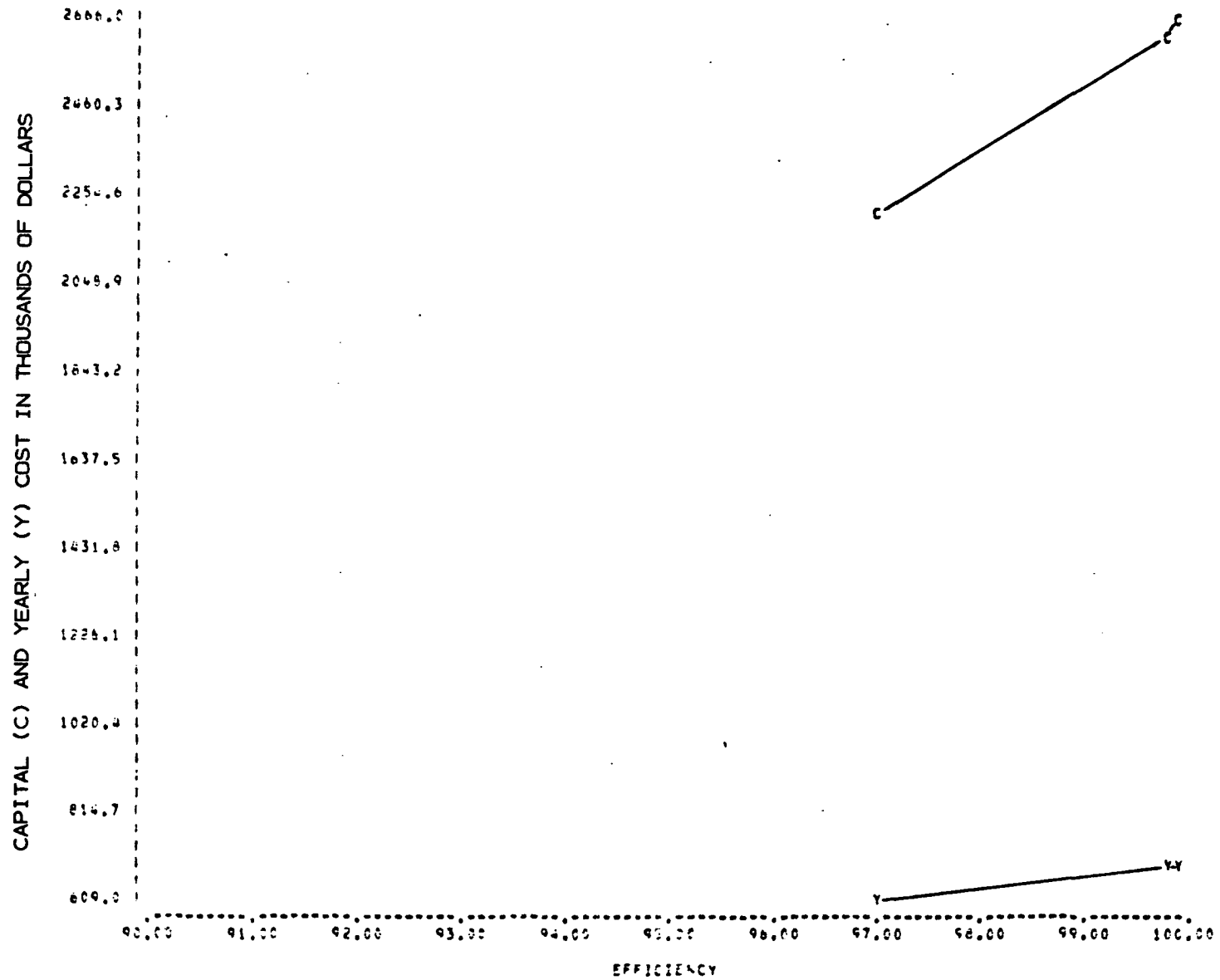


FIGURE 317

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 24-V

TABLE 317

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-VI
(MOLASSES DISTILLERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY,... 99.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
F1...MULTIPLE EFFECT EVAPORATOR
Y...HOLDING TANK
B...PUMPING STATION
Y...HOLDING TANK
B...PUMPING STATION
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS

INVESTMENT COSTS:

1. CONSTRUCTION	2280360.00
2. LAND	22660.00
3. ENGINEERING	228040.00
4. CONTINGENCY	228040.00
TOTAL	2759100.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	336600.00
3. CHEMICALS	4390.00
4. MAINTENANCE & SUPPLIES	55350.00
TOTAL	471310.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	471310.00
2. YEARLY INVESTMENT COST RECOVERY	110360.00
3. DEPRECIATION	136820.00
TOTAL	718490.00

TABLE 318

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-VII
(MOLASSES DISTILLERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
F1...MULTIPLE EFFECT EVAPORATOR
Y...HOLDING TANK
B...PUMPING STATION
Y...HOLDING TANK
B...PUMPING STATION
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	2302930.00
2. LAND	22660.00
3. ENGINEERING	230290.00
4. CONTINGENCY	230290.00
TOTAL	2786170.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	340880.00
3. CHEMICALS	4390.00
4. MAINTENANCE & SUPPLIES	55690.00
TOTAL	475930.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	475930.00
2. YEARLY INVESTMENT COST RECOVERY	111450.00
3. DEPRECIATION	138180.00
TOTAL	725560.00

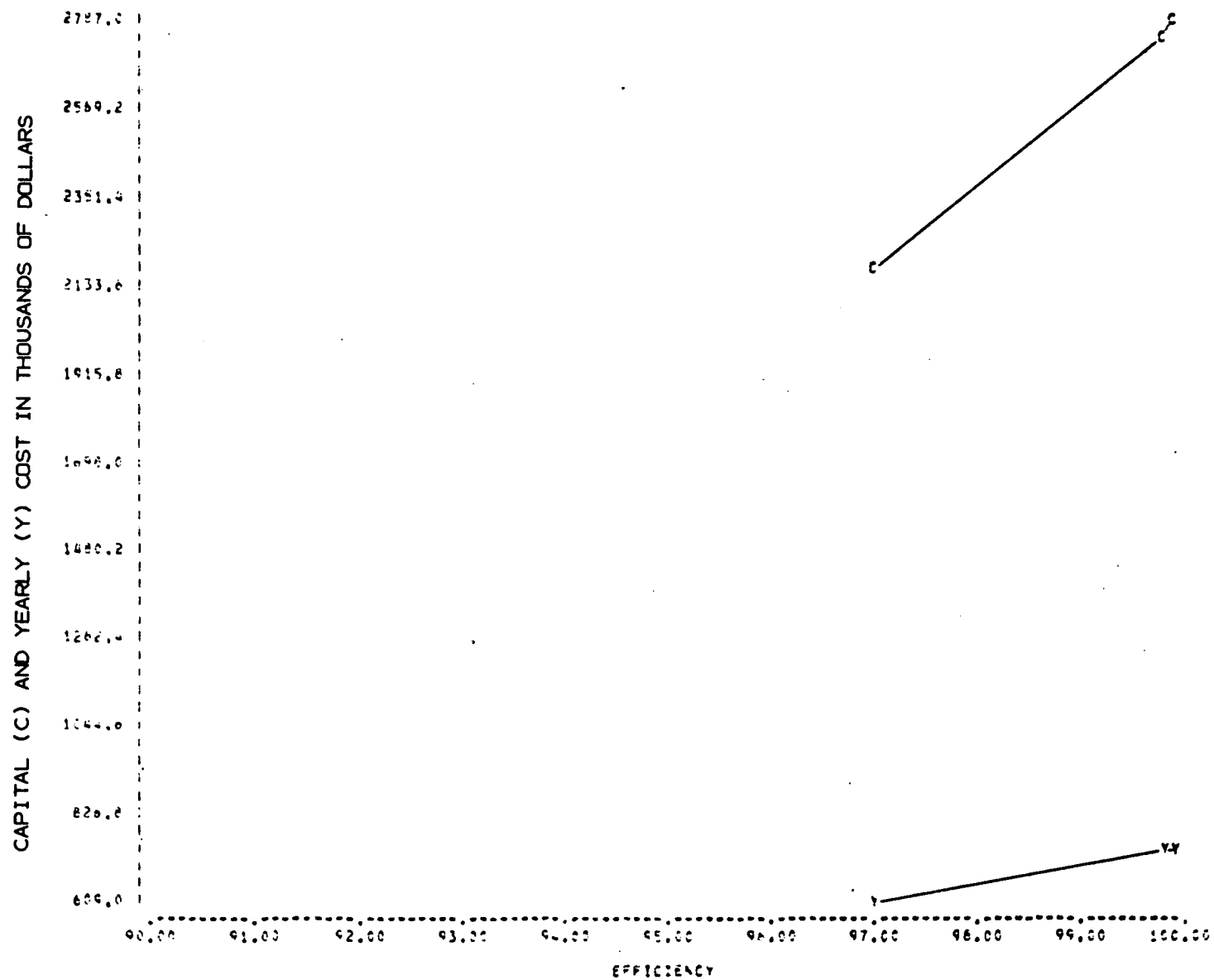


FIGURE 318

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 24-VII

Alternative A 24-VIII - This alternative replaces the activated sludge and sludge handling modules in Alternative A 24-II with an aerated lagoon system.

The resulting BOD waste load is 1.16 kg/1000 pg (2.56 lb/1000 pg), and the suspended solids load is 0.69 kg/1000 pg (1.52 lb/1000 pg).

Costs: Total investment cost: \$2,665,800
Total yearly cost: 800,510

An itemized breakdown of costs is presented in Table 319. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.9 percent
SS: 99.6 percent

Alternative A 24-IX - This alternative provides in addition to Alternative A 24-VIII dual media filtration.

The resulting BOD waste load is 0.58 kg/1000 pg (1.28 lb/1000 pg), and the suspended solids load is 0.35 kg/1000 pg (0.77 lb/1000 pg).

Costs: Total investment cost: \$2,692,880
Total yearly cost: \$ 807,580

An itemized breakdown of costs is presented in Table 320. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that six operators are required.

Reduction Benefits: BOD: 99.9 percent
SS: 99.8 percent

A cost efficiency curve is presented in Figure 319.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 25 - Bottling and Blending of Beverage Alcohol

Two model plants representative of Subcategory A 25 were developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, three alternatives were selected as being applicable engineering alternatives for each model plant. These alternatives provide for various levels of waste reductions for the model plants.

Model plant A produces a flow of 4 cu m/day (0.001 MGD).

Alternative A 25-A-I - This alternative assumes no treatment and no reduction in the waste load.

Costs: 0
Reduction Benefits: None

TABLE 319

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-VIII
(MOLASSES DISTILLERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
P...PUMPING STATION
F1...MULTIPLE EFFECT EVAPORATOR
Y...HOLDING TANK
B...PUMPING STATION
Y...HOLDING TANK
B...PUMPING STATION
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
T...PHOSPHORUS ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	2206570.00
2. LAND	5830.00
3. ENGINEERING	220660.00
4. CONTINGENCY	220660.00
5. PVC LINER	12080.00
TOTAL	2665800.00

YEARLY OPERATING COSTS:

1. LABOR	74970.00
2. POWER	437430.00
3. CHEMICALS	4390.00
4. MAINTENANCE & SUPPLIES	43640.00
5. PVC LINER	450.00
TOTAL	560880.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	560880.00
2. YEARLY INVESTMENT	
COST RECOVERY	106630.00
3. DEPRECIATION	133000.00
TOTAL	800510.00

TABLE 320

ITEMIZED COST SUMMARY FOR ALTERNATIVE A24-IX
(MOLASSES DISTILLERS)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 F1...MULTIPLE EFFECT EVAPORATOR
 Y...HOLDING TANK
 B...PUMPING STATION
 Y...HOLDING TANK
 R...PUMPING STATION
 R...PUMPING STATION
 C...EQUALIZATION BASIN
 H...NITROGEN ADDITION
 I...PHOSPHORUS ADDITION
 L...AERATED LAGOON
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	2229150.00
2.	LAND	5830.00
3.	ENGINEERING	222910.00
4.	CONTINGENCY	222910.00
5.	PVC LINER	12080.00
	TOTAL	2692880.00

YEARLY OPERATING COSTS:

1.	LABOR	74970.00
2.	POWER	441700.00
3.	CHEMICALS	4390.00
4.	MAINTENANCE&SUPPLIES	44000.00
5.	PVC LINER	450.00
	TOTAL	565510.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	565510.00
2.	YEARLY INVESTMENT COST RECOVERY	107720.00
3.	DEPRECIATION	134350.00
	TOTAL	807580.00

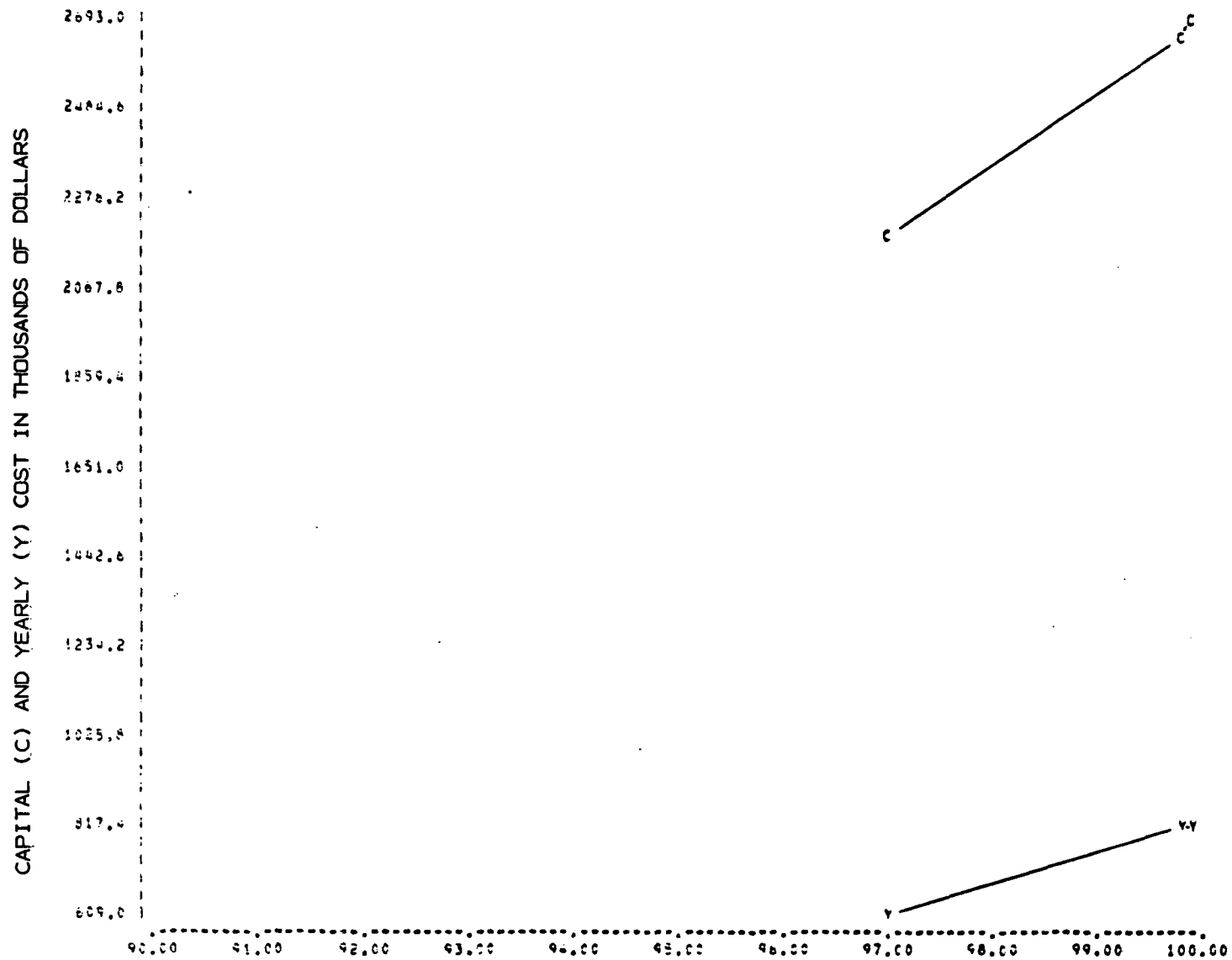


FIGURE 319

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 24-IX

Alternative A 25-A-II - This alternative provides daily truck hauling of all plant process wastes to municipal treatment facilities or approved land disposal sites. A holding tank is provided.

