ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT

EPA-330/2-78-004

Engineering Evaluation
Water and Air Compliance
Honokaa Sugar Company
Honokaa, Hawaii Sugar Cane Mill

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
DENVER, COLORADO
AND
REGION IX, SAN FRANCISCO

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Environmental Protection Agency
Office of Enforcement
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ENGINEERING EVALUATION
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HONOKAA SUGAR COMPANY
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I. INTRODUCTION

The Honokaa Sugar Company cane factory is located approximately 40 miles north of Hilo, Hawaii, on the Hilo-Hamakua Coast of the Big Island of Hawaii. In August 1977, EPA Region IX requested assistance of NEIC-Denver in support of an enforcement action against the Honokaa Sugar Company. The Company stated on June 27, 1977 that during periods of prolonged wet weather, the treatment system was underdesigned but additional equipment has been ordered which should be operational in March 1978. Honokaa Sugar Company was scheduled to comply with NPDES final limitations on July 1, 1976. The Discharge Monitoring Reports submitted by the Company show Total Suspended Solids (TSS) excesses for the months of October and November, 1976 and March through May, 1977. Settleable solids limits have been violated continuously during the months of July through November 1976 and March through June 1977.

NEIC-Denver met with the Region IX Enforcement Division staff on September 23, 1977, in San Francisco including Messrs. Harlan Agnew, Robert Wills, Greg Fischer and Terry Brubaker. NEIC was asked to investigate the Honokaa Sugar Company situation with special emphasis upon: 1) corroborative evidence on the nature of documented air and water violations; 2) thorough evaluation of the Honokaa treatment systems, current operation and maintenance practices, and conditions corresponding to design treatment criteria; and 3) determine if possible, additional equipment necessary to achieve compliance and the time required for installation.

The Honokaa field evaluation was made by Mr. E. J. Struzeski over the period of October 24 through October 31, 1977. Field support was provided by Mr. Greg Fischer during October 24-27 and Mr. William Sonnet of the Effluent Guidelines Division, EPA Headquarters over October 24-28.

EPA met with the Honokaa Sugar Company in Hawaii on October 24, 27 and 29, 1977. Contacts were also made at other times. Information contained in this report was obtained from EPA Region IX files, Honokaa Sugar Company officials, and supplemental data sources including the Dorr Oliver Company of Stamford, Connecticut, published papers, etc. In-depth discussions were held with Honokaa Sugar Company including Mr. P. Ernest Bouvet, Vice President and General Manager; Mr. Jean-Paul Merle, Boiling House Superintendent; and Mr. John Bersch, Technical Director, Sugar Engineering and Special Consultant with Theo H. Davies and Company, Ltd., Honolulu. Laupahoehoe Sugar Co. personnel attended a meeting on October 27, 1977, held at the Honokaa facilities which included Mr. Gordon Trenholme, Environmental Coordinator and Mr. Tim Bennett, Associate Engineer from Laupahoehoe Sugar.

In February 1975, NEIC-Denver together with Region IX and the State of Hawaii conducted a reconnaissance inspection of the Honokaa Sugar Company. This was followed by a compliance monitoring survey in May 1975 and a report giving an evaluation of the 1975 findings.* The October 1977 activity represents an extension of the earlier investigation.

* *"Report on Compliance Monitoring at the Honokaa Sugar Company, Honokaa, Hawaii, Hawaii," EPA, National Field Investigations Center, Denver, Colorado, September 4, 1975.*

II. SUMMARY AND CONCLUSIONS

1. Estimates of soil loads entering the Honokaa WWTP were developed in 1973 by Mr. John Bersch of Theo Davies and Company, Ltd. These values were used by Region IX in developing the NPDES permit. It now appears that soil loadings in the Bersch analysis were expressed as WET rather than DRY weights as had been originally believed. The Bersch analysis also assumed substantial implementation of Toft harvesters which would give a cleaner cane coming into the Honokaa factory. (However, the concept of Toft harvesting appears now to have been minimized by the Company). Consequently, the Honokaa WWTP was likely designed on the basis of around 250 TPD dry solids. Wet weather loads have since been shown to reach up to 600 TPD dry solids. Mr. Jean-Paul Merle of Honokaa Sugar in a November 1976 paper stated that solids loads as high as 544 TPD dry solids are entering the hydro-separator compared to the 250 TPD dry solids that had been predicted in 1973-1974. Based upon these factors, the Honokaa WWTP is significantly underdesigned.

2. The John Bersch analysis and the NPDES permit for Honokaa were developed on the basis that 33 to 50% of all cane would be harvested by Toft means. Minimizing the Toft concept has placed a greater waste load upon the Honokaa WWTP. The Company did not inform the EPA and the State of the consequences of this change. Further, no provisions were made to compensate for waste load increases caused by non-implementation of the Toft harvesting. Honokaa Sugar continues to utilize 100 percent push-rake harvesting which transfers maximum soil loads from the field to the factory.

3. When the full-scale Honokaa WWTP was started up in August 1975,* pretreatment consisting of DSM screens was incorporated as an essential part of the overall system. The DSM screens were intended to remove up to 60 percent of the incoming TSS and offer suitable protection to the hydroseparator and vacuum filter. The DSM screens were abandoned in early 1976 because of excessive wear. A grit separator was subsequently installed and is said to remove up to 6 percent of the TSS. It is evident that the grit separator is not an adequate substitute for the DSM units and the hydroseparator and vacuum filter are experiencing greatly increased loads over previous levels. Compensations have not been made for these increases.

4. The Honokaa WWTP was designed for a wastewater flow of 4.5 mgd.** Based upon Company results over the period of July 14, 1976 to November 30, 1976, flows in the Honokaa WWTP circuit have exceeded the 4.5 mgd design on 22 of the 39 days of record. These flows are detrimental to WWTP removal efficiencies.

5. Design of the full-scale hydroseparator was based upon laboratory experiments without benefit of pilot plant study. Conservative engineering design should be used when extrapolating from laboratory settleability tests to full-scale clarifiers. This may not have been the case at Honokaa. Wastewater detention time and water depth are minimal with the Honokaa hydroseparator and are less than conventional treatment design. The hydroseparator is relatively shallow and does not permit good separation of the sludge blanket from the quiescent settling zone.

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* *However it was not until June 1976 that the vacuum filter necessary for dewatering solids removed by the hydroseparator was actually installed. WWTP sludges were discharged to the final effluent.*

** *From "Laboratory and Pilot Plant Study of Factory Wastewater," Jean-Paul Merle, paper presented at 33rd Annual Conference of Hawaiian Sugar Technologists, November 1974, and Report of NEIC trip made to Dorr-Oliver, Inc., Stamford, Conn., October 11, 1977.*

There is also limited opportunity for retaining and consolidating the bottom sludges. Mr. Richard Hunwick of Dorr Oliver in a 1977 published paper* has described the Honokaa-type low detention system as ... "becoming more tempermental, i.e. less resistant to shock loads, and ... (requiring) ... careful monitoring of the operation."

6. During the week of October 23, 1977, the hydroseparator overflow was observed to be heavily laden with solids; large quantities of floatable material and fly ash were present on the surface of the clarifier; and excessive flow surging was occurring at the center well of the clarifier. Dorr Oliver has indicated that fly ash adversely affects solids separation in the settler. High flow velocities at the center well reduce separation capabilities. The Honokaa treatment system also lacks waste equalization which decreases solids removal efficiency.

7. Sizing of the vacuum filter at Honokaa was probably based upon a WWTP design load of 250 TPD dry solids. When the Company realized that incoming solids loads could peak as high as 600 TPD dry weight, a second vacuum filter was ordered from Dorr Oliver, Inc. This second unit is expected to be installed in Spring 1978. Mr. Jean-Paul Merle of Honokaa Sugar Co. has stated that filtration rates with the stainless steel filter media are in the range of 40 to 50 lb dry solids/ft^2/ hour. Two 10 foot by 20 foot rotary vacuum filters may not be adequate to cope with maximum soil loads, especially if Honokaa decides to increase its process rates.