The resulting BOD waste load is zero, and the suspended solids load is zero.

Costs: Total investment cost: \$12,860
Total yearly cost: \$16,470

An itemized breakdown of costs is presented in Table 321. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

Alternative A 25-A-III - This alternative provides for spray irrigation of the final effluent. A holding tank, pump, and pipelines are provided.

The resulting BOD waste load is zero, and the suspended solids load is zero.

Costs: Total investment cost: \$38,270
Total yearly cost: \$ 5,210

An itemized breakdown of costs is presented in Table 322. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

Model plant B has a flow of 40 cu m (0.01 MG) per day.

Alternative A 25-B-I - This alternative assumes no treatment and no reduction in the waste load.

Costs: 0
Reduction Benefits: None

Alternative A 25-B-II - This alternative provides daily truck hauling for all plant process wastes to municipal treatment facilities or approved land disposal sites. A holding tank is provided.

The resulting BOD waste load is zero, and the suspended solids load is zero.

Costs: Total investment cost: \$ 14,670
Total yearly cost: \$153,470

TABLE 321

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 25-A-II
(BOTTLING AND BLENDING OF BEVERAGE ALCOHOL)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
V... TRUCK HALLING

INVESTMENT COSTS:

1. CONSTRUCTION	8490.00
2. LAND	2670.00
3. ENGINEERING	850.00
4. CONTINGENCY	850.00
TOTAL	12860.00

YEARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	0.0
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	15450.00
TOTAL	15450.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	15450.00
2. YEARLY INVESTMENT	
COST RECOVERY	510.00
3. DEPRECIATION	510.00
TOTAL	16470.00

TABLE 322

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 25-A-III
(BOTTLING AND BLENDING OF BEVERAGE ALCOHOL)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	29390.00
2. LAND	3000.00
3. ENGINEERING	2940.00
4. CONTINGENCY	2940.00
TOTAL	38270.00

YEARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	840.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	1080.00
TOTAL	1920.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	1920.00
2. YEARLY INVESTMENT COST RECOVERY	1530.00
3. DEPRECIATION	1760.00
TOTAL	5210.00

An itemized breakdown of costs is presented in Table 323. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

Alternative A 25-B-III - This alternative provides truck hauling on a monthly basis for redistillation residue, bad product, and demineralizer regeneration. It is assumed these wastes are collected in holding tanks. All other process wastes are spray irrigated. A holding tank, pump, and pipeline are provided.

The resulting BOD waste load is zero, and the suspended solids load is zero.

Costs: Total investment cost: \$48,860
Total yearly cost: \$ 6,360

An itemized breakdown of costs is presented in Table 324. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that no operators are required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 26 - Soft Drink Canners

A model plant representative of Subcategory A 26 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, seven alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 309 cu m (81,500 gal) per day.

Alternative A 26-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 309 cu m (81,500 gal) per day plant is 229 cu m (0.0605 MG) per day. The BOD waste load is 1.02 kg/cu m (0.505 lb/1000 gal), and the suspended solids load is 0.123 kg/cu m (1.03 lb/1000 gal).

Costs: 0
Reduction Benefits: None

Alternative A 26-II - This alternative provides a control house, flow equalization, nutrient addition, a complete mix activated sludge system, sludge thickening, and spray irrigation of sludge.

The resulting BOD waste load is 0.052 kg/cu m (0.43 lb/1000 gal), and the suspended solids load is 0.030 kg/cu m (0.25 lb/1000 gal).

TABLE 323

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 25-B-II
(BOTTLING AND BLENDING OF BEVERAGE ALCOHOL)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
V... TRUCK HALLING

INVESTMENT COSTS:

1. CONSTRUCTION	9940.00
2. LAND	2750.00
3. ENGINEERING	990.00
4. CONTINGENCY	990.00
TOTAL	14670.00

YEARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	0.0
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	152280.00
TOTAL	152280.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	152280.00
2. YEARLY INVESTMENT	
CCST RECOVERY	590.00
3. DEPRECIATION	600.00
TOTAL	153470.00

TABLE 324

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 25-B-III
(BOTTLING AND BLENDING OF BEVERAGE ALCOHOL)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	37110.00
2. LAND	4330.00
3. ENGINEERING	3710.00
4. CONTINGENCY	3710.00
TOTAL	48860.00

YEARLY OPERATING COSTS:

1. LABOR	0.0
2. POWER	880.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	1300.00
TOTAL	2180.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	2180.00
2. YEARLY INVESTMENT COST RECOVERY	1950.00
3. DEPRECIATION	2230.00
TOTAL	6360.00

DRAFT

Costs: Total investment cost: \$238,880
Total yearly cost: \$ 49,390

An itemized breakdown of costs is presented in Table 325. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.9 percent
SS: 76.0 percent

Alternative A 26-III - This alternative provides in addition to Alternative A 26-II dual media filtration.

The resulting BOD waste load is 0.026 kg/cu m (0.22 lb/1000 gal), and the suspended solids load is 0.015 kg/cu m (0.13 lb/1000 gal).

Costs: Total investment cost: \$258,070
Total yearly cost: \$ 55,010

An itemized breakdown of costs is presented in Table 326. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 97.5 percent
SS: 88.1 percent

A cost efficiency curve is presented in Figure 320.

Alternative A 26-IV - This alternative provides a control house, flow equalization, nutrient addition, a complete mix activated sludge system, and sludge thickening.

The resulting BOD waste load is 0.052 kg/cu m (0.43 lb/1000 gal), and the suspended solids load is 0.030 kg/cu m (0.25 lb/1000 gal).

Costs: Total investment cost: \$210,270
Total yearly cost: \$ 47,070

An itemized breakdown of costs is presented in Table 327. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.9 percent
SS: 76.0 percent

Alternative A 26-V - This alternative provides, in addition to alternative A 26-IV dual media filtration.

The resulting BOD waste load is 0.026 kg/cu m (0.22 lb/1000 gal), and the suspended solids load is 0.015 kg/cu m (0.13 lb/1000 gal).

TABLE 325

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 26-II
(SOFT DRINK CANNERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	185180.00
2. LAND	16660.00
3. ENGINEERING	18520.00
4. CONTINGENCY	18520.00
TOTAL	238880.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	9940.00
3. CHEMICALS	890.00
4. MAINTENANCE&SUPPLIES	5400.00
TOTAL	28720.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	28720.00
2. YEARLY INVESTMENT COST RECOVERY	9560.00
3. DEPRECIATION	11110.00
TOTAL	49390.00

TABLE 326

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 26-III
(SOFT DRINK CANNERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
Y...HOLDING TANK
U...SPRAY IRRIGATION
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	201170.00
2. LAND	16660.00
3. ENGINEERING	20120.00
4. CONTINGENCY	20120.00
TOTAL	258070.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	12850.00
3. CHEMICALS	890.00
4. MAINTENANCE&SUPPLIES	6390.00
TOTAL	32620.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	32620.00
2. YEARLY INVESTMENT COST RECOVERY	10320.00
3. DEPRECIATION	12070.00
TOTAL	55010.00

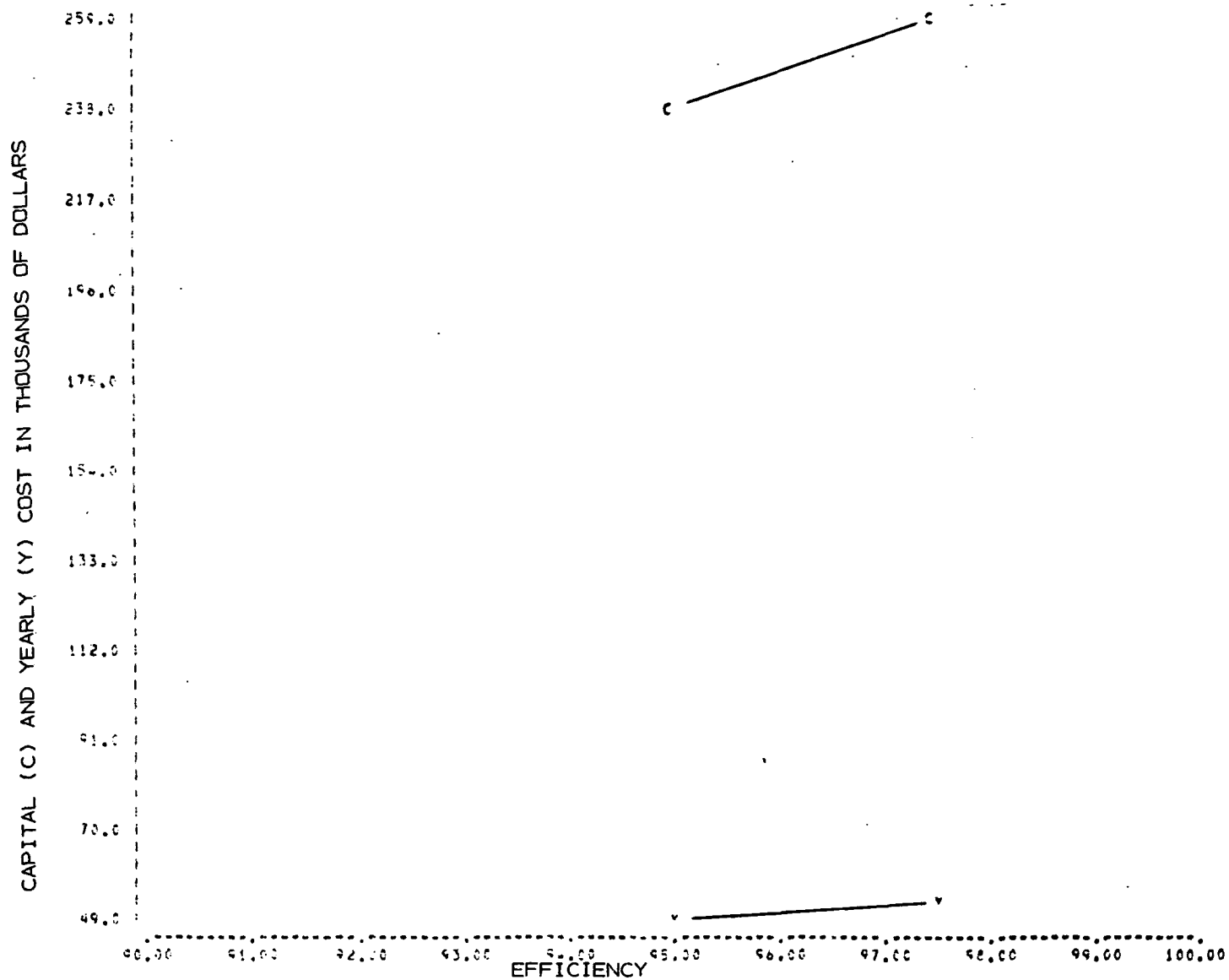


FIGURE 320

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 26, ALT. 26-II-A26-III

TABLE 327

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 26-IV
(SOFT DRINK CANNERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	153010.00
2. LAND	26660.00
3. ENGINEERING	15300.00
4. CONTINGENCY	15300.00
TOTAL	210270.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	9100.00
3. CHEMICALS	890.00
4. MAINTENANCE&SUPPLIES	7000.00
TOTAL	29480.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	29480.00
2. YEARLY INVESTMENT COST RECOVERY	8410.00
3. DEPRECIATION	9180.00
TOTAL	47070.00

Costs: Total investment cost: \$227,790
Total yearly cost: \$ 52,630

An itemized breakdown of costs is presented in Table 328. It is assumed that land cost \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 97.5 percent
SS: 88.1 percent

A cost efficiency curve is presented in Figure 321.

Alternative A 26-VI - This alternative provides flow equalization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load is 0.052 kg/cu m (0.43 lb/1000 gal), and the suspended solids load is 0.030 kg/cu m (0.25 lb/1000 gal).

Costs: Total investment cost: \$204,690
Total yearly cost: \$ 66,240

An itemized breakdown of costs is presented in Table 329. It is assumed that land costs \$4100 per hectare (1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.9 percent
SS: 76.0 percent

Alternative A 26-VII - This alternative provides in addition to Alternative A 26-VI dual media filtration.

The resulting BOD waste load is 0.026 kg/cu m (0.22 lb/1000 gal), and the suspended solids load is 0.015 kg/cu m (0.13 lb/1000 gal).

Costs: Total investment cost: \$223,890
Total yearly cost: \$ 71,860

An itemized breakdown of costs is presented in Table 330. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 97.5 percent
SS: 88.1 percent

A cost efficiency curve is presented in Figure 322.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 27 - Soft Drink Bottling or Combined Bottling/Canning Plants

A model plant representative of Subcategory A 27 was developed in Section V for the purpose of applying control and treatment alter-

TABLE 328

ITEMIZED COST SUMMARY FOR ALTERNATIVE A 26-V
(SOFT DRINK CANNERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
Y...HOLDING TANK

N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	169000.00
2. LAND	24990.00
3. ENGINEERING	16900.00
4. CONTINGENCY	16900.00
TOTAL	227790.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	12010.00
3. CHEMICALS	890.00
4. MAINTENANCE&SUPPLIES	7990.00
TOTAL	33380.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	33380.00
2. YEARLY INVESTMENT COST RECOVERY	9110.00
3. DEPRECIATION	10140.00
TOTAL	52630.00

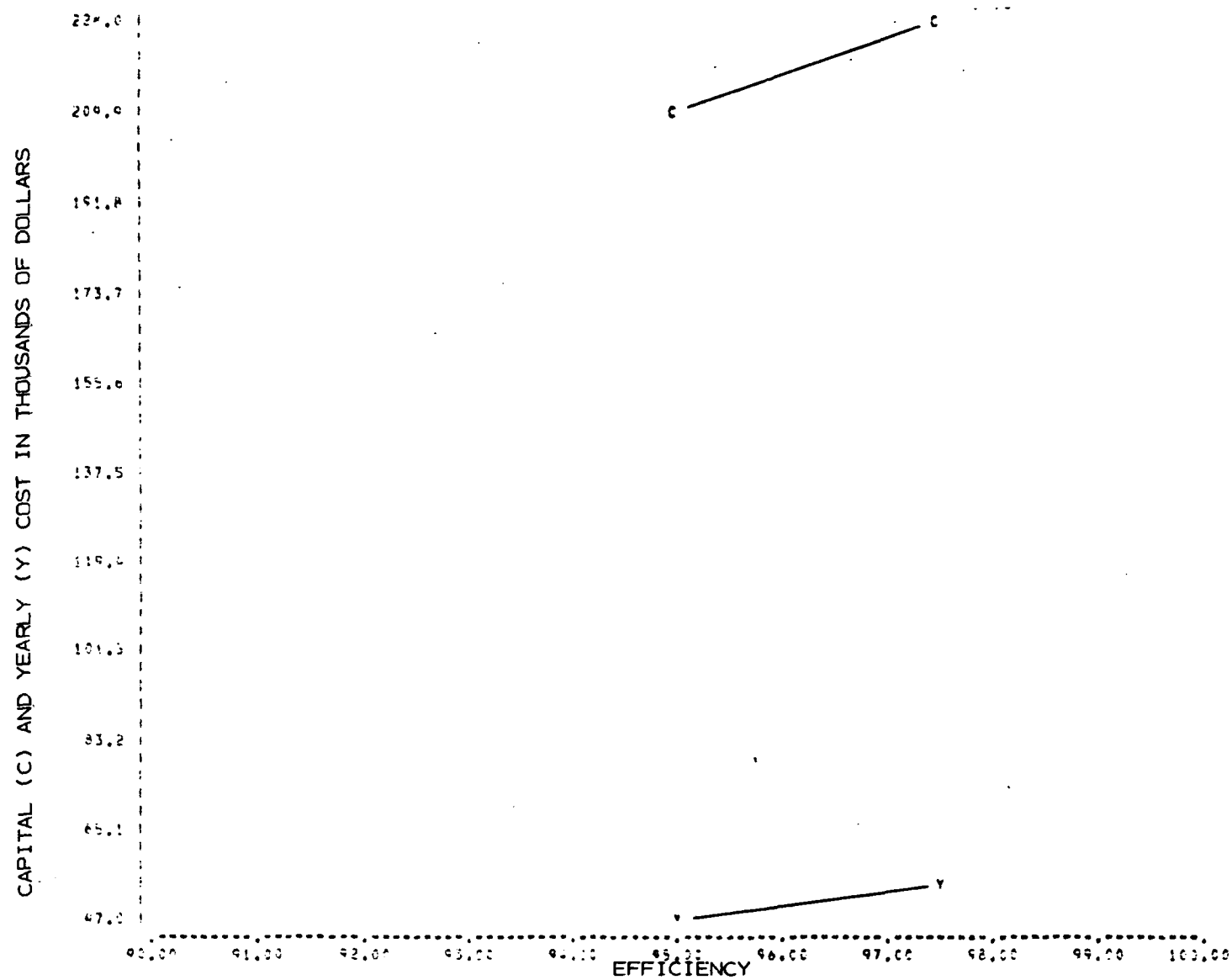


FIGURE 321

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 26-IV THROUGH A 26-V

TABLE 329

ITEMIZED COST SUMMARY FOR ALTERNATIVE A26-VI
(SOFT DRINK CANNERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.3 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	164360.00
2. LAND	3580.00
3. ENGINEERING	16440.00
4. CONTINGENCY	16440.00
5. PVC LINER	3870.00
TOTAL	204690.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	35480.00
3. CHEMICALS	890.00
4. MAINTENANCE&SUPPLIES	5210.00
5. PVC LINER	160.00
TOTAL	47990.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	47990.00
2. YEARLY INVESTMENT	
COST RECOVERY	8190.00
3. DEPRECIATION	10060.00
TOTAL	66240.00

TABLE 330

ITEMIZED COST SUMMARY FOR ALTERNATIVE A26-VII
(SOFT DRINK CANNERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
H...NITROGEN ADDITION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	180360.00
2. LAND	3580.00
3. ENGINEERING	18040.00
4. CONTINGENCY	18040.00
5. PVC LINER	3870.00
TOTAL	223890.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	38390.00
3. CHEMICALS	890.00
4. MAINTENANCE&SUPPLIES	6190.00
5. PVC LINER	160.00
TOTAL	51880.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	51880.00
2. YEARLY INVESTMENT COST RECOVERY	8960.00
3. DEPRECIATION	11020.00
TOTAL	71860.00

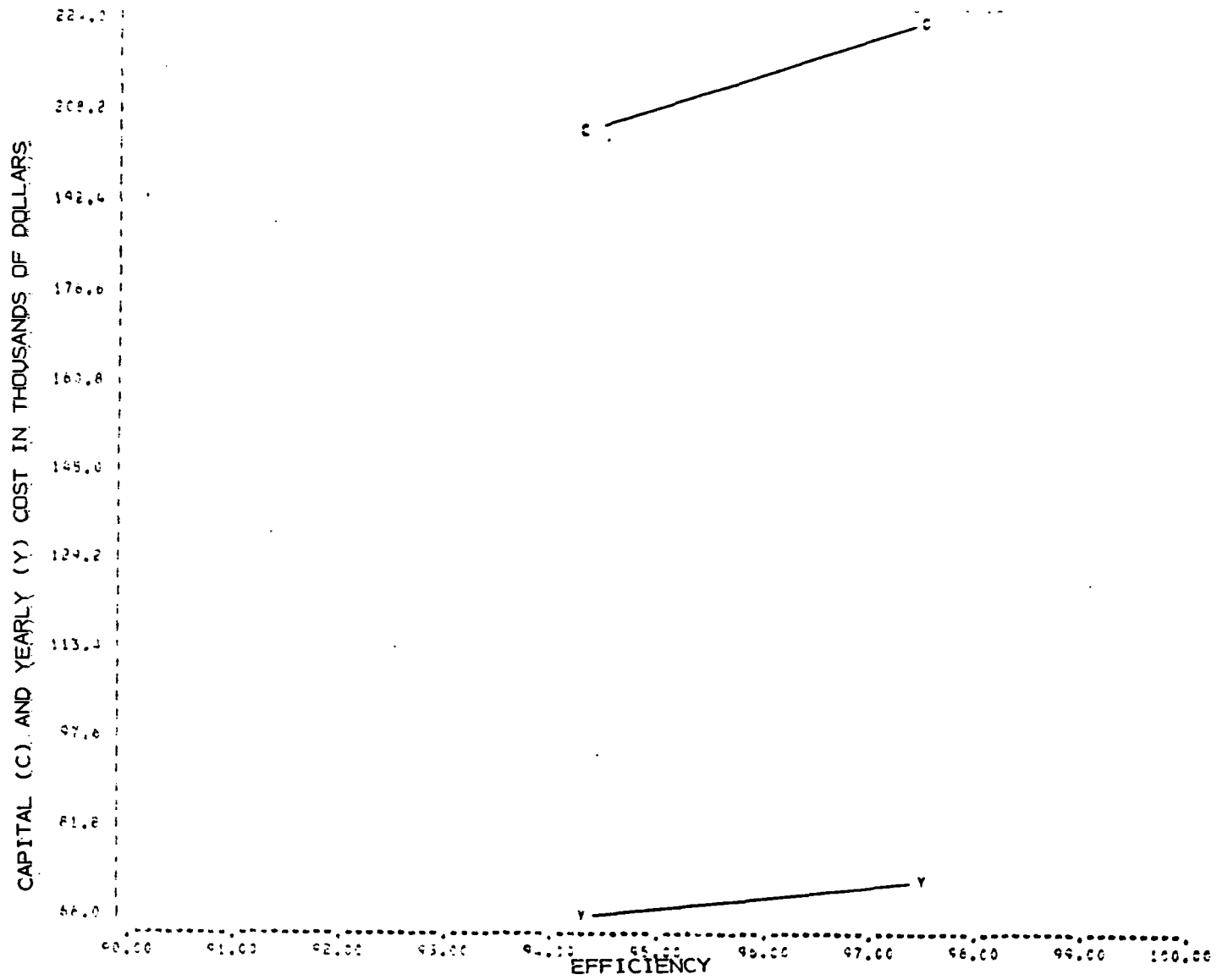


FIGURE 322

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 26, ALT. VII

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natives. In Section VII, seven alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 136 cu m (35,900 gal) per day.

Alternative A 27-I - This alternative assumed no treatment and no reduction in the waste load. It is estimated that the effluent from a 136 cu m (35,900 gal) per day plant is 477 cu m (0.126 MG) per day. The BOD waste load is 2.30 kg/cu m (19.2 lb/1000 gal), and the suspended solids load is 0.38 kg/cu m (3.2 lb/1000 gal).

Costs: 0
Reduction Benefits: None

Alternative A 27-II - This alternative provides a control house, flow equalization, neutralization, nutrient addition, a complete mix activated sludge system, sludge thickening, and spray irrigation of sludge.

The resulting BOD waste load is 0.24 kg/cu m (2.00 lb/1000 gal), and the suspended solids load is 0.14 kg/cu m (1.17 lb/1000 gal).

Costs: Total investment cost: \$289,990
Total yearly cost: \$ 65,980

An itemized breakdown of costs is presented in Table 331. It is assumed that land costs \$20,510 per hectare (\$8300 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 89.4 percent
SS: 63.0 percent

Alternative A 27-III - This alternative provides in addition to Alternative A 27-II dual media filtration.

The resulting BOD waste load is 0.123 kg/cu m (1.03 lb/1000 gal), and the suspended solids load is 0.07 kg/cu m (0.584 lb/1000 gal).

Costs: Total investment cost: \$313,900
Total yearly cost: \$ 72,700

An itemized breakdown of costs is presented in Table 332. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.7 percent
SS: 81.5 percent

A cost efficiency curve is presented in Figure 323.

Alternative A 27-IV - This alternative provides a control house, flow equalization, neutralization, nutrient addition, a complete-mix activated sludge system, and sludge thickening.

TABLE 331

ITEMIZED COST SUMMARY FOR ALTERNATIVE A27-II
(SOFT DRINK PLANTS EXCEPT A26)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 89.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	225690.00
2. LAND	19160.00
3. ENGINEERING	22570.00
4. CONTINGENCY	22570.00
TOTAL	289990.00

YEARLY OPERATING COSTS:

1. LABOR	18740.00
2. POWER	11580.00
3. CHEMICALS	4520.00
4. MAINTENANCE&SUPPLIES	6000.00
TOTAL	40840.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	40840.00
2. YEARLY INVESTMENT COST RECOVERY	11600.00
3. DEPRECIATION	13540.00
TOTAL	65980.00

TABLE 332

ITEMIZED COST SUMMARY FOR ALTERNATIVE A27-III
(SOFT DRINK PLANTS EXCEPT A26)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
Y...HOLDING TANK
U...SPRAY IRRIGATION
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	245620.00
2. LAND	19160.00
3. ENGINEERING	24560.00
4. CONTINGENCY	24560.00
TOTAL	313900.00

YEARLY OPERATING COSTS:

1. LABOR	18740.00
2. POWER	15830.00
3. CHEMICALS	4520.00
4. MAINTENANCE SUPPLIES	6310.00
TOTAL	45400.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	45400.00
2. YEARLY INVESTMENT COST RECOVERY	12560.00
3. DEPRECIATION	14740.00
TOTAL	72700.00

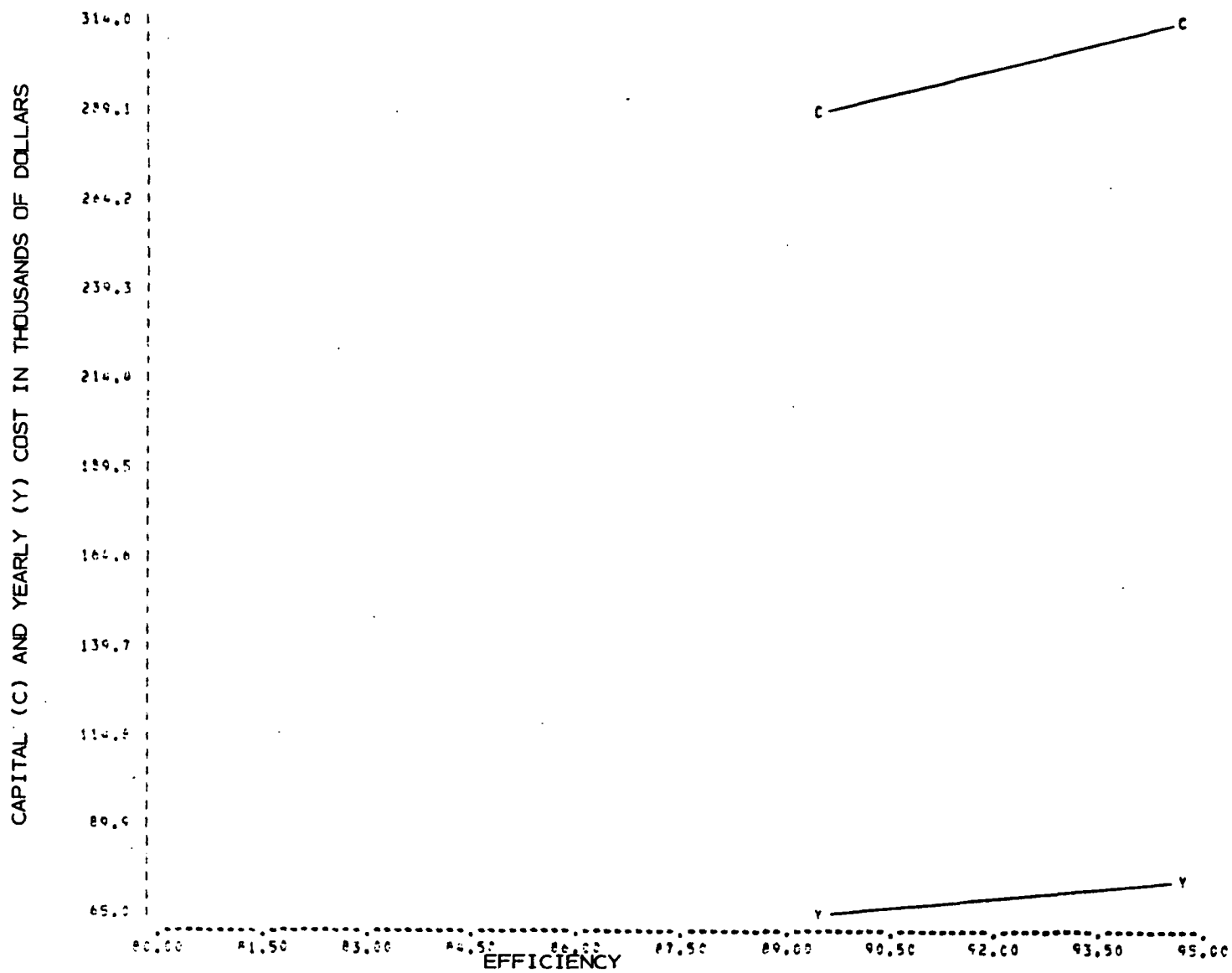


FIGURE 323

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 27, ALT. III

The resulting BOD waste load is 0.24 kg/cu m (2.00 lb/1000 gal), and the suspended solids load is 0.14 kg/cu m (1.17 lb/1000 gal).