8. An unreported discharge was found during the week of October 23, 1977, originating as an overflow from the Honokaa boiling house reservoir and finding its way to the ocean. Other waste releases from the main boiling house may also be occurring.

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* *"Treatment of Sugar Cane Wash Water," Hunwick, R.J., Sugar y Azucar, pp 73-80, March 1977.*

9. Self-monitoring results for 1976 and 1977 were reviewed and compared to NPDES permit limitations. Final limitations came into effect on July 1, 1976. Since July 1976, the Company has been in violation of the average daily TSS limits in 8 of 12 months for which data are available through September 1977. On settleable solids limits, the Company has been out of compliance for virtually the entire period from July 1976 to September 1977. A definite correlation exists between TSS and settleable solids in the Honokaa 001 effluent. For the four months in which the permittee was in compliance with TSS limits, settleable solids averaged about 3 ml/l. During the remaining months when the permittee was out of compliance, the settleable solids averaged 26 ml/l. The Company in June 1974 proposed effluent limits of 1.0 mg/l on an average daily basis and 2.0 ml/l on a maximum daily basis. Based upon Laupahoehoe Sugar Co. experience in meeting permitted TSS limits and corresponding settleable solids levels, the latter parameter for Honokaa could be reestablished as 2.0 ml/l on an average daily basis and 5.0 mg/l on a maximum daily basis.

10. Not only has Honokaa violated NPDES permit limits almost continuously since July 1976, but also there has been no improvement in effluent quality over this same period. Discharge volume has changed in the past few months because part of the effluent is now being diverted to field irrigation. Based upon the record, the Honokaa WWTP will not meet the permitted limits the majority of the time. Permit violations will occur predominately during the wet months of February through April and October through December, but will also occur through the drier months of May through September, at least part of the time. It is doubtful that the Honokaa WWTP could meet NPDES limits a high percent of the time given the lack of substantial "pretreatment" (such as DSM screens) even if another vacuum filter and clarifier were added to the system. A partial solution may be to construct solids bleedoff ponds similar to that of the Laupahoehoe Sugar Company. However, even this measure may not assure consistent attainment of permit levels.

11. A new boiler system which is under construction at Honokaa is expected to be completed in late 1978. The Company hopes that the new boiler and its attendant controls will overcome air pollution and emission violations that have persisted over the years. However, there is no strong guarantee that this will occur. As best as can be determined, the new boiler will allow Honokaa Sugar to expand processing to the 200 TPH net cane level. Effects of a process increase could adversely impact upon wastewater treatment. No wastewater treatment plans have been announced to cope with possible increase in sugar cane processing rates as indicated by the new boiler construction.

12. Visible emissions (air) tests were conducted by NEIC-Denver on October 29, 1977, and again on October 31, 1977. The results of three tests were in excess of the Hawaii SIP.

13. BOD (although not a permitted parameter) continues at high levels in the Honokaa wastewater discharge in spite of treatment. The Hilo-Hamakua Coast factories have shown that BOD loads will remain almost constant regardless of the level of TSS removal. BOD could be of major concern in the future.

14. Honokaa Sugar is presently conducting sampling of the WWTP influent and effluent under agreement with the Hawaii State Department of Health order dated January 14, 1977 (Docket No. PIE-EO-W-40). The Company conducts analysis on a composite sample made up of 20 individual grab samples taken over a seven consecutive day period. Honokaa Sugar then applies the single composite sample result to the daily flows to give seven different daily waste load values. The manner and duration over which the samples are composited and the type of calculations made by the Company cause these data to have limited value. This sampling program should be modified to provide more meaningful data on WWTP removal efficiencies.

III. PROCESS OPERATIONS

The Honokaa Sugar Company exclusively relies upon the pushrake method of field harvesting because of relatively steep and rocky terrain over the plantation. Pushrake harvesting is the least expensive means of moving the cane from the field to the factory but also produces the maximum amounts of trash and soil carried with the cane to the factory. Honokaa receives 60 to 70 inches of rainfall annually compared to 110 inches per year by the adjoining Laupahoehoe Sugar Company. Irrigation is practiced by Honokaa Sugar about 6 months of the year.

The process campaign at Honokaa Sugar normally extends from around early March through late November. Over the first half of 1977, monthly average receipts of net cane have ranged between 2,600 and 3,000 TPD. Corresponding field cane receipts have been 4,700 to 5,300 TPD. The mill operates 24 hours per day, 7 days per week. Scheduled plant maintenance is conducted generally on Tuesdays from 0700 to 1500 hours at which time processing is stopped.

Cane cleaning at Honokaa consists of three stages of cane washing and cleaning. After cleaning, the cane is sliced, shredded and passed through a series of 5-roll press mills. Four milling stages are present. Bagasse, juice and molasses represent the main products from the milling operations.

Honokaa Sugar generates steam and electricity by hydro and by conventional means. Water from the upper part of the plantation reaches the mill site carrying a pressure head of 200 psi. Bagasse represents the primary fuel at the Honokaa factory. The Honokaa boiler produces up to 160,000 lb/hour steam at 550 to 610 psi. Moisture content of incoming bagasse is usually maintained between 44 and 52 percent.

The Honokaa boiler system was purchased second-hand in 1963 and converted from a coal-burning to a bagasse-burning unit. Company personnel in October 1977 and also in an application of variance on June 3, 1977 affirmed that stack emissions continue to exceed permissable limits, especially in bad weather. Installation of a scrubber system probably could bring the existing boiler into compliance. However, the Honokaa Sugar Company indicated that space was unavailable for this equipment. A new boiler is under construction.

IV. DERIVATION OF RAW WASTE LOADS FOR HONOKAA SUGAR COMPANY

Soil loads coming into the Honokaa sugar mill were essentially based upon study results developed by the Hawaiian Sugar Planters Association (HSPA) in 1969. These results were subsequently refined by Mr. John Bersch of Theo Davis & Co. in 1973. The HSPA focused upon an experimental dry cane cleaner system at Laupahoehoe, and in this study, soil load estimates were developed for both wet and dry weather conditions. The HSPA report made available in October 1969 was titled "Experiment Station, Hawaiian Sugar Planters Association, Technical Supplement to Factory Report 58 and Mechanization Research Report 12, Cane Dry Cleaning at Laupahoehoe Sugar Co., 1969" compiled by Warren Gibson and L. J. Rhodes. A summary of Mr. John Bersch's analysis is presented below. Most importantly, soil and trash loadings in the Bersch analysis very much appear to be expressed in terms of WET weights rather than DRY weights. These same data given to the EPA in 1973-1974 were asssumed to have been dry weight values. This has created confusion in constructing the technical history on waste treatment at Honokaa.

A) THEO DAVIES ANALYSIS

Yearly crop estimated at 675,000 net tons (∿ 2700 TPD net cane assuming 250 process days).

1) Average Year Conditions

1962-1971 Avg. % Trash in field cane = 46.55%

Tons total trash/year = $\frac{675,000}{(1-.4655)} \times .4655$ = 587,900 tons/year

Pushrake harvesting was assumed in the fields estimated to yield 11% soil based upon field cane harvested.

Tons soil/year therefore amounts to $\frac{675,000}{(1-.4655)} \times .11$ = 138,900 tons/year

and Leafy Trash = 587,900 tons/year - 138,900 tons/year = 449,000 tons/year.

[Mr. John Bersch on October 27, 1977, indicated that the foregoing soil weights were on a dry weight basis, whereas all trash weights were on a wet weight basis].