Costs: Total investment cost: \$264,650
Total yearly cost: \$ 61,140

An itemized breakdown of costs is presented in Table 333. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 89.4 percent
SS: 63.0 percent

Alternative A 26-V - This alternative provides in addition to Alternative A 26-IV dual media filtration.

The resulting BOD waste load is 0.123 kg/cu m (1.03 lb/1000 gal), and the suspended solids load is 0.07 kg/cu m (0.584 lb/1000 gal).

Costs: Total investment cost: \$288,560
Total yearly cost: \$ 67,840

An itemized breakdown of costs is presented in Table 334. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.7 percent
SS: 81.5 percent

A cost efficiency curve is presented in Figure 324.

Alternative A 27-VI - This alternative provides flow equalization, neutralization, nutrient addition, and an aerated lagoon system.

The resulting BOD waste load is 0.24 kg/cu m (2.00 lb/1000 gal), and the suspended solids load is 0.14 kg/cu m (1.17 lb/1000 gal).

Costs: Total investment cost: \$243,870
Total yearly cost: \$ 78,820

An itemized breakdown of costs is presented in Table 335. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 89.4 percent
SS: 63.0 percent

Alternative A 27-VII - This alternative provides in addition to Alternative A 27-VI dual media filtration.

The resulting BOD waste load is 0.123 kg/cu m (1.03 lb/1000 gal), and the suspended solids load is 0.07 kg/cu m (0.584 lb/1000 gal).

TABLE 333

ITEMIZED COST SUMMARY FOR ALTERNATIVES A27-IV
(SOFT DRINK PLANTS EXCEPT A26)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 89.4 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	194160.00
2. LAND	31650.00
3. ENGINEERING	19420.00
4. CONTINGENCY	19420.00
TOTAL	264650.00

YEARLY OPERATING COSTS:

1. LABOR	18740.00
2. POWER	10740.00
3. CHEMICALS	4520.00
4. MAINTENANCE&SUPPLIES	4900.00
TOTAL	38900.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	38900.00
2. YEARLY INVESTMENT COST RECOVERY	10590.00
3. DEPRECIATION	11650.00
TOTAL	61140.00

TABLE 334

ITEMIZED COST SUMMARY FOR ALTERNATIVE A27-V
(SOFT DRINK PLANTS EXCEPT A26)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	214090.00
2. LAND	31650.00
3. ENGINEERING	21410.00
4. CONTINGENCY	21410.00
TOTAL	288560.00

YEARLY OPERATING COSTS:

1. LABOR	19740.00
2. POWER	14990.00
3. CHEMICALS	4520.00
4. MAINTENANCE&SUPPLIES	5200.00
TOTAL	43450.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	43450.00
2. YEARLY INVESTMENT COST RECOVERY	11540.00
3. DEPRECIATION	12850.00
TOTAL	67840.00

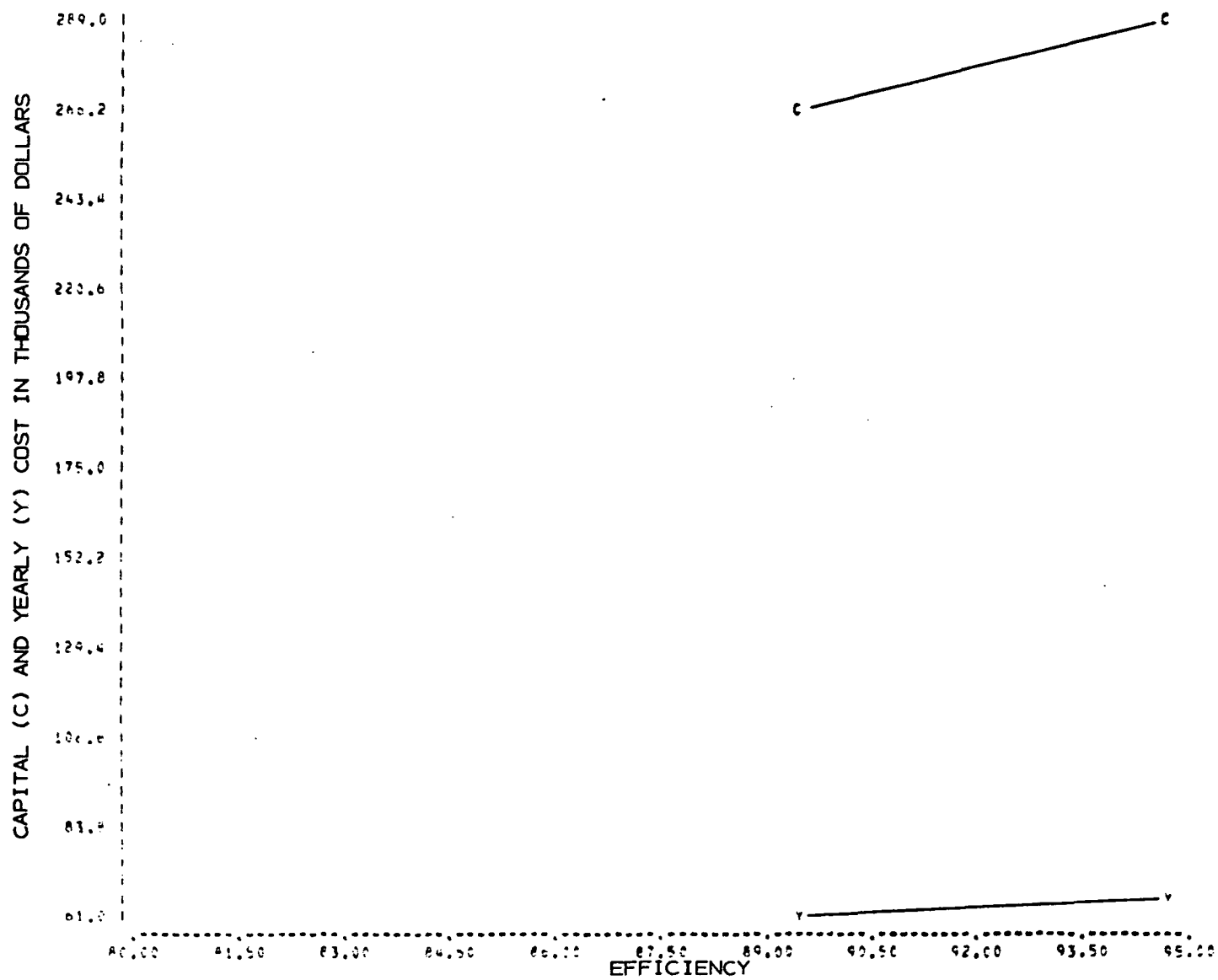


FIGURE 324

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 27, ALT. V

TABLE 335

ITEMIZED COST SUMMARY FOR ALTERNATIVE A27-VI
(SOFT DRINK PLANTS EXCEPT A26)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 89.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	195880.00
2. LAND	4160.00
3. ENGINEERING	19590.00
4. CONTINGENCY	19590.00
5. PVC LINER	4650.00
TOTAL	243870.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	34210.00
3. CHEMICALS	4520.00
4. MAINTENANCE&SUPPLIES	5540.00
5. PVC LINER	320.00
TOTAL	57080.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	57080.00
2. YEARLY INVESTMENT COST RECOVERY	9750.00
3. DEPRECIATION	11990.00
TOTAL	78820.00

Costs: Total investment cost: \$267,780
Total yearly cost: \$ 85,530

An itemized breakdown of costs is presented in Table 336. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 94.7 percent
SS: 81.5 percent

A cost efficiency curve is presented in Figure 325.

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 28 - Beverage Bases

A model plant representative of subcategory A 28 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, thirteen alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 379 cu m (0.10 M g) of beverage bases per day.

It is estimated that the effluent from a 379 cu m (0.10 M g) per day plant is 379 cu m (0.10 M g) per day. The BOD waste load is 0.24 kg/cu m (2.00 lb/1000 gal), and the suspended solids load is 0.05 kg/cu m (0.42 lb/1000 gal).

Alternative A 28-I - This alternative consists of a pumping station, a flow equalization tank, and an aerated lagoon.

The resulting BOD waste load is 0.010 kg/cu m (0.084 lb/1000 gal), and the suspended solids load is 0.003 kg/cu m (0.025 lb/1000 gal).

Costs: Total investment cost: \$290,570
Total yearly cost: \$114,720

An itemized breakdown of costs is presented in Table 337. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 95.8 percent
SS: 40.0 percent

Alternative A 28-II - This alternative consists of a pumping station, a flow equalization tank, a complete-mix activated sludge basin, a sludge thickener, an aerobic digester, and a sludge holding tank followed by land application of the digester sludge.

The resulting BOD waste load is 0.018 kg/cu m (0.084 lb/1000 gal), and the suspended solids load is 0.003 kg/cu m (0.025 lb/1000 gal).

TABLE 336

ITEMIZED COST SUMMARY FOR ALTERNATIVE A27-VII
(SOFT DRINK PLANTS EXCEPT A26)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 94.7 PERCENT BOD REDUCTION

TREATMENT MODULES:

R...PUMPING STATION
C...EQUALIZATION BASIN
F...ACID NEUTRALIZATION
H...NITROGEN ADDITION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	215810.00
2. LAND	4160.00
3. ENGINEERING	21580.00
4. CONTINGENCY	21580.00
5. PVC LINER	4650.00
TOTAL	267780.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	38460.00
3. CHEMICALS	4520.00
4. MAINTENANCE&SUPPLIES	5850.00
5. PVC LINER	320.00
TOTAL	61640.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	61640.00
2. YEARLY INVESTMENT	
COST RECOVERY	10710.00
3. DEPRECIATION	13180.00
TOTAL	85530.00

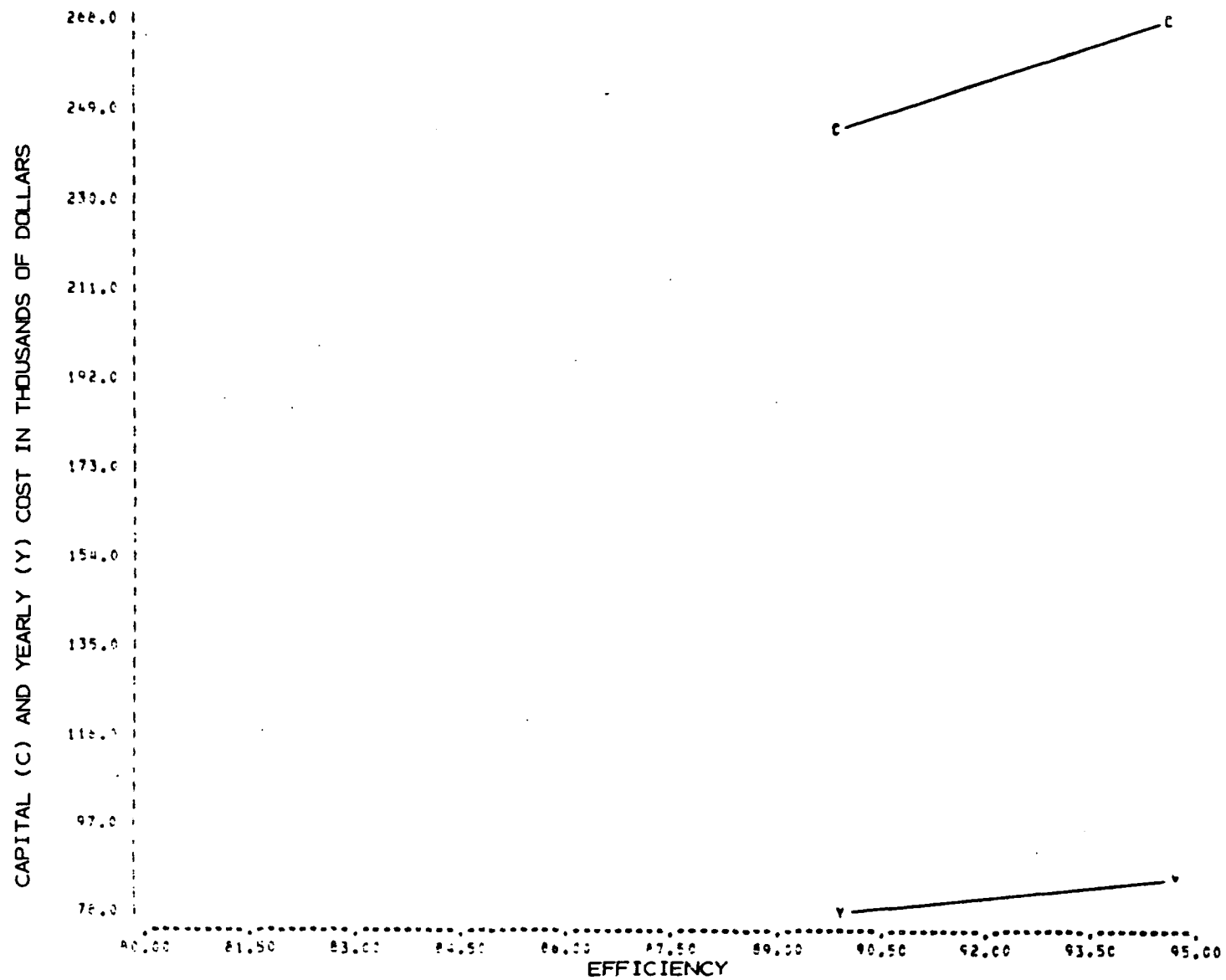


FIGURE 325

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 27, ALT. VII

TABLE 337

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-I
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY,... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	233430.00
2. LAND	4160.00
3. ENGINEERING	23340.00
4. CONTINGENCY	23340.00
5. PVC LINER	6300.00
TOTAL	290570.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	70050.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	5970.00
5. PVC LINER	270.00
TOTAL	88780.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	88780.00
2. YEARLY INVESTMENT COST RECOVERY	11620.00
3. DEPRECIATION	14320.00
TOTAL	114720.00

Costs: Total investment cost: \$720,590
Total yearly cost: \$123,020

An itemized breakdown of costs is presented in Table 338. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 95.8 percent
SS: 40.0 percent

Alternative A 28-III - This alternative replaces the land spreading of digester sludge in alternative A 29-II with vacuum filtration.

The resulting BOD waste load is 0.010 kg/cu m (0.084 lb/1000 gal), and the suspended solids load is 0.003 kg/cu m (0.025 lb/1000 gal).

Costs: Total investment cost: \$359,350
Total yearly cost: \$ 99,690

An itemized breakdown of costs is presented in Table 339. It is that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 95.8 percent
SS: 40.0 percent

Alternative A 28-IV - This alternative replaces the land spreading of digester sludge in Alternative A 29-II with sand drying beds.

The resulting BOD waste load is 0.010 kg/cu m (0.084 lb/1000 gal), and the suspended solids load is 0.003 kg/cu m (0.025 lb/1000 gal).

Costs: Total investment cost: \$545,980
Total yearly cost: \$138,320

An itemized breakdown of costs is presented in Table 340. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 95.8 percent
SS: 40.0 percent

Alternative A 28-V - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 28-I

The resulting BOD waste load is 0.005 kg/cu m (0.042 lb/1000 gal), and the suspended solids load is 0.001 kg/cu m (0.0083 lb/1000 gal).

Costs: Total investment cost: \$324,190
Total yearly cost: \$124,150

TABLE 338

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-II
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

H1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	306170.00
2. LAND	353180.00
3. ENGINEERING	30620.00
4. CONTINGENCY	30620.00
TOTAL	720590.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	27600.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	10750.00
TOTAL	75830.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	75830.00
2. YEARLY INVESTMENT COST RECOVERY	28820.00
3. DEPRECIATION	18370.00
TOTAL	123020.00

TABLE 339

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-III
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	277250.00
2. LAND	26660.00
3. ENGINEERING	27720.00
4. CONTINGENCY	27720.00
TOTAL	359350.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	21760.00
3. CHEMICALS	3060.00
4. MAINTENANCE&SUPPLIES	6390.00
TOTAL	68690.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	68690.00
2. YEARLY INVESTMENT COST RECOVERY	14370.00
3. DEPRECIATION	16630.00
TOTAL	99690.00

TABLE 340

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-IV
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.8 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	451370.00
2. LAND	4330.00
3. ENGINEERING	45140.00
4. CONTINGENCY	45140.00
TOTAL	545980.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	27600.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	24320.00
TOTAL	89400.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	89400.00
2. YEARLY INVESTMENT COST RECOVERY	21840.00
3. DEPRECIATION	27080.00
TOTAL	138320.00

An itemized breakdown of costs is presented in Table 341. It is assumed that land costs \$4100 per hectare (\$1600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 97.9 percent
SS: 80.0 percent

Alternative A 28-VI - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 28-II.

The resulting BOD waste load is 0.005 kg/cu m (0.042 lb/1000 gal), and the suspended solids load is 0.001 kg/cu m (0.0083 lb/1000 gal).

Costs: Total investment cost: \$754,210
Total yearly cost: \$132,450

An itemized breakdown of costs is presented in Table 342. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 97.9 percent
SS: 80.0 percent

Alternative A 28-VII - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 28-III.

The resulting BOD waste load is 0.005 kg/cu m (0.042 lb/1000 gal), and the suspended solids load is 0.001 kg/cu m (0.0083 lb/1000 gal).

Costs: Total investment cost: \$393,000
Total yearly cost: \$109,130

An itemized breakdown of costs is presented in Table 343. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 97.9 percent
SS: 80.0 percent

Alternative A 28-VIII - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 28-IV.

The resulting BOD waste load is 0.005 kg/cu m (0.042 lb/1000 gal), and the suspended solids load is 0.001 kg/cu m (0.0083 lb/1000 gal).

Costs: Total investment cost: \$579,610
Total yearly cost: \$147,750

An itemized breakdown of costs is presented in Table 344. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that three operators are required.

TABLE 341

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-V
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	261450.00
2. LAND	4160.00
3. ENGINEERING	26140.00
4. CONTINGENCY	26140.00
5. PVC LINER	6300.00
TOTAL	324190.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	75920.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	6500.00
5. PVC LINER	270.00
TOTAL	95180.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	95180.00
2. YEARLY INVESTMENT COST RECOVERY	12970.00
3. DEPRECIATION	16000.00
TOTAL	124150.00

TABLE 342

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-VI
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	334190.00
2. LAND	353180.00
3. ENGINEERING	33420.00
4. CONTINGENCY	33420.00
TOTAL	754210.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	33470.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	11280.00
TOTAL	82230.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	82230.00
2. YEARLY INVESTMENT COST RECOVERY	30170.00
3. DEPRECIATION	20050.00
TOTAL	132450.00

TABLE 343

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-VII
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	305280.00
2. LAND	26660.00
3. ENGINEERING	30530.00
4. CONTINGENCY	30530.00
TOTAL	393000.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	27620.00
3. CHEMICALS	3060.00
4. MAINTENANCE&SUPPLIES	6930.00
TOTAL	75090.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	75090.00
2. YEARLY INVESTMENT COST RECOVERY	15720.00
3. DEPRECIATION	18320.00
TOTAL	109130.00

TABLE 344

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-VIII
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.9 PERCENT BOD REDUCTION

TREATMENT MODULES:

R1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTER
T...SAND DRYING BEDS
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	479400.00
2. LAND	4330.00
3. ENGINEERING	47940.00
4. CONTINGENCY	47940.00
TOTAL	579610.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	33470.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	24860.00
TOTAL	95810.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	95810.00
2. YEARLY INVESTMENT	
COST RECOVERY	23180.00
3. DEPRECIATION	28760.00
TOTAL	147750.00

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Reduction Benefits: BOD: 97.9 percent
SS: 80.0 percent

Alternative A 28-IX - This alternative provides carbon adsorption in addition to the treatment modules of Alternative A 28-V.

The resulting BOD waste load is 0.0025 kg/cu m (0.021 lb/1000 gal), and the suspended solids load is 0.005 kg/cu m (0.0042 lb/1000 gal).

Costs: Total investment cost: \$406,070
Total yearly cost: \$152,030

An itemized breakdown of costs is presented in Table 345. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 98.9 percent
SS: 90.0 percent

A cost efficiency curve is presented in Figure 326.

Alternative A 28-X - This alternative provides carbon adsorption in addition to the treatment modules of Alternative A 28-VI.

The resulting BOD waste load is 0.0025 kg/cu m (0.021 lb/1000 gal), and the suspended solids load is 0.0005 kg/cu m (0.00042 lb/1000 gal).

Costs: Total investment cost: \$836,070
Total yearly cost: \$160,320

An itemized breakdown of costs is presented in Table 346. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 98.9 percent
SS: 90.0 percent

A cost efficiency curve is presented in Figure 327.

Alternative A 28-XI - This alternative provides carbon adsorption in addition to the treatment modules of Alternative A 28-VII.

The resulting BOD waste load is 0.0025 kg/cu m (0.021 lb/1000 gal), and the suspended solids load is 0.0005 kg/cu m (0.0042 lb/1000 gal).

Costs: Total investment cost: \$474,860
Total yearly cost: \$137,000

An itemized breakdown of costs is presented in Table 347. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that three operators are required.

TABLE 345

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-IX
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	329670.00
2. LAND	4160.00
3. ENGINEERING	32970.00
4. CONTINGENCY	32970.00
5. PVC LINER	6300.00
TOTAL	406070.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	79180.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	23750.00
5. PVC LINER	270.00
TOTAL	115690.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	115690.00
2. YEARLY INVESTMENT COST RECOVERY	16240.00
3. DEPRECIATION	20100.00
TOTAL	152030.00

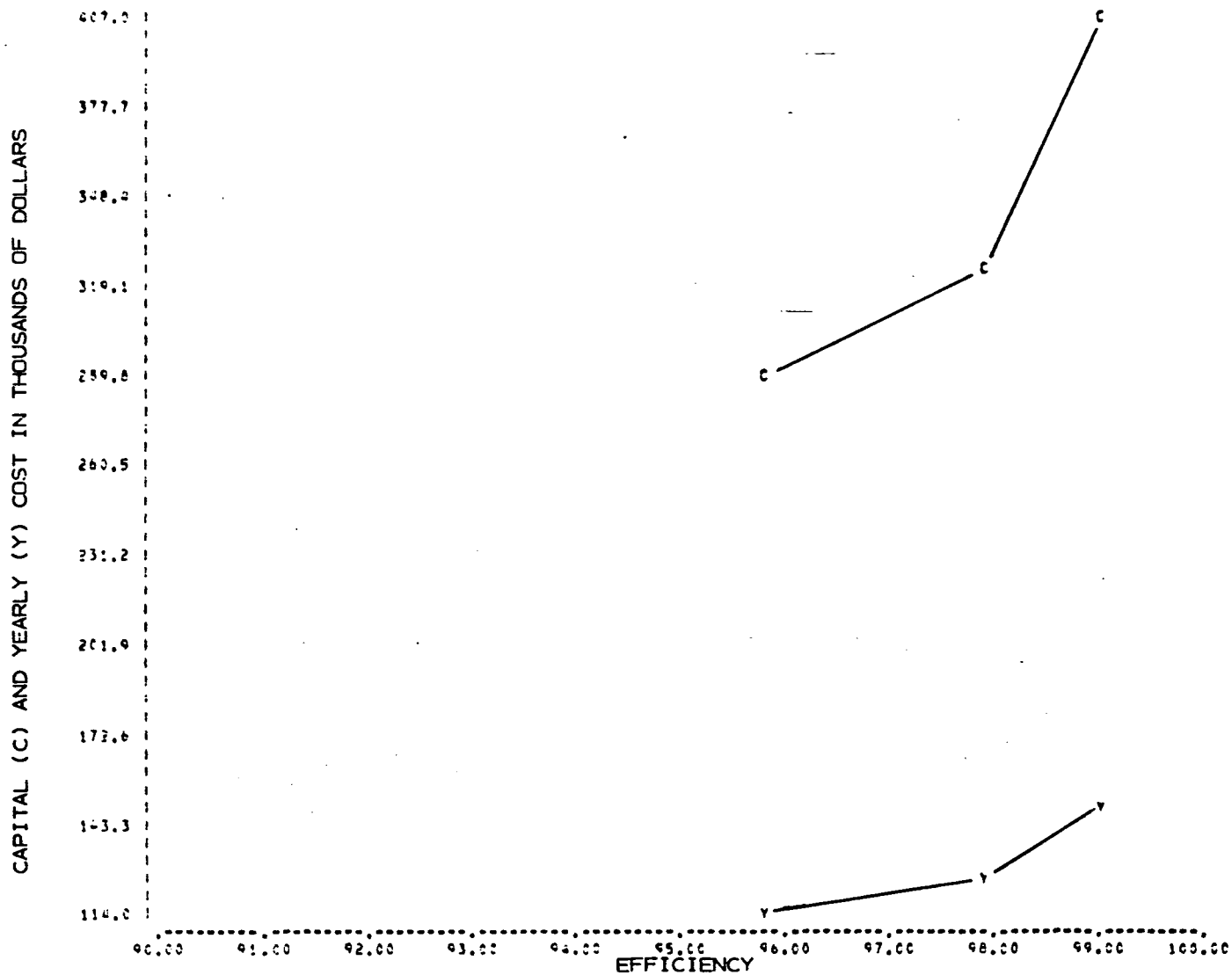


FIGURE 326

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 28, ALT. I, V, IX

TABLE 346

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-X
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY,... 99.0 PERCENT BOD REDUCTION.

TREATMENT MODULES:

B1..CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
R...AEROBIC DIGESTOR
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	402410.00
2. LAND	353180.00
3. ENGINEERING	40240.00
4. CONTINGENCY	40240.00
TOTAL	836070.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	36730.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	28530.00
TOTAL	102740.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	102740.00
2. YEARLY INVESTMENT COST RECOVERY	33440.00
3. DEPRECIATION	24140.00
TOTAL	160320.00

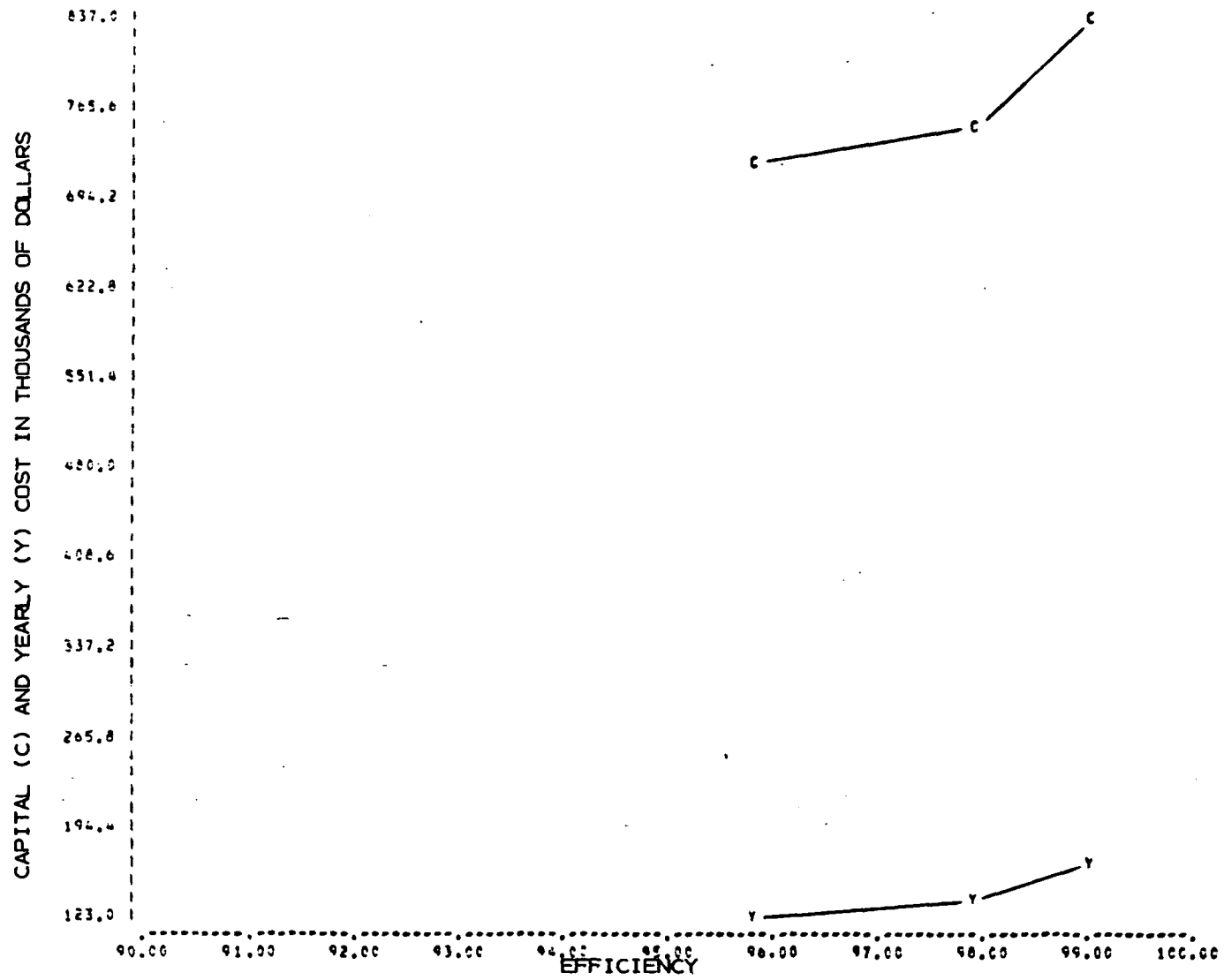


FIGURE 327

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 28, ALT. II, VI, X

TABLE 347

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-XI
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
G...SLUDGE THICKENER
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

1. CONSTRUCTION	373500.00
2. LAND	26660.00
3. ENGINEERING	37350.00
4. CONTINGENCY	37350.00
TOTAL	474860.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	30890.00
3. CHEMICALS	3060.00
4. MAINTENANCE&SUPPLIES	24170.00
TOTAL	95600.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	95600.00
2. YEARLY INVESTMENT	
COST RECOVERY	18990.00
3. DEPRECIATION	22410.00
TOTAL	137000.00

Reduction Benefits: BOD: 98.9 percent
SS: 90.0 percent

A cost efficiency curve is presented in Figure 328.