During 1972-1973, rudimentary trash screening and juice filter mud disposal were incorporated at Honokaa and a portion of the soil was estimated as removed along with the trash producing the following residual waste loads:
Soil - 99,000 tons/year wet weight
Leafy Trash - 0 tons/year

Additional assumptions included 250 operating days per year incorporation of Toft harvesting for 50% of the cane expected to begin in 1976. It was also assumed that installation of a hydroseparator along with settling basins and reservoirs would provide 90 percent removal of TSS, leaving a final soil discharge of 4950 tons per year (wet). The average daily discharge was computed to be 4950 tons ÷ 250 days = <u>19.8 TPD</u> (wet). Yearly Avg. lbs TSS/ton field cane = <u>9.9</u> (wet). However, an alternate analysis was also cited at the meeting of October 27, 1977. This alternate analysis is presented below for comparative purposes.

2) <u>Average Year Conditions (Alternate Analysis)</u>

50% cane harvested by pushrake techniques = 337,500 TPY net cane
50% cane harvested by Toft methods = 337,500 TPY net cane
Avg. % trash in pushrake field cane = 46.55%; that in Toft field cane = 8.9%
Soil in field cane was estimated at 11% for pushrake cane; that for Toft field cane = 3.2%
Field cane harvested by pushrake methods = $\frac{337,500}{(1-.4655)}$ = 631,430 TPY

Field cane harvested by Toft method = $\frac{337,500}{(1-.0890)}$ = 370,500 TPY

Weight soil = 0.11 x 631,430 + .032 x 370,500 = 81,320 TPY

Soil remaining in effluent after hydroseparator treatment (90% removals assumed) = (0.11 x 631,430) x .10 =6,950 TPY = 27.8 TPD (wet)

Yearly Avg. lbs TSS/ton field cane = 13.87 (wet)

3) <u>Wet Year Conditions</u>

Avg. % trash in field cane estimated at 55.0%

Tons total trash/year = $\frac{675,000}{(1-.550)}$ x .55 = 825,000 TPY

Pushrake harvesting during wet year conditions was presumed to yield 13% soil based upon <u>field</u> harvested cane.

Tons soil/year therefore amounts to $\frac{675,000}{(1-.55)}$ x.13 = 195,000 TPY and

Leafy Trash = 825,000 TPY - 195,000 TPY = 630,000 TPY

Rudimentary trash screening and juice filter mud disposal which were incorporated into Honokaa were estimated to reduce soil levels down to 139,800 TPY.

Additional assumptions included 250 operating days per year and incorporation of Toft harvesting for 30% of the cane expected to begin in 1976. It was also assumed that installation of a hydroseparator system would provide 90 percent removal of TSS, leaving a final soil discharge of 140,000 TPY x .10 x .7 = 9800 TPY (wet). The average daily discharge was computed to be 9800 tons ÷ 250 days = <u>39.2 TPD</u> (wet). Yearly Avg. lbs TSS/ton field cane = <u>19.6</u> (wet). As for the Average Year Conditions above, an alternate analysis was cited at the meeting of October 27, 1977. This alternative analysis is presented below for comparative purposes.

4) Wet Year Conditions (Alternate Analysis)

70% cane harvested by pushrake techniques = 472,500 TPY net cane

30% cane harvested by Toft methods = 202,500 TPY net cane

Avg. % trash in pushrake field cane = 55%; that in Toft field cane = 12.3%

Soil in field cane estimated at 13% for pushrake cane; that for Toft field cane = 3.9%

Field cane harvested by pushrake methods = $\frac{472{,}500}{(1-.55)}$ = 1,050,000 TPY

Field cane harvested by Toft method = $\frac{202{,}500}{(1-.123)}$ = 230,900 TPY

Weight soil = .13 x 1,050,000 + .039 x 230,900 = 145,500 TPY

Soil remaining in effluent after hydroseparator treatment (90% removal assumed) = (.13 x 1,050,000) x .10 = 13,650 TPY = 54.6 TPD (Wet)

Yearly Avg. lbs TSS/ton field cane = 21.3 (Wet)

5) Peak Conditions

Avg. % trash in field cane estimated at 60%.

Tons total trash/year = $\frac{675{,}000}{(1-.6)}$ x .6 = 1,012,500 TPY

Pushrake harvesting during peak conditions was presumed to yield 14% soil based upon field harvested cane. No Toft harvested cane was assumed.

Tons Soil/Year therefore amounts to $\frac{675{,}000}{(1-.6)}$ x.14 = 236,250 TPY, and Leafy Trash = 1,012,500 TPY - 236,250 TPY = 776,250 TPY

No credit was given in the John Bersch analysis for soil reduction due to rudimentary trash screening and juice filter mud disposal as was the case for Average Year and Wet Year conditions above. Furthermore, Mr. Bersch assumed 90% TSS removal through the hydroseparator, but only 180 operating days per year for Peak Conditions rather than 250 days per year. The average daily discharge of TSS was computed to be

$\frac{236{,}250 \text{ TPY} \times .10}{180 \text{ days}}$ = 131 TPD (Wet)

B) EPA REGION IX ANALYSIS OF RAW LOADS

Production assumed to be 3000 TPD net cane.

1) For Average Conditions

20% soil anticipated to be removed during trash disposal.

Soil load = .12 tons/ton field cane = .24 tons/ton net cane.

50% of the cane was assumed to be harvested by conventional means and 50% by Toft means.

Tons soil/day to WWTP = 3000 (.80)(.24)(.5) = 288 TPD dry weight

95% removal of TSS predicted by primary treatment. Remaining soil = 288 TPD x .05 = 14.4 TPD dry weight. Furthermore, it has been presumed if only 2/3 of the Toft harvesters may be delivered and in use by the NPDES Permit deadline, then the effluent would contain 3000(.80)(.24)(.667)(.05) = 19.2 TPD dry weight.

The Avg. Daily TSS limit was established as 17.5 TPD ~ 35,000 lb/day TSS.

2) For Worse Conditions

15% soil anticipated to be removed concurrent with trash disposal.

Soil load = .145 tons/ton field cane = .29 tons/ton net cane.

70% of the cane assumed to be harvested by conventional means and 30% by Toft means.

Tons soil/day to WWTP = 3000(.85)(.29)(.7) = 517.7 TPD dry weight.

90% removal of TSS predicted by primary treatment leaves 51.8 TPD in effluent.

The Max. Daily Limit was established as 51.8 TPD ~ 110,000 lb/day TSS.

C) RECENT DATA ON SOIL LOADS

Mr. Jean-Paul Merle during the EPA visit of October 24-31, 1977 reported on the wet solids loads being removed from the WWTP mud storage bin to field disposal. The transport trucks have an 18 Ton capacity and the muds are assumed to contain about 50% water. During the week of October 23, 1977, from 41 to 67 truckloads a day was recorded equivalent to 740 to 1200 TPD wet solids or 350 to 600 TPD dry solids. During the week of October 16, an average of 45 truck loads per day was recorded = 810 TPD wet solids ∿ 400 TPD dry solids. From 26 to 39 truckloads were logged on a daily basis during the week of October 9 = 470 to 700 TPD wet solids ∿ 230 to 350 TPD dry solids. Over the period of March 1 to 15, 1977, Honokaa Sugar reported between 420 and 440 TPD TSS (dry weight) entering the treatment works.

Mr. Jean-Paul Merle of Honokaa Sugar, in a report given at the 33rd Annual Conference of Hawaiian Sugar Technologists in November 1974, indicated the new Honokaa WWTP was designed to receive a wastewater flow of 4.5 mgd containing about 250 TPD soil on a dry basis. In a later paper of November 1976, given at the 35th Annual Conference of the Hawaiian Sugar Technologists, Mr. Merle stated that soil loads as high as 594 TPD dry solids were entering the hydroseparator vs. the 250 TPD dry solids that had been expected in 1974.