Alternative A 28-XII - This alternative provides carbon adsorption in addition to the treatment modules of Alternative A 28-VIII.

The resulting BOD waste load is 0.0025 kg/cu m (0.021 lb/1000 gal), and the suspended solids load is 0.005 kg/cu m (0.0042 lb/1000 gal).

Costs: Total investment cost: \$661,470
Total yearly cost: \$175,630

An itemized breakdown of costs is presented in Table 348. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 98.3 percent
SS: 90.0 percent

A cost efficiency curve is presented in Figure 329.

Alternative A 28-XIII - This alternative consists of a pumping station, a flow equalization tank, and spray irrigation of the raw waste effluent.

The resulting BOD waste load is 0.0 kg/cu m (0.0 lb/1000 gal), and the suspended solids load is 0.0 kg/cu m (0.0 lb/1000 gal).

Costs: Total investment cost: \$192,790
Total yearly cost: \$ 27,360

An itemized breakdown of costs is presented in Table 349. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one-half time operator is required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory A 30 - Instant Tea

A model plant representative of subcategory A 30 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, eight alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which produces 9.1 kkg (10 ton) of soluble "instant" tea per day.

Alternative A 30-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 9.1 l1g (10 ton) per day plant is 454 cu m (0.12 MG) per day. The BOD waste

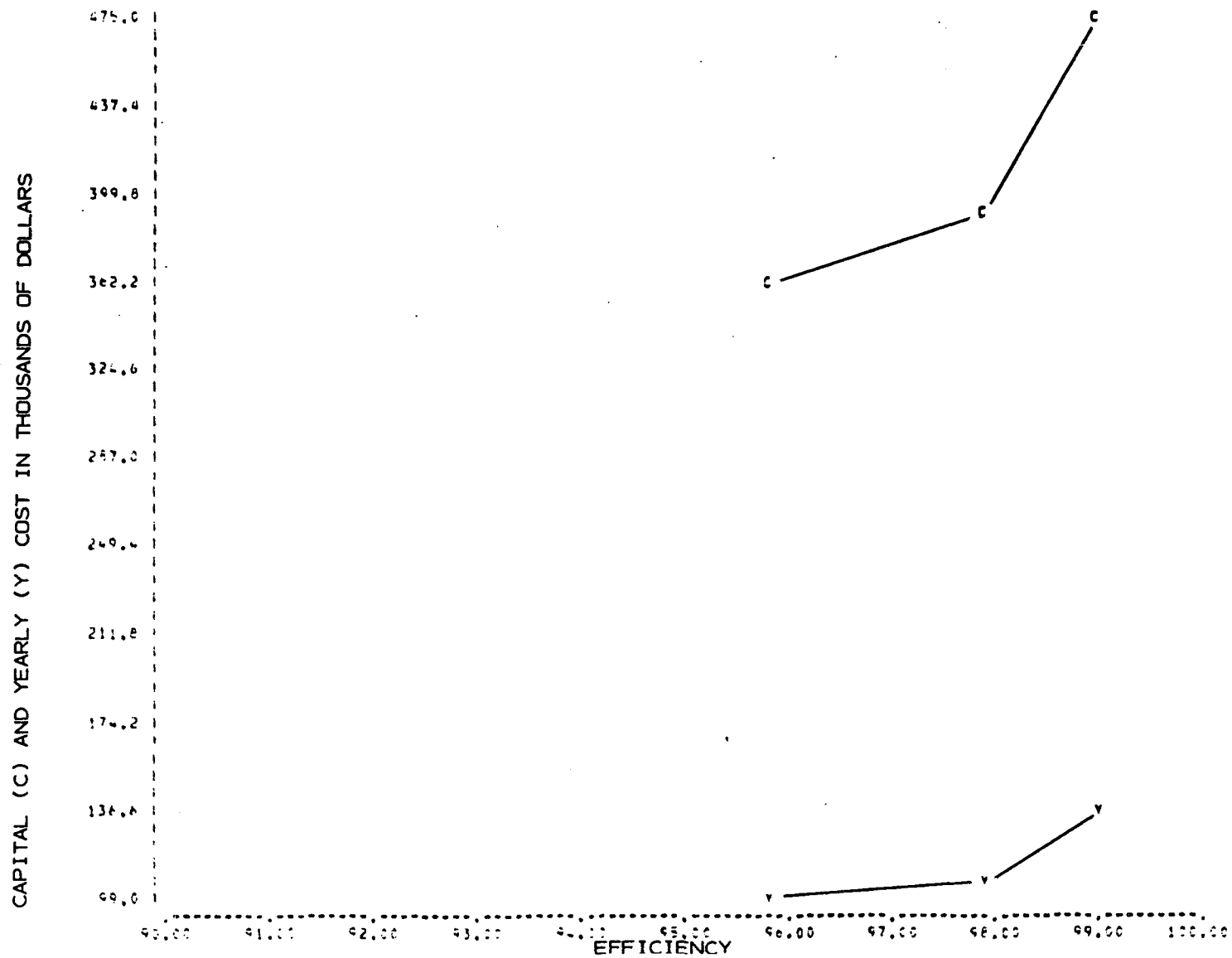


FIGURE 328

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 28, ALT. III, VI, XI

TABLE 348

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-XII
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 99.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
Y...HOLDING TANK
R...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION
Z...ACTIVATED CARBON ADSORPTION

INVESTMENT COSTS:

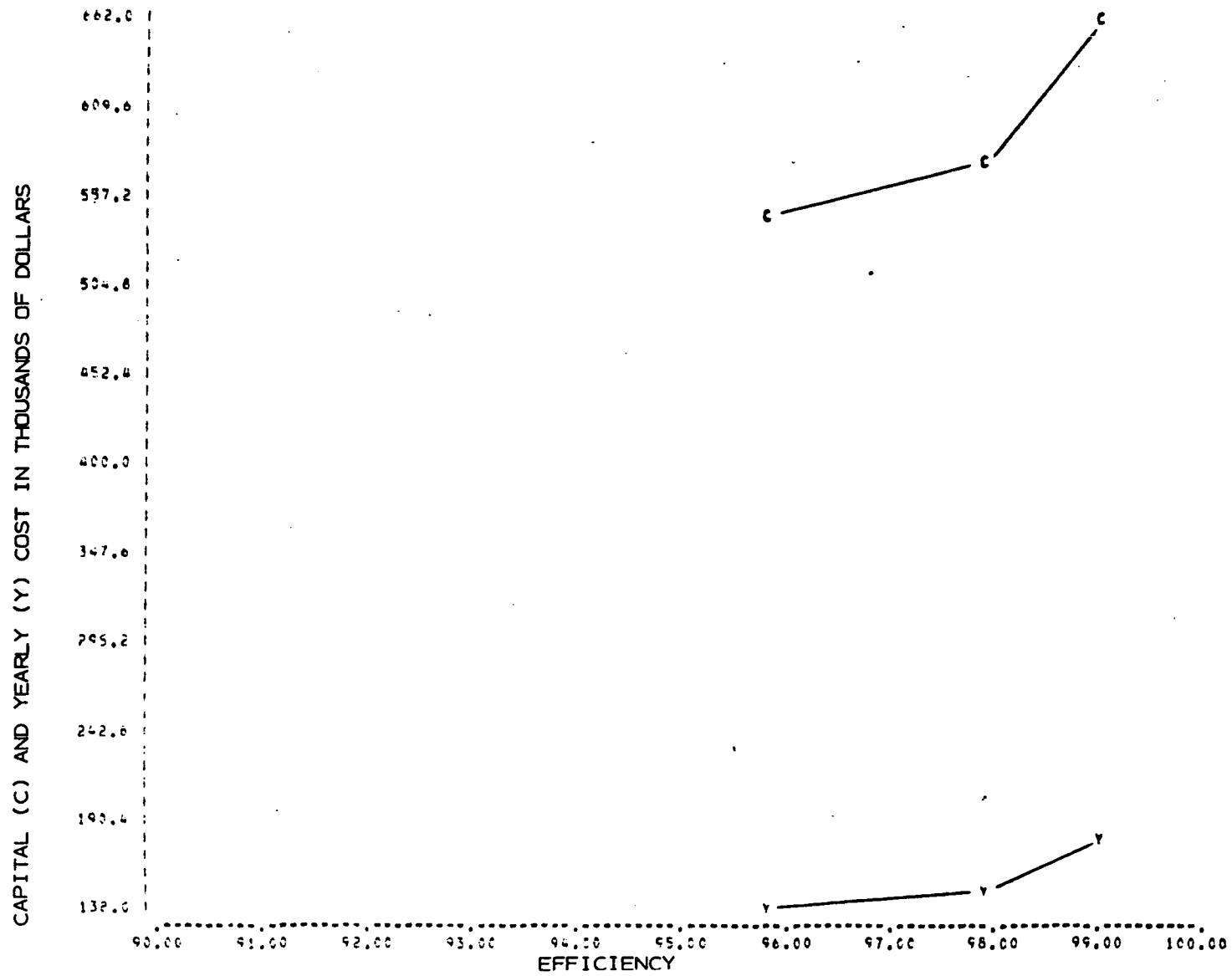
1. CONSTRUCTION	547620.00
2. LAND	4330.00
3. ENGINEERING	54760.00
4. CONTINGENCY	54760.00
TOTAL	661470.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	36730.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	42100.00
TOTAL	116310.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	116310.00
2. YEARLY INVESTMENT COST RECOVERY	26460.00
3. DEPRECIATION	32860.00
TOTAL	175630.00



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FIGURE 329

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 28, ALT. IV, VIII, XII

TABLE 349

ITEMIZED COST SUMMARY FOR ALTERNATIVE A28-XIII
(BEVERAGE BASE SYRUP)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK

U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	132890.00
2. LAND	33320.00
3. ENGINEERING	13290.00
4. CONTINGENCY	13290.00
TOTAL	192790.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	1620.00
3. CHEMICALS	0.0
4. MAINTENANCE & SUPPLIES	3810.00
TOTAL	11680.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	11680.00
2. YEARLY INVESTMENT COST RECOVERY	7710.00
3. DEPRECIATION	7970.00
TOTAL	27360.00

DRAFT

load is 50.0 kg/kkg (100.0 lb/ton), and the suspended solids load is 37.5 kg/kkg (75.0 lb/ton).

Alternative A 30-II - This alternative consists of a pumping station, a flow equalization tank, primary clarification, a complete-mix activated sludge basin, sludge thickening, aerobic digestion and vacuum filtration.

The resulting BOD waste load is 2.00 kg/kkg (4.0 lb/ton), and the suspended solids load is 5.50 kg/kkg (11.0 lb/ton).

Costs: Total investment cost: \$358,430
Total yearly cost: \$ 97,010

An itemized breakdown of costs is presented in Table 350. It is that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 96.0 percent
SS: 85.3 percent

Alternative A 30-III - This alternative replaces the vacuum filtration module of alternative A 30-II with sand drying beds.

The resulting BOD waste load is 2.00 kg/kkg (4.00 lb/ton) and the suspended solids load is 5.5 kg/kkg (11.0 lb/ton).

Cost: Total investment cost: \$402,290
Total yearly cost: \$103,830

An itemized breakdown of costs is presented in Table 351. It is that land costs \$20,510 per hectare (\$8,330 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 96.0 percent
SS: 85.3 percent

Alternative A 30-IV - This alternative consists of a pumping station, a flow equalization tank and aerated lagoon.

The resulting BOD waste load is 2.0 kg/kkg (4.0 lb/ton) and the suspended solids load is 5.5 kg/kkg (11.0 lb/ton).

Costs: Total investment cost: \$359,080
Total yearly cost: \$140,200

An itemized breakdown of costs is presented in Table 352. It is that land costs \$4,100 per hectare (\$1,660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 96.0 percent
SS: 85.3 percent

TABLE 350

ITEMIZED COST SUMMARY FOR ALTERNATIVE A30-II
(INSTANT TEA)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 E...CLARIFIER
 K...ACTIVATED SLUDGE
 G...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 S...VACUUM FILTRATION
 Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	273700.00.
2. LAND	29990.00
3. ENGINEERING	27370.00
4. CONTINGENCY	27370.00
TOTAL	358430.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	18990.00
3. CHEMICALS	2670.00
4. MAINTENANCE&SUPPLIES	7110.00
TOTAL	66250.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	66250.00
2. YEARLY INVESTMENT COST RECOVERY	14340.00
3. DEPRECIATION	16420.00
TOTAL	97010.00

TABLE 351

ITEMIZED COST SUMMARY FOR ALTERNATIVE A30-III
(INSTANT TEA)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
C...EQUALIZATION BASIN
E...CLARIFIER
K...ACTIVATED SLUDGE
Q...SLUDGE THICKENER
R...AEROBIC DIGESTOR
T...SAND DRYING BEDS
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	318580.00
2. LAND	19990.00
3. ENGINEERING	31860.00
4. CONTINGENCY	31860.00
TOTAL	402290.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	16630.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	14520.00
TOTAL	68630.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	68630.00
2. YEARLY INVESTMENT COST RECOVERY	16090.00
3. DEPRECIATION	19110.00
TOTAL	103830.00

TABLE 352

ITEMIZED COST SUMMARY FOR ALTERNATIVE A30-IV
(INSTANT TEA)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
L...AERATED LAGOON

INVESTMENT COSTS:

1. CONSTRUCTION	288570.00
2. LAND	4660.00
3. ENGINEERING	28860.00
4. CONTINGENCY	28860.00
5. PVC LINER	8130.00
TOTAL	359080.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	87140.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	8180.00
5. PVC LINER	310.00
TOTAL	108120.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	108120.00
2. YEARLY INVESTMENT	
COST RECOVERY	14360.00
3. DEPRECIATION	17720.00
TOTAL	140200.00

Alternative A 30-V - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 30-II.

The resulting BOD waste load is 1.0 kg/kkg (2.0 lb/ton), and the suspended solids load is 1.0 kg/kkg (2.0 lb/ton).

Costs: Total investment cost: \$382,030
Total yearly cost: \$103,680

An itemized breakdown of costs is presented in Table 353. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one operator is required.

Reduction Benefits: BOD: 98.0 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 330.

Alternative A 30-VI - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 30-III.

The resulting BOD waste load is 1.0 kg/kkg (2.0 lb/ton).

Costs: Total investment cost: \$463,070
Total yearly cost: \$120,500

An itemized breakdown of costs is presented in Table 354. It is assumed that land costs \$20,510 per hectare (\$8330 per acre). It is further assumed that three operators are required.

Reduction Benefits: BOD: 98.0 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 331.

Alternative A 30-VII - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 30-IV.