V. AIR AND WASTEWATER POLLUTION CONTROL

AIR POLLUTION

Honokaa Sugar in 1973 was required to implement a two-phase air pollution abatement program. Phase I called for a large overfire air system to be completed by January 30, 1974. Phase II was to consist of an additional fractionating dust collector to augment existing dry dust collection units. Phase II was scheduled for completion by May 31, 1975, but was never implemented.

In November 1976, the State granted authority to the Company to construct a new bagasse-fuel oil fired steam generation system integrated with a multiclone dust collection system. The new boiler is expected to be in full operation by late 1978. In accordance with this action, the Company has requested a variance to continue operation of the old boiler until such time that the new boiler is on line.

Applicable regulations under the Hawaii SIP require for the existing Honokaa boiler that visible emissions not exceed 40 percent opacity and that particulate emissions be limited to 0.4 lbs/100 lb bagasse burned. Continous opacity instrumentation is available at the Honokaa power plant control room. However, the opacity meter did not correlate well with VEO readings made by the EPA on October 24, 1977 and again on October 29, 1977. On October 29, the opacity meter readings decreased while concurrent VEO readings made by NEIC-Denver demonstrated a substantial increase. Visible emission tests were conducted by Mr. E. Struzeski of NEIC-Denver on October 29, 1977, from 1332 to 1352 hours and from 1410 to 1423 hours. Another test was conducted on October 31, 1977, from 1109 to 1121 hours. All three tests showed that visible emissions were in excess of the allowable 40 percent opacity regulation (see attachments). A number of high VEO's was noted for the Honokaa Sugar Company including a series of 100 percent opacity readings on October 29, 1977. Discussion with Mr. Glen Kawanishi of the Hawaii State Department of Health located at Hilo, indicated in the past he also has experienced 100 percent opacity readings at Honokaa Sugar.

Fly ash from the Honokaa furnace is slurried into a relatively large water flow and pumped to the main cane wash screen conveyor entering the WWTP directly ahead of the grit separator.

WASTEWATER

Water Balance

A water balance including fresh water intake and the boiling house operations with its auxiliary spray cooling pond is shown in Figure 1. The power plant and boiling house condensers mostly control the amount of water used at the Honokaa mill. The spray cooling pond is relatively new. The rate of recycle of boiling house condenser water through the spray pond is approximately 8,400 gpm (12.2 mgd). The objective is to cool the condenser waters from 115°F down to about 95°F. From Figure 1 it can be seen that the boiling house is a heavier user of water than cane cleaning. Fly ash sluice water is derived from fresh water supply or excess condensates at the front end of the mill. Fly ash sluicing uses around 1.4 mgd water.

A flow balance for the Honokaa wastewater treatment plant is provided in Figure 2. The liquor pressed through the vacuum filter media and otherwise known as filtrate is returned to the head end of treatment. This waste stream has a typical flow of about 300 gpm (0.4 mgd) and contains around 35,000 mg/l TSS. The Honokaa facility presently pumps

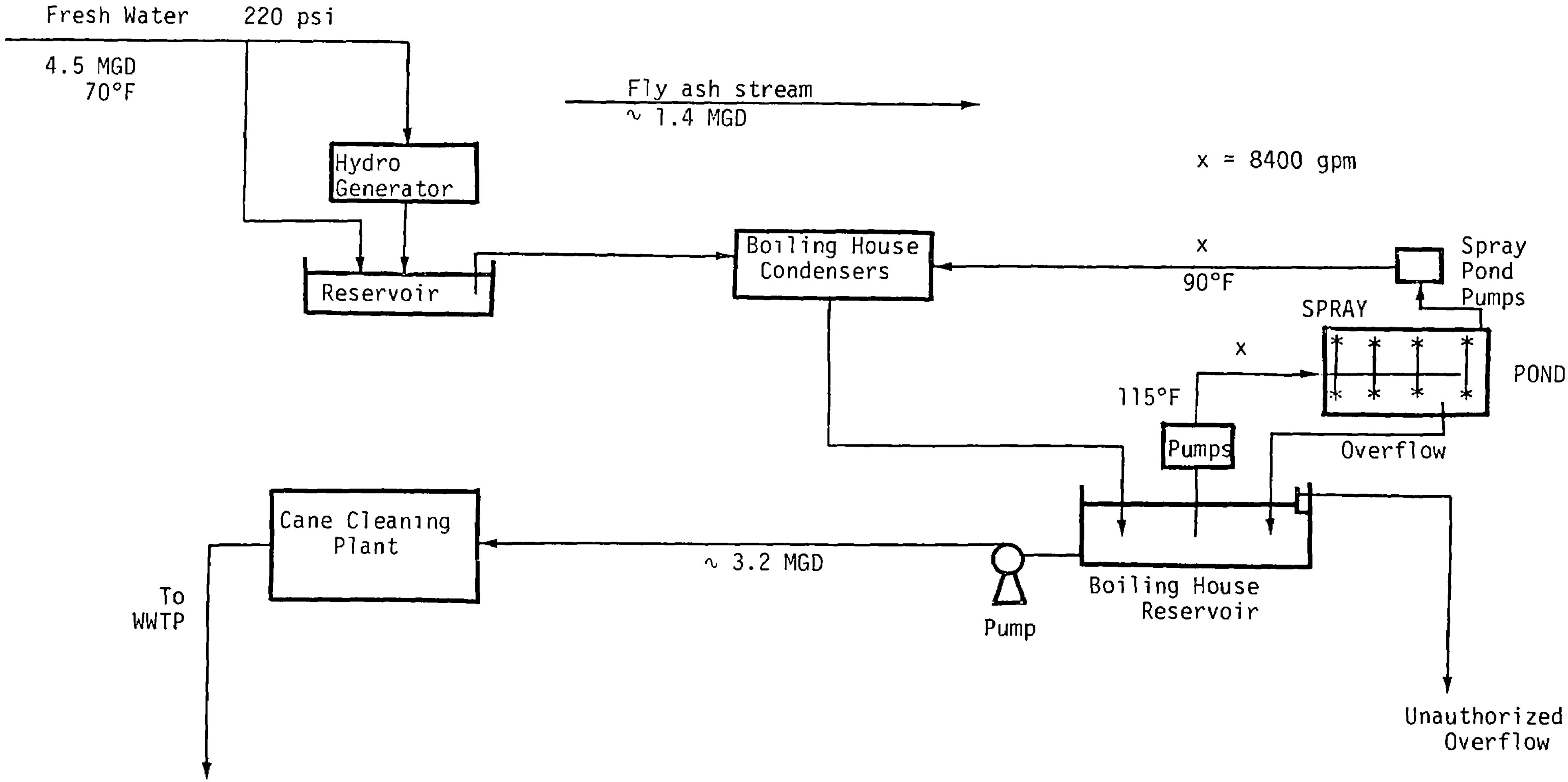
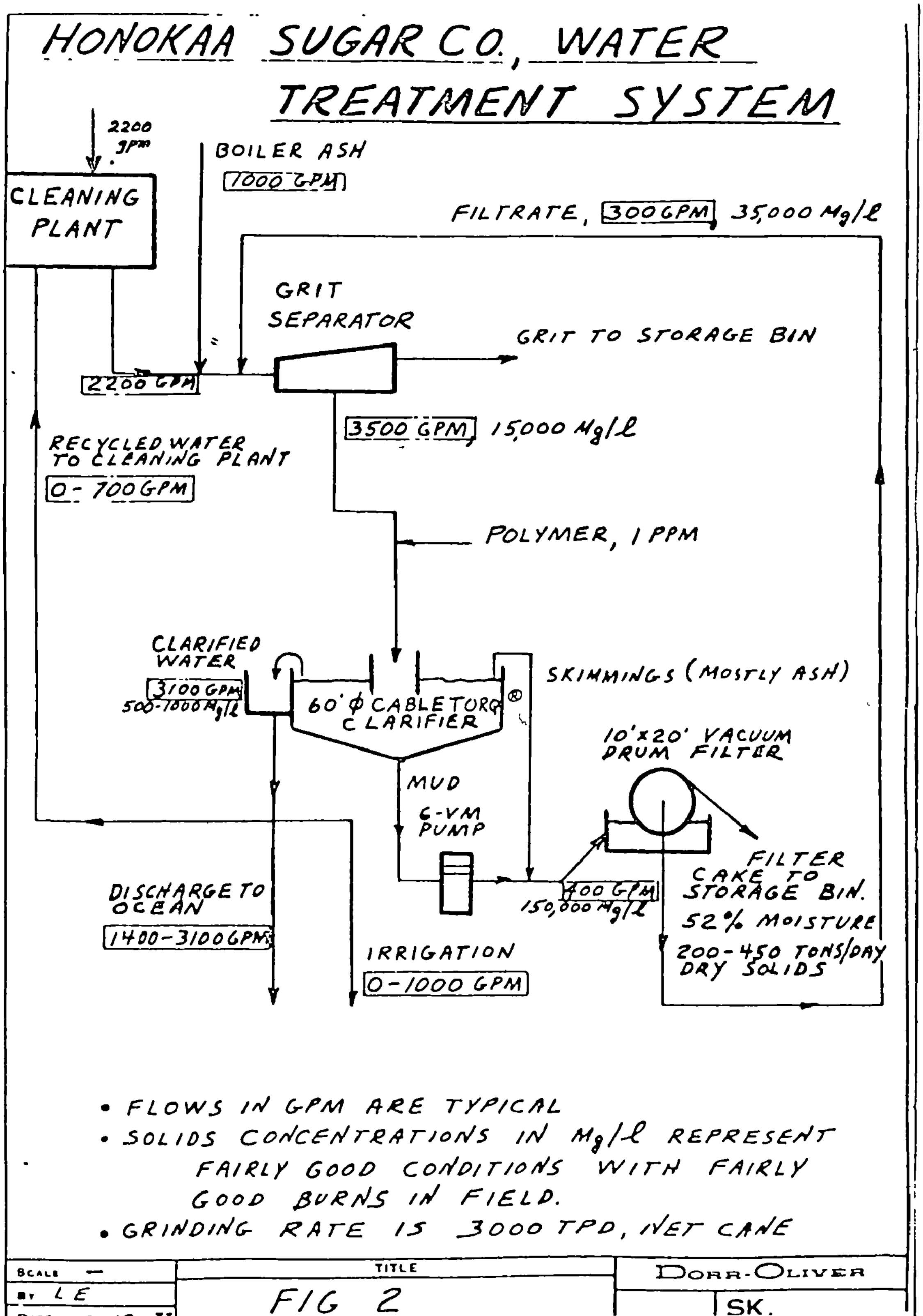


Figure 1. Water Balance
Honokaa Sugar Co.
Boiling House Operations
Power Plant, Cane Cleaning



Courtesy of Honokaa Sugar Co.

treated wastewater for field irrigation amounting to about 1.4 mgd, but is not recycling any clarified water to cane cleaning. If cane water recycle were incorporated, the Company might find it necessary to discharge boiling house condenser water rather than reusing this supply for the boiling house and for cane washing. (Cane wash recycle however could potentially reduce total plant waste loads discharged). Honokaa Sugar plans to increase the size of its spray pond in the next few months. During October 1977, WWTP discharge to the ocean was approximating 3.1 mgd, i.e. 4.5 mgd (3,100 gpm) from the WWTP minus 1.4 mgd (1,000 gpm) for irrigation use.

Preliminary Screening

An overhead screen conveyor system with one-quarter inch openings is used for final separation of trash and fibrous materials from plant wastewaters. Cane wash waters and sluiced fly ash enter as two individual waste streams onto the screen conveyor. The screenings are carried onto a belt conveyor and then to an adjacent solids storage pile. Two mud collection and transfer bins are situated directly adjacent to the screen conveyor. One bin is used for juice filter muds and the other for the solids removed at the WWTP. A solids overflow was noted from the WWTP solids storage bin back to the belt conveyor off the cane wash screen conveyor system. Flow of the cane wash and fly ash sluice stream are reported by the Company as amounting to 2,200 gpm (3.2 mgd) and 1,000 gpm (1.4 mgd), respectively. Total flow into the WWTP is said by the Company to average between 4.3 and 4.6 mgd (3,000 to 3,200 gpm) with a maximum of 5.1 mgd (3,500 gpm).

Grit Separator

Wastewater is drawn off from the compartment under the screen conveyor to a grit separator. The grit separator was estimated to be about 30 feet long by 18 inches wide. The grit chamber was incorporated at the front end of the treatment works after the failure of DSM screens. Heavy amounts of fly ash were observed in the grit separator. Two waste return lines enter the front end of the grit chamber. One contains filtrate from the vacuum filter and the other represents overflow from the feed box of the vacuum filter. The grit chamber was designed by Mr. John Bersch of Theo Davis & Company. Waste detention time in this unit is minimal. Solids are removed from the grit separator by a slat conveyor which feeds into a chute and then to the main solids conveyor to the WWTP solids storage bin. Honokaa Sugar Company personnel during the week of October 23, 1977 reported that the grit chamber should be removing about 6 percent of the incoming TSS to the WWTP. However, visual observations indicated that removal of solids through this device was poor. The Company has previously diverted waste flows around the entire WWTP when the slat conveyor on the grit chamber has been down for repairs (e.g. September 13, 1977). Standby facilities should be available to preclude this type of bypassing.

The grit separator unfortunately has never served as an adequate substitute for the DSM screens. The DSM screens had been originally designed to remove 50 to 60 percent of the TSS imposed upon the system.* Failure of the DSM units was a severe setback for the Honokaa WWTP. The grit chamber is considered essential by the Company to protect the vacuum filter from abrasive solids. Honokaa Sugar was asked in October 1977 if Wedge Wire screens might be appropriate. The Company indicated they did not care to experiment with screen systems following the failure of the DSM units. Mr. John-Paul Merle reported it is their

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* *See "Laboratory and Pilot Plant Study of Factory Wastewater", Jean-Paul Merle, 33rd Annual Conference of Hawaiian Sugar Technologists, November, 1974; "The Water Treatment System at Honokaa Sugar Company," Jean-Paul Merle, 35th Annual Conference of Hawaiian Sugar Technologists, November 1976; and Report of NEIC trip made to Dorr-Oliver, Inc., Stamford, Conn., October 11, 1977.*

objective to achieve almost completely unattended operation of the WWTP in the future; installation of more screens would require additional manual labor.

Waste flow is taken off the bottom front end of the grit separator into a collector box and trough leading to the hydroseparator. Polymer addition is made at the collector box. Honokaa purchases Nalco 7415-SC polymer in a liquid form. Polymer feed rate at Honokaa is 40 lb/day as dry solids which equates to around 1 mg/l in a flow of 4.5 mgd. Honokaa does not use polymer for vacuum filter improvement.

Hydroseparator

In March 1974, following laboratory treatment studies, an order was placed with the Dorr Oliver Company of Stamford, Connecticut, for a 60-foot diameter clarifier. (No engineering consultant is known to have been employed by Honokaa Sugar for design of the clarifier). Dorr Oliver supplied Honokaa Sugar with laboratory test procedures used in sizing the clarifier. Based upon laboratory results, Dorr Oliver made final sizing determinations. Dorr Oliver has emphasized that it performs no engineering design; it sizes and makes available standardized equipment based upon the needs of its client.