The resulting BOD waste load is 1.0 kg/kkg (2.0 lb/ton), and the suspended solids load is 1.0 kg/kkg (2.0 lb/ton).

Costs: Total investment cost: \$424,650
Total yearly cost: \$148,560

An itemized breakdown of costs is presented in Table 355. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 98.0 percent
SS: 97.3 percent

A cost efficiency curve is presented in Figure 332.

TABLE 353

ITEMIZED COST SUMMARY FOR ALTERNATIVE A30 -V
(INSTANT TEA)ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 E...CLARIFIER
 K...ACTIVATED SLUDGE
 Q...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 S...VACUUM FILTRATION
 Y...HOLDING TANK
 B...PUMPING STATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	293360.00
2.	LAND	29990.00
3.	ENGINEERING	29340.00
4.	CONTINGENCY	29340.00
	TOTAL	382030.00

YEARLY OPERATING COSTS:

1.	LABOR	37480.00
2.	POWER	23240.00
3.	CHEMICALS	2670.00
4.	MAINTENANCE&SUPPLIES	7410.00
	TOTAL	70800.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	70800.00
2.	YEARLY INVESTMENT COST RECOVERY	15280.00
3.	DEPRECIATION	17600.00
	TOTAL	103680.00

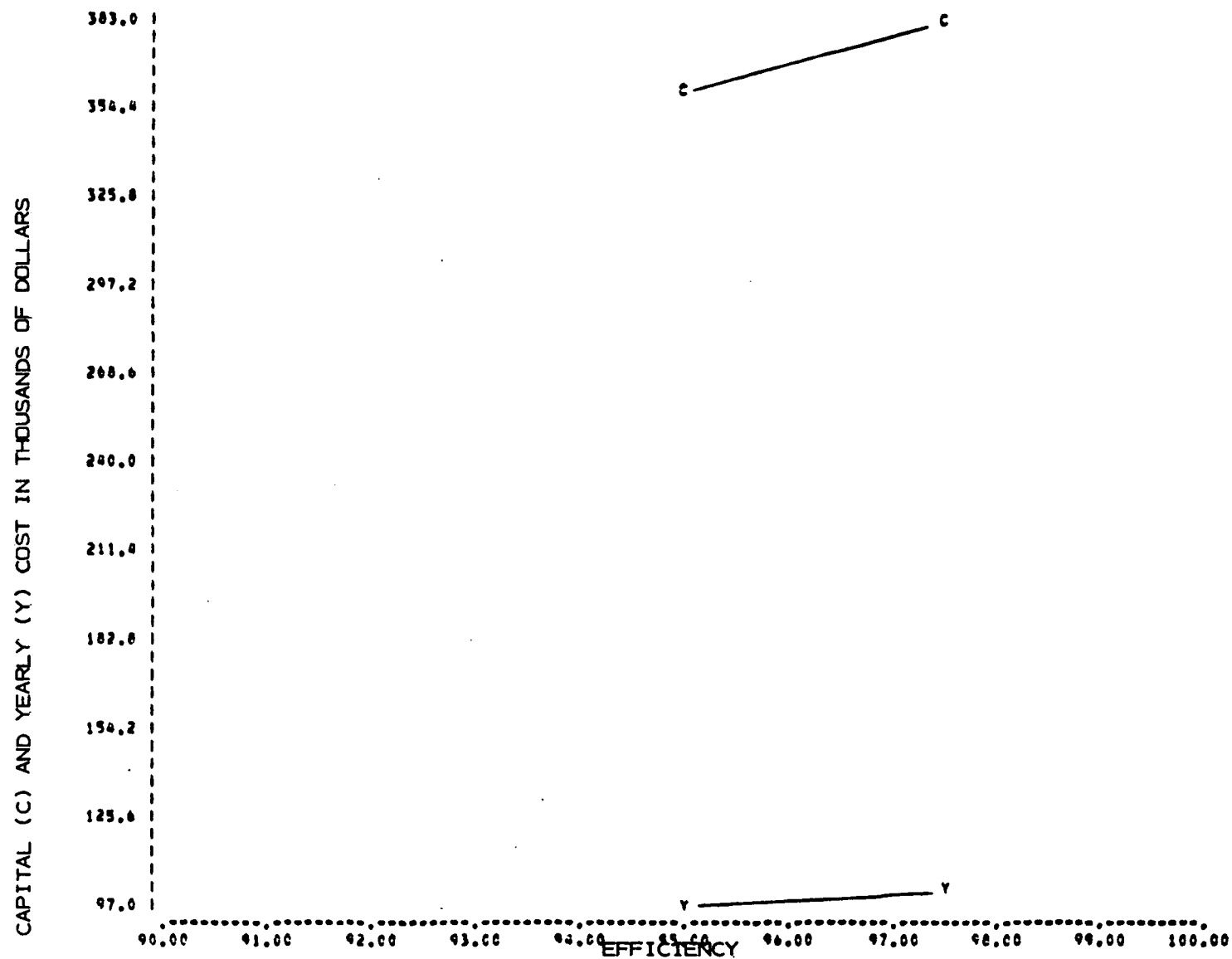


FIGURE 330

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 30, ALT. II, V

TABLE 354

**ITEMIZED COST SUMMARY FOR ALTERNATIVE A30-VI
(INSTANT TEA)**

**ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION**

TREATMENT MODULES:

B1...CONTROL HOUSE
 B...PUMPING STATION
 C...EQUALIZATION BASIN
 E...CLARIFIER
 K...ACTIVATED SLUDGE
 Q...SLUDGE THICKENER
 R...AEROBIC DIGESTOR
 T...SAND DRYING BEDS
 Y...HOLDING TANK
 B...PUMPING STATION
 N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1. CONSTRUCTION	338240.00
2. LAND	19990.00
3. ENGINEERING	33820.00
4. CONTINGENCY	33820.00
TOTAL	425870.00

YEARLY OPERATING COSTS:

1. LABOR	37480.00
2. POWER	20880.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	14820.00
TOTAL	73180.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	73180.00
2. YEARLY INVESTMENT COST RECOVERY	17030.00
3. DEPRECIATION	20290.00
TOTAL	110500.00

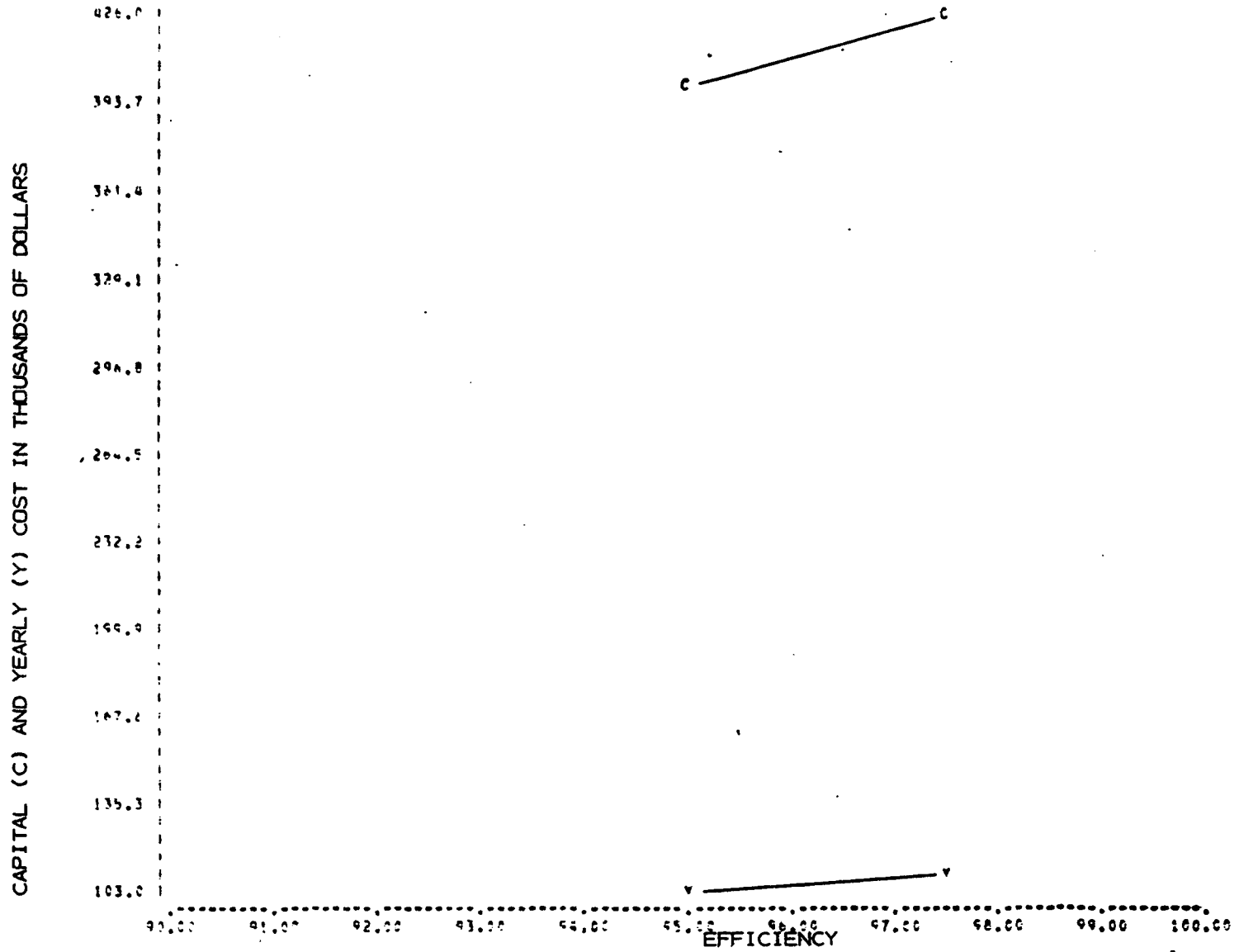


FIGURE 331

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 30, ALT. 30 III, VI

TABLE 355

ITEMIZED COST SUMMARY FOR ALTERNATIVE A30-VII
(INSTANT TEA)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 97.5 PERCENT BOD REDUCTION

TREATMENT MODULES:

B...PUMPING STATION
C...EQUALIZATION BASIN
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	308230.00
2. LAND	46650.00
3. ENGINEERING	30820.00
4. CONTINGENCY	30820.00
5. PVC LINER	8130.00
TOTAL	424650.00

YEARLY OPERATING COSTS:

1. LABOR	12490.00
2. POWER	91390.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	8480.00
5. PVC LINER	310.00
TOTAL	112670.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	112670.00
2. YEARLY INVESTMENT	
COST RECOVERY	16990.00
3. DEPRECIATION	18900.00
TOTAL	148560.00

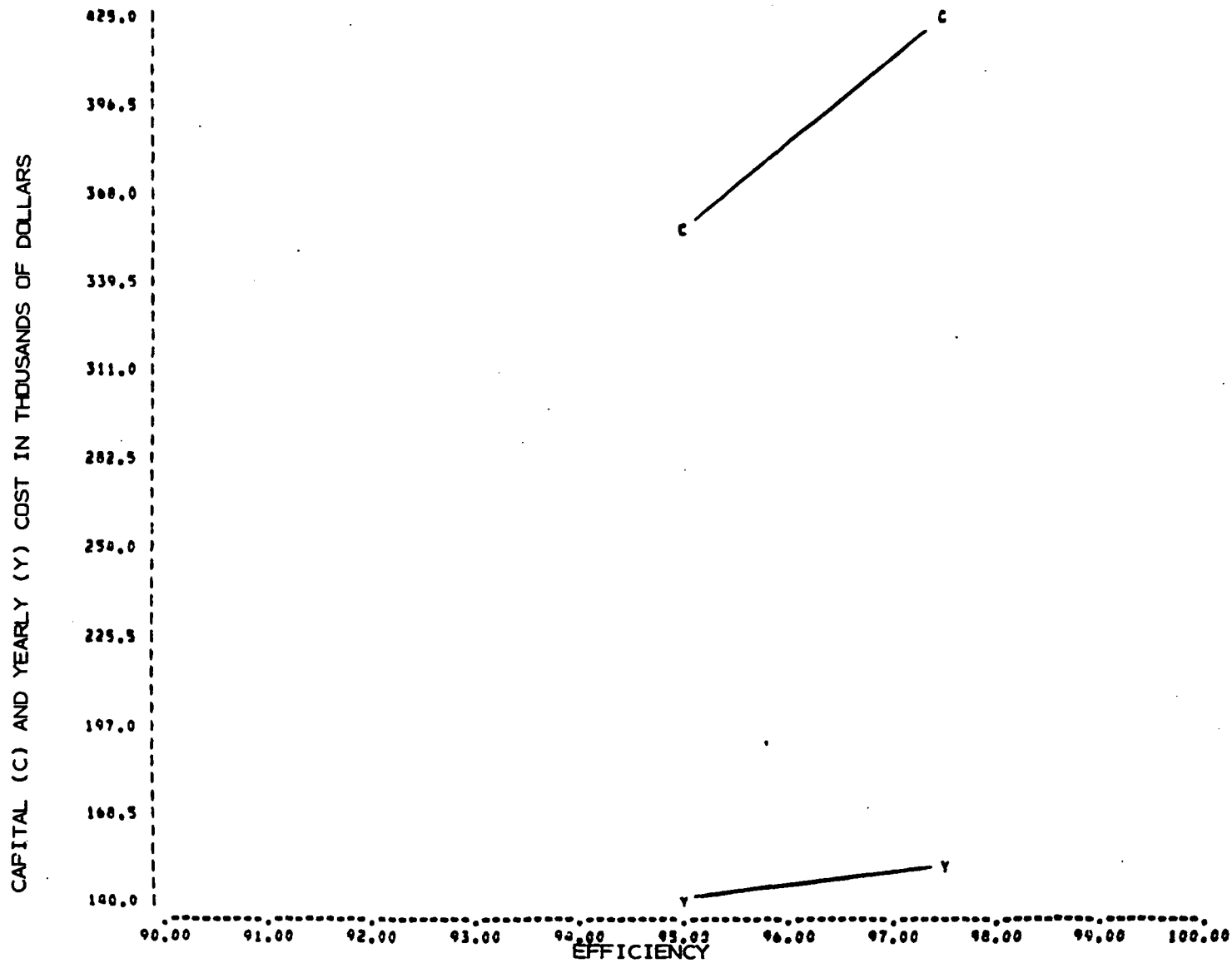


FIGURE 332

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY A 30, ALT. A 30 IV

Alternative A 30-VIII - This alternative provides dual media filtration in addition to the treatment modules of Alternative A 30-IV.

The resulting BOD waste load is 1.0 kg/kkg (2.0 lb/ton).

Costs: Total investment cost: \$223,650
Total yearly cost: \$ 30,250

An itemized breakdown of costs is presented in Table 356. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that one half-time operator is required.

Reduction Benefits: BOD: 100 percent
SS: 100 percent

Cost and Reduction Benefits of Alternative Treatment Technologies for Subcategory C 8 - Coffee Roasting with Wet Scrubbers

A model plant representative of Subcategory C 8 was developed in Section V for the purpose of applying control and treatment alternatives. In Section VII, four alternatives were selected as being applicable engineering alternatives. These alternatives provide for various levels of waste reductions for the model plant which consumes 60 kkg (65 ton) of coffee beans per day.

Alternative C 8-I - This alternative assumes no treatment and no reduction in the waste load. It is estimated that the effluent from a 60 kkg (65 ton) per day plant is 64.3 cu m/day (0.017 MGD). The BOD concentration is 350 mg/l, and the suspended solids concentration is 200 mg/l.

Costs: 0
Reduction Benefits: None

Alternative C 8-II - This alternative consists of a pumping station, caustic neutralization, a primary clarifier, an activated sludge system, sludge thickening, vacuum filtration, and sludge storage and hauling. A control house is provided.

The resulting BOD waste load is 0.038 kg/kkg (0.076 lb/ton), and the suspended solids load is 0.066 kg/kkg (0.13 lb/ton).

Costs: Total investment cost: \$181,710
Total yearly cost: \$ 78,600

An itemized breakdown of costs is presented in Table 357. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 90 percent
SS: 70 percent

TABLE 356

ITEMIZED COST SUMMARY FOR ALTERNATIVE A30-VIII
(INSTANT TEA)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...100.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

Y...HOLDING TANK
U...SPRAY IRRIGATION

INVESTMENT COSTS:

1. CONSTRUCTION	150420.00
2. LAND	43150.00
3. ENGINEERING	15040.00
4. CONTINGENCY	15040.00
TOTAL	223650.00

YEARLY OPERATING COSTS:

1. LABOR	6250.00
2. POWER	1840.00
3. CHEMICALS	0.0
4. MAINTENANCE&SUPPLIES	4190.00
TOTAL	12280.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	12280.00
2. YEARLY INVESTMENT COST RECOVERY	8950.00
3. DEPRECIATION	9020.00
TOTAL	30250.00

TABLE 357

ITEMIZED COST SUMMARY FOR ALTERNATIVE C8-II
(COFFEE ROASTING WITH WET SCRUBBERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...90.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
G...CAUSTIC NEUTRALIZATION
E...CLARIFIER
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
S...VACUUM FILTRATION
Y...HOLDING TANK

INVESTMENT COSTS:

1. CONSTRUCTION	129210.00
2. LAND	26660.00
3. ENGINEERING	12920.00
4. CONTINGENCY	12920.00
TOTAL	181710.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	5200.00
3. CHEMICALS	16880.00
4. MAINTENANCE&SUPPLIES	16510.00
TOTAL	63580.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	63580.00
2. YEARLY INVESTMENT COST RECOVERY	7270.00
3. DEPRECIATION	7750.00
TOTAL	78600.00

Alternative C 8-III - This alternative consists of Alternative C 8-II with the addition of dual media filtration.

The resulting BOD waste load is 0.019 kg/kkg (0.038 lb/ton), and the suspended solids load is 0.018 kg/kkg (0.035 lb/ton).

Costs: Total investment cost: \$207,430
Total yearly cost: \$ 85,260

An itemized breakdown of costs is presented in Table 358. It is assumed that land costs \$41,000 per hectare (\$16,600 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 95 percent
SS: 92 percent

A cost efficiency curve is presented in Figure 333.

Alternative C 8-IV - This alternative consists of a pumping station, caustic neutralization, nutrient addition, and aerated lagoons.

The resulting BOD waste load is 0.038 kg/kkg (0.076 lb/ton), and the suspended solids load is 0.11 kg/kkg (0.22 lb/ton).

Costs: Total investment cost: \$218,760
Total yearly cost: \$ 67,090

An itemized breakdown of costs is presented in Table 359. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 90 percent
SS: 50 percent

Alternative C 8-V - This alternative consists of Alternative C 8-IV with the addition of dual media filtration.

The resulting BOD waste load is 0.019 kg/kkg (0.038 lb/ton), and the suspended solids load is 0.031 kg/kkg (0.062 lb/ton).

Costs: Total investment cost: \$244,470
Total yearly cost: \$ 73,750

An itemized breakdown of costs is presented in Table 360. It is assumed that land costs \$4100 per hectare (\$1660 per acre). It is further assumed that two operators are required.

Reduction Benefits: BOD: 95 percent
SS: 86 percent

A cost efficiency curve is presented in Figure 334.

TABLE 358

ITEMIZED COST SUMMARY FOR ALTERNATIVE C8-III
(COFFEE ROASTING WITH WET SCRUBBERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY...95.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION
G...CAUSTIC NEUTRALIZATION
E...CLARIFIER
H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
K...ACTIVATED SLUDGE
S...VACUUM FILTRATION
Y...HOLDING TANK
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRAIN

INVESTMENT COSTS:

1. CONSTRUCTION	150650.00
2. LAND	26660.00
3. ENGINEERING	15060.00
4. CONTINGENCY	15060.00
TOTAL	207430.00

YEARLY OPERATING COSTS:

1. LABOR	24990.00
2. POWER	7530.00
3. CHEMICALS	16880.00
4. MAINTENANCE&SUPPLIES	18520.00
TOTAL	67920.00

TOTAL YEARLY COSTS:

1. YEARLY OPERATING COST	67920.00
2. YEARLY INVESTMENT COST RECOVERY	8300.00
3. DEPRECIATION	9040.00
TOTAL	85260.00

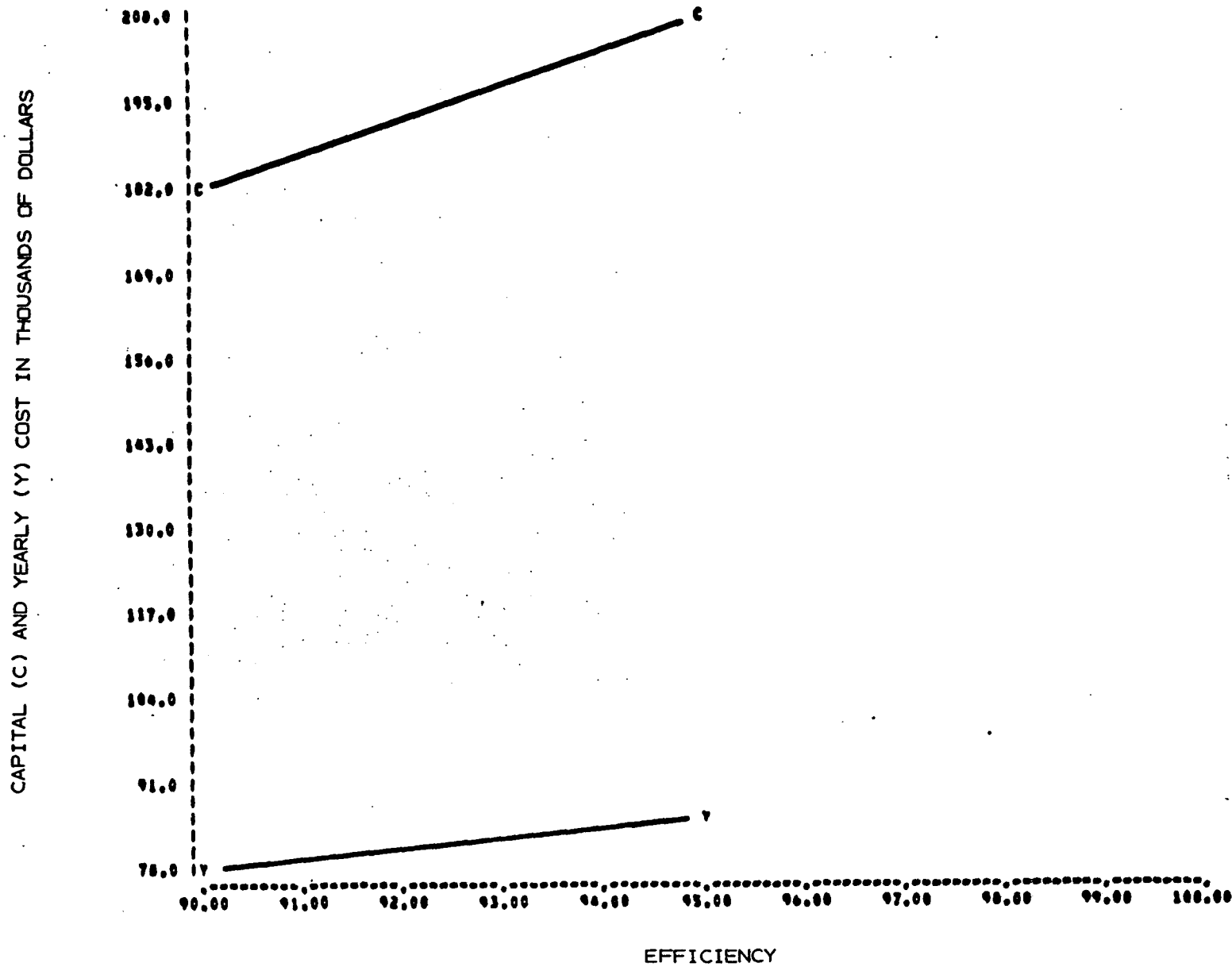


FIGURE 333

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY C8, ALT. III

TABLE 359

ITEMIZED COST SUMMARY FOR ALTERNATIVE C8-IV
(COFFEE ROASTING WITH WET SCRUBBERS)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 90.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION

H...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON

INVESTMENT COSTS:

1.	CONSTRUCTION	154980.00
2.	LAND	28320.00
3.	ENGINEERING	15500.00
4.	CONTINGENCY	15500.00
5.	PVC LINER	4460.00
	TOTAL	218760.00

YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	2210.00
3.	CHEMICALS	15140.00
4.	MAINTENANCE&SUPPLIES	6210.00
5.	PVC LINER	270.00
	TOTAL	48820.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	48820.00
2.	YEARLY INVESTMENT COST RECOVERY	8750.00
3.	DEPRECIATION	9520.00
	TOTAL	67090.00

TABLE 360

ITEMIZED COST SUMMARY FOR ALTERNATIVE C8-V
(EGG PROCESSING)

ITEMIZED COST SUMMARY FOR WASTEWATER TREATMENT CHAIN
DESIGN EFFICIENCY... 95.0 PERCENT BOD REDUCTION

TREATMENT MODULES:

B1...CONTROL HOUSE
B...PUMPING STATION

M...NITROGEN ADDITION
I...PHOSPHORUS ADDITION
L...AERATED LAGOON
B...PUMPING STATION
N...DUAL MEDIA PRESSURE FILTRATION

INVESTMENT COSTS:

1.	CONSTRUCTION	176410.00
2.	LAND	28320.00
3.	ENGINEERING	17640.00
4.	CONTINGENCY	17640.00
5.	PVC LINER	4460.00
	TOTAL	244470.00

YEARLY OPERATING COSTS:

1.	LABOR	24990.00
2.	POWER	4540.00
3.	CHEMICALS	15140.00
4.	MAINTENANCE&SUPPLIES	8220.00
5.	PVC LINER	270.00
	TOTAL	53160.00

TOTAL YEARLY COSTS:

1.	YEARLY OPERATING COST	53160.00
2.	YEARLY INVESTMENT COST RECOVERY	9780.00
3.	DEPRECIATION	10810.00
	TOTAL	73750.00

CAPITAL (C) AND YEARLY (Y) COST IN THOUSANDS OF DOLLARS

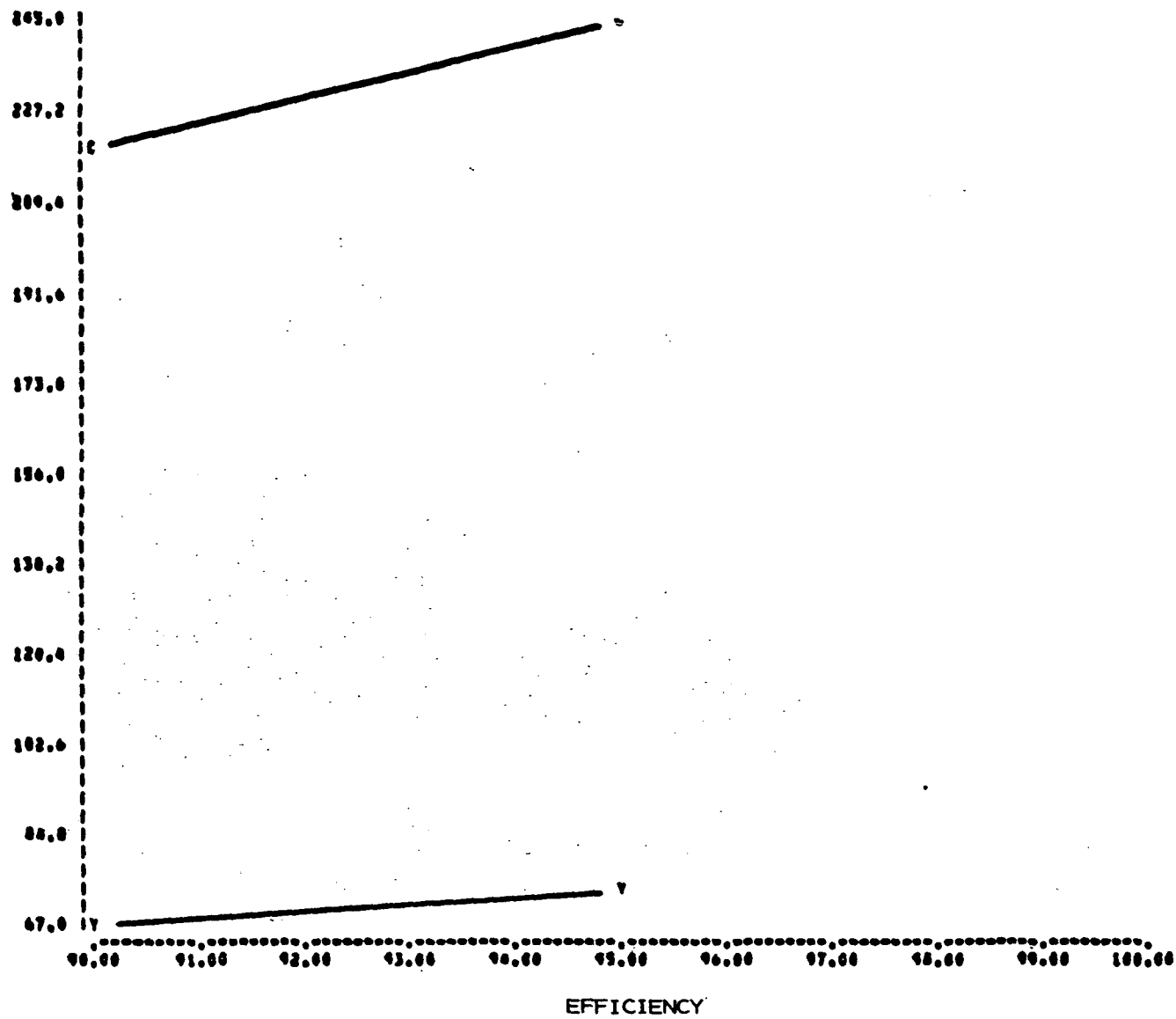


FIGURE 334

INVESTMENT AND YEARLY COSTS FOR SUBCATEGORY C8, ALT. V