According to information received from Dorr Oliver in October 1977, design flow for the Honokaa WWTP was 4.5 mgd giving a waste detention time in the hydroseparator between 45 and 55 minutes. The settler is a Dorr Oliver Cable-Torq Thickener, Type A, 60 feet in diameter. The unit was reported to have a side wall depth of only about 7 feet and a depth at the center well of around 11 feet. The Dorr Oliver handbook for Type A thickeners cites 11 feet as the minimum available depth among its many units available. Dorr Oliver stated based upon the assumptions above, that the shallow thickener would be permissable. Capacity of the thickener was reported to be 175,000 gallons. The overflow rate for the Honokaa thickener was calculated as 1,600 gpd/ft^2. The clarifier is a standard center well feed unit with sludges being swept into a center cone at the bottom of the settler and the sludges pumped to a vacuum filter. The settler has a single set of weirs along the periphery of the tank. It is common practice at Honokaa to pump part of the clarifier overflow to field irrigation. During the week of October 23, a portable pump was observed used for continuous application of clarifier effluent to field irrigation. Field irrigation is estimated around 1.5 mgd leaving 2.5 to 3.5 mgd in the WWTP discharge going to the ocean. Last year, clarifier overflow was recycled back to the cane washer but not this year because of an abundant supply of water at the main mill.

The hydroseparator overflow in October 1977 was observed to be heavily laden with solids. This indicates less than adequate solids separation. Large quantities of flotable material and fly ash were present on the clarifier surface. The flow into the hydroseparator had undesirably high velocity and excessive surging was observed at the center feed well of the clarifier. The clarifier is equipped with a screw conveyor system which is designed to collect floating matter and fly ash from the scum collection box and transfer this material to the vacuum filter. It is believed that scum collection can be improved by minor modifications.

Mr. Jean-Paul Merle in November 1976 described the Honokaa clarifier as having a sludge underflow rate of 150 to 500 gpm containing 10 to 30 percent solids. The Company in October 1977 indicated that the clarifier mud flow rate approximates 400 gpm with about 20% solids going to the vacuum filter. Polymer addition is said to improve solids concentration of the underflow.

Honokaa Sugar and the Dorr Oliver Company have not provided the EPA with specific treatment design criteria on waste removal efficiencies and effluent characteristics. The record indicates the main objective of the treatment works has been to remove as much solids as economically possible from the raw waste. Attaining a clear effluent has been a secondary objective. Besides the lack of design data, there has been relatively little reliable data on concurrent sampling of the influent and effluent of the WWTP. Part of the reason is inaccessibility of the treatment system to influent sampling.

Vacuum Filter

The Honokaa WWTP is equipped with a single, 10 foot x 20 foot Dorr Oliver vacuum filter. The filtration surface is comprised of stainless steel perforated screen of the same type as used in boiling house juice filtration. Honokaa placed the order for the vacuum filter with Dorr Oliver in August 1974 and the unit was installed around June 1976. After it was becoming increasingly evident that the vacuum filter was overloaded, the Company, in May 1977, placed an order with Dorr Oliver for a second 10 foot by 20 foot vacuum filter. Dorr Oliver has commented that stainless steel perforated screen compared to filter cloth gives a much dirtier filtrate, although the stainless steel media permits considerably higher filtration rates.

The Company had anticipated that the vacuum filter would provide filtration rates up to 70 lbs dry solids/ft^2/hr, which is an exceptionally high filtration rate.* The 10 foot by 20 foot vacuum filter has a total surface area of 620 square feet. Assuming that the vacuum filter could handle 70 lbs/ft^2/hour (which is not the case), the maximum permissible solids load to the filter would be about 470 tons solids/day (dry). Solids loads during heavy rainfall periods can easily exceed the 470 TPD level as described earlier in this report. Honokaa Sugar presumed it

* *From verbal discussions of October 24-31, 1977 with the Honokaa Sugar Company.*

could meet EPA discharge limits if certain conditions were continuously met including: maximum solids concentrations entering the hydroseparator of about 20,000 mg/l; good polymer reaction; and the absence of mechanical problems.

During the week of October 23, 1977, a relatively thin cake was observed being collected off the rotary vacuum filter. Quality of the filter cake varies greatly. At times, a thick cake is attainable together with filtrate values as low as 7,000 mg/l TSS. Moisture content of the cake is usually around 52 percent. Filter cake is transferred over two sets of belt conveyors to a small hopper which also receives solids from the grit separator. The combined solids from the hopper are carried up a main conveyor to the WWTP mud storage bin. The filtrate return to the grit separator approximates a flow of 200 to 300 gpm and TSS levels of 7,000 to 12,000 mg/l. The Company reports that polymer addition would improve vacuum filtration but not enough to justify additional cost of the polymer. The use of chlorine has been suggested in treatment but Company personnel indicate not only is the chlorine demand high but chlorine causes pH depression in already acidic waters and consequently corrosion could be accelerated throughout the process circuits.

Additional Comments by Honokaa Sugar on Treatment

In the meeting of October 27, 1977, Company personnel indicated that Theo Davis & Company, Ltd. did not wish to make additional expenditures on air pollution abatement at either Honokaa or Laupahoehoe, but such might be necessary in the future. The Company made claim for pollution abatement costs of between $6.00 and $7.19 per ton sugar produced which presumably is for both water and air. It is not known what items may be involved in these calculations, but is is likely that pollution costs include writeoffs for old plant and equipment. Nevertheless, a cost of say $6 per ton sugar, even if valid, would still represent only about 2.2 percent of incoming revenues, assuming a current sugar price of about 13.5 cents per pound.

VI. UNAUTHORIZED DISCHARGE FROM BOILING HOUSE AND BOILING HOUSE RESERVOIR

A schematic of the boiling house condensers, boiling house reservoir and accompanying spray cooling pond are shown as part of Figure 1. During the week of October 23, an unreported overflow was found originating from the boiling house reservoir. This overflow represents the origin of an unauthorized stream finding its way to the ocean. A series of pipes protruding from the base of the boiling house and buried in heavy vegetation was observed alongside the stream. Direct discharge from the boiling house to this stream is highly probable.

In May 1975, Honokaa Sugar reported that all unauthorized discharges but one had been eliminated from the boiling house. The plant was waiting delivery of a "positioner" which would control excess water from the boiling house reservoir. The device was intended to reroute all discharges to the 001 outfall. Caustic soda and/or acid are reported to be used at the boiling house for cleanout and maintenance mainly of evaporators and vacuum pans. Cleaning wastes are said to be routed to a cesspool near the boiling house. Change in existing piping may be necessary for controlling these waste flows.

The above stream emerges in the general vicinity of the 001 sampling and flow measurement station about 100 yards northwest of the 001 parshall flume. A lower plantation road crosses both the 001 outfall and the unauthorized discharge. The stream can easily be sampled and flow rated just before it crosses under the plantation road.

VII. NPDES REQUIREMENTS, SELF-MONITORING, SAMPLING AND FLOW MEASUREMENT

NPDES PERMIT LIMITATIONS

The current version of the NPDES Permit for the Honokaa Sugar Company became effective June 2, 1977, and will expire September 30, 1978. The Honokaa mill has a single authorized discharge, i.e., outfall 001. The permit is based on a daily average mill processing level of 3,000 tons/day of net cane, and contains the following important provisions.

Parameter	Daily Avg. Limit	Daily Max. Limit	Monitoring Frequency
Flow	--	--	Continuous
TSS	35,000 lb/day	110,000 lb/day	1/wk; composite
Settl. Solids	0.1 ml/l	0.2 ml/l	1/wk; grab

Additional Provisions

The effluent shall not contain any trash, bagasse, ash, clinker, soot or filter cake at anytime, provided however that all such material passing through a 0.5 mm screen shall be considered and measured as TSS in the main discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

The discharge shall not cause objectionable odors at the surface of the receiving waters.

For each day during which TSS are monitored, the permittee shall record the number of tons processed of total field cane and of total net cane.

A composite sample shall consist of no fewer than 8 individual samples obtained at equal time intervals over the sampling period. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever is shorter.

NPDES SELF-MONITORING RESULTS

Total plant discharge and waste loads compiled by the Honokaa Sugar Company over the past 20 months are summarized in the following. Table I presents average monthly data for the period February 1976 through June 1977. Table II gives recent daily sampling results from July 6, 1977 through September 26, 1977. Honokaa Sugar Company is experiencing great difficulty in meeting NPDES limitations.

SAMPLING AND FLOW MEASUREMENT AT THE HONOKAA 001 MONITORING STATION

The Honokaa 001 Outfall is measured a few hundred yards downstream of the WWTP as the outfall crosses under a lower plantation road and before the discharge reaches the ocean. The effluent ditch has a very high velocity and the Company near the end of 1976 constructed an elaborate stilling device immediately ahead of a stainless steel 12-inch parshall flume encased in concrete on the 001 outfall. Small waves were evident on the approach to the flume, but no whitewater was present. A steel float and rod are provided in the control section of the parshall flume attached to a device which transmits electronic signals proportional to the head on the flume. The monitoring station is covered with a protective shed and has been equipped with DC power. A seven-day flow recorder was present together with a convenient chart for compositing

TABLE I. SOLIDS AND BOD LOADS IN FINAL DISCHARGE HONOKAA SUGAR MILL, PRIOR TO JULY 1977

Month	Flow	TSS		Settl. Sol.	BOD_5	
	(mgd)	(mg/l)	(lb/D)	(ml/l)	(mg/l)	(lb/D)
Feb. 76	4.20	11,000	384,900	37	580	20,300
March 76	4.89	12,800	521,200	58	570 est.	22,600
April 76	4.75	11,100	440,000 est.	36	600	23,800 est.
May 76	4.80	7,230	289,500 est.	26	198	7,900 est.
June 76	4.00	4,820	160,900 est.	17	725	24,200 est.
Avg. Feb.- June 76	4.53	9,400	359,000	35	535	19,800
July 76	4.54	3,370	127,600	10	637	24,100
Aug. 76	5.00	674	28,100	1.3	-	-
Sept. 76	4.10	285	9,740	2.8	316	10,800
Oct. 76	3.73	4,910	152,700	22	805	25,000
Nov. 76	4.58	9,220	351,900	34	885	33,800
Avg. July- Nov. 76	4.39	3,690	134,000	14	660	23,400
March 77	5.02	3,530	147,800	31	1,190	49,600
April 77	5.22	2,903	126,300	30	795	33,300
May 77	4.29	639	22,900	7	1,590	56,900
June 77	2.29	541	10,300	2	-	-
Avg. March- June 77	4.21	1,900	76,800	18	1,190	46,600

TABLE II. SOLIDS AND BOD LOADS IN FINAL DISCHARGE HONOKAA SUGAR MILL, JULY TO SEPTEMBER 1977

Date*	Flow (mgd)	TSS (mg/l)	TSS (lb/D)	Settl. Sol. (ml/l)	Comments
July 6	2.10	4,280	75,000	16	Extensive breakdowns on both July 13 and 20 resulted in highly erratic waste flow patterns
July 13	3.30	1,190	--	4	
July 20	2.30	362	--	2	
Mo. Avg.	-	1,940	--	7.3	
Aug. 4	3.54	3,610	106,600	20	
Aug. 10	2.66	8,410	186,700	40	
Aug. 17	2.82	10,930	257,200	45	
Aug. 24	2.59	7,490	162,000	27	
Mo. Avg.	2.90	7,610	178,100	33	
Aug. 31**	2.59	5,330	115,200	27	
Sept. 7	3.30	7,200	198,300	25	
Sept. 14	3.08	5,120	131,600	28	
Sept. 21	2.80	812	19,000	5	
Sept. 28	3.50	9,300	271,600	37	
Mo. Avg.	3.05	5,550	147,100	24.4	
3 Mo. Avg.	2.84	5,030	121,100	22	

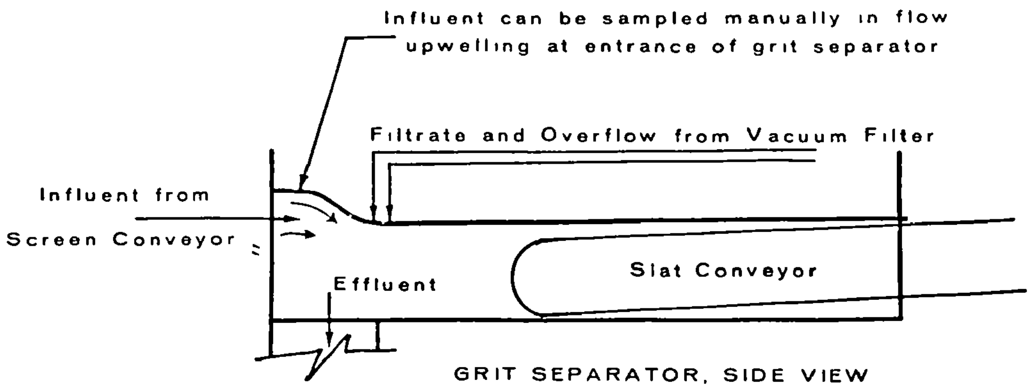
* Date given is that on which the composite sample was initiated; e.g. the composite sample gathered over July 6 to 7, 1977, is entered as July 6.

** The Company has aggregated the August 31 to September 1 sample with the September results rather than the August results.

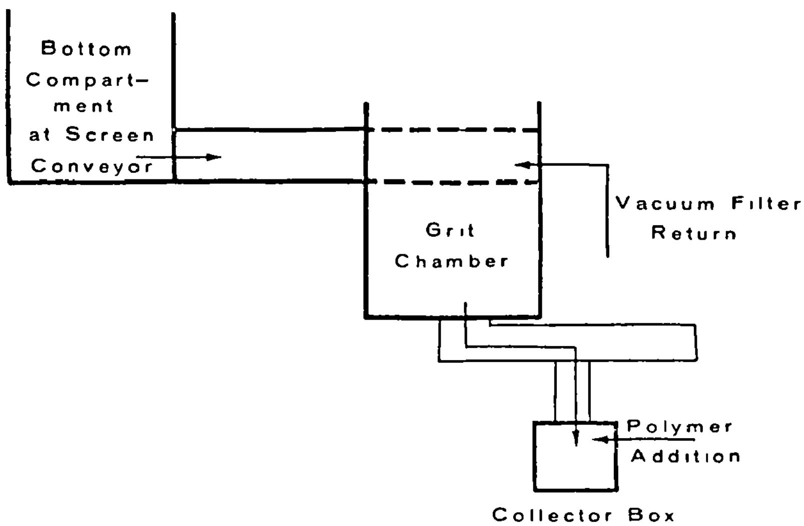
sub-samples proportional to flow. The approach section to the parshall flume showed some flow disturbance but these effects were judged minor. The parshall was considered acceptable. Flow through the 001 parshall flume was reported by the Company as varying between 2.5 and 3.5 mgd. Grabs for NPDES permit purposes are collected at the 001 location by manual means every three hours and made into a daily composite sample on a flow proportionate basis. The 24-hour composite sample normally extends from Wednesday morning to Thursday morning each week.

ADDITIONAL SAMPLING LOCATIONS AT HONOKAA WWTP

One of the objectives of the NEIC-Denver inspection of October 1977 at Honokaa was to select tentative sampling locations for the purpose of specifically determining waste removal efficiencies through the WWTP. Establishing sampling points inside the treatment plant is difficult because of the non-accessibility of waste streams and various interference factors within the system. It was ascertained that influent can be sampled only in the flow upwelling at the very front end of the grit separator. This particular location is illustrated in Figure 3. Two lines from the vacuum filter enter near the head of the grit separator and sampling must be conducted ahead of these interferences. Sampling further downstream would not give representative results. The effluent from the WWTP can be sampled at the main overflow box of the hydro-separator which is also the point of irrigation water takeoff from the Honokaa WWTP.



GRIT SEPARATOR, SIDE VIEW



FRONT VIEW GRIT SEPARATOR ASSEMBLY

Figure 3 Suggested Sampling, WWTP Influent, Honokaa Sugar Co

VIII. ANALYSIS OF HONOKAA WWTP DESIGN

Investigation of primary treatment at Honokaa Sugar started in early 1973 with laboratory settling tests using 1000 ml graduate cylinders. The laboratory procedures were apparently developed by Dorr Oliver, Inc. Unit settling area expressed as ft^2/ton solids/day was calculated from the laboratory data, and a safety factor of 20 percent then applied. The test procedures called for 100 mesh screening of the feed material to laboratory settling. Polymer at 1 to 3 mg/l, together with lime, were found necessary for rapid solids settling. Besides flocculation of soil particles, lime was determined to have good disinfectant properties. The Company concluded that lime was too expensive for use in treatment.

The Company conducted 24 laboratory settling experiments in 1973 and 21 additional experiments in 1974. Company calculation sheets for the first 24 runs showed widely varying results. Settling area computations, based upon WWTP design flow of 4.5 mgd, ranged from 715 ft^2 up to 6900 ft^2, equivalent to a hydroseparator having a diameter of 27 feet up to 83 feet. Unfortunately, the majority of the tests were conducted at TSS concentrations less than 11,000 mg/l. The average feed concentration for the 24 runs was only 12,000 mg/l, which corresponds to a daily loading rate of 225 TPD. It was noted earlier in this report that solids loads had been found in 1975 and 1976 to be in the range of 400 to 600 TPD dry weight, and even higher.

The 1974 lab settling tests generally showed lower settling rates compared to the 1973 tests. The files of the Honokaa Sugar Co. indicate some thought was given in 1974 that an 82 foot diameter thickener might be necessary for a flow of 4.5 mgd and a solids content of 12,000 mg/l in the incoming feed. The files also show recognition by the Company that waste flows were approximating 5.3 mgd, in other words, 0.8 mgd higher than the 4.5 mgd being designed for. The Company was, however, anticipating reducing water usage whereby the designed target waste flow of 4.5 mgd could be reached. Nevertheless, based upon flow results contained in a Company letter of March 19, 1977 to the Hawaii DOH, it is noted for 39 monitoring days over the period of July 14, 1976 to November 30, 1976, that discharge flows exceeded the 4.5 mgd WWTP design flow on 22 of these days.

Engineering design should be conservative when extrapolating from laboratory settleability tests to full-scale settlers. Pilot scale studies are preferrable to graduate cylinder or beaker tests for predicting full-scale requirements. Metcalf and Eddy, Inc., in "Wastewater Engineering, Collection, Treatment, Disposal", McGraw-Hill, Inc., 1972, recommend that preliminary settling evaluation should be conducted in a container no less than 6 to 8 inches in diameter and equivalent in depth to the full-scale sedimentation tank. For settling of discrete particles, Metcalf and Eddy further recommend when using the test cylinder above, that the critical settling velocity should be muliplied by 0.65 to give design velocity in the full-scale unit. Also, detention time in the test cylinder should be multiplied by a factor of 1.75 to 2.0 for scale-up to full size.

An evaluation report was prepared by a representative of Dorr Oliver, Inc. in January 1974 essentially based upon the 24 laboratory settling experiments described above. This report indicated that the size of a full-scale clarifier based upon the laboratory results, should be roughly 45 to 60 feet in diameter. The report commented that settling area requirements did not decrease with increasing solids concentration. The report further estimated that wastewaters in the hydroseparator would have a detention time between 30 and 45 minutes. This compares to a range of 90 to 120 minutes minimum detention time commonly used for wastewater settling. Mr. Richard Hunwick of Dorr Oliver, in a report appearing in Sugar y Azucar in March 1977, described the Honokaa low detention type system as ... "more tempermental, i.e. less resistant to shock loads, and (requiring) careful monitoring of the operation." Mr. Hunwick also specified hydroseparator detention times of 1.5 to 2.5 hours when the cane wash recirculation ratio is low, which is the case at Honokaa Sugar. In 1974, a pilot-scale hydroseparator 6 foot in diameter by 8 feet in depth, and having a 1300 gallon capacity, was deployed by Honokaa Sugar. However, this unit was almost exclusively used in conjunction with mud filtration experiments rather than developing settling data.

From available evidence, the Honokaa Sugar Co.-Dorr Oliver approach to waste settling has been optimistic. The sugar company and Dorr Oliver have advised the EPA that waste treatment technology for the Hilo-Hamakua Coast sugar mills has been unique and complex. Yet the decision was made to base full-scale settling requirements upon graduate cylinder results and without the benefit of pilot testing. Liberal design was employed and safety factors were relatively small in going from laboratory to full-scale treatment. No consulting design engineer appears to have been involved in these studies. Amounts of soil entering the WWTP under heavy rainfall conditions appear to have been seriously underestimated. This was partly due to the DSM screens preceding settling having been discontinued in 1976. The Honokaa hydroseparator is extremely shallow and does not permit good separation of the sludge blanket from the quiescent settling zone. The Honokaa hydroseparator offers limited opportunity for retaining and consolidating the sludge blanket. The hydroseparator receives enormous amounts of TSS during runoff conditions, i.e. up to 500-600 TPD dry weight, and with the more or less conventional rake and scrapper mechanism, may not be capable of physically removing all solids from the bottom of the clarifier. If the solids are not taken from the bottom of the settler, they must then escape over the overflow weirs. At the high clarifier overflow rate of around 1,600 gpd/ft^2 the solids must settle rapidly if they are to be removed. High flow velocities are experienced at the center feed well making quiescent settling more difficult. The treatment system also lacks waste equalization which adversely impacts upon solids removal efficiency.

Following failure of the DSM screens in the treatment circuit, Honokaa conducted experiments in early1976 with a rotary screen having 0.5 mm openings. Unfortunately, the rotary screen was placed on the fly ash sluice stream and not the combined WWTP influent. The rotary screen was discontinued after a short period because of alleged difficulties in handling the screenings. It is not entirely clear why the rotary screen studies were stopped. It is believed that appropriate data were not collected for the rotary screen to adequately determine its performance efficiency.

Laboratory filtration tests were conducted by Honokaa Sugar in 1973 using a 0.1 square foot leaf filter provided by Dorr Oliver, Inc. A plant safety factor of 0.65 was employed with these tests. The Company thinking, as exemplified in Mr. JeanPaul Merle's report of November 1974 before the 33rd Annual Conference of Hawaiian Sugar Technologists, was that no more than 250 TPD of dry solids would be experienced at the factory. With a vacuum filter of 10 feet by 20 feet giving a total filtration area of 620 ft^2, it was anticipated that a filtration rate of about 33 lbs. dry solids/hour/ft^2 would be adequate at Honokaa. The preliminary vacuum filtration work led to pilot plant testing in August 1974 with a 3 foot by 1 foot filter. Using stainless steel screening on the vacuum filter, high filtration rates were achieved, although the filtrate was relatively dirty. Mr. Merle, in his November 1974 paper based upon the study results, found that filtration rates greater than 20 lbs dry solids/hour/ft^2 were obtainable. In August 1974, the Honokaa Sugar Co. placed an order with Dorr Oliver for a single 10 foot by 20 foot rotary vacuum filter.

The Company, through 1975, continued to have difficulty in reaching desirable filtration rates. In 1976, with the full-scale vacuum filter in operation and polymers being added to the vacuum filter feed, filtration rates were obtained between 66 and 77 lb dry solids/ hour/ft^2. However, these rates were demonstrated only over extremely short intervals. At this stage, the Company recognized that solids loads could peak as high as 600 TPD dry weight, and that a single vacuum filter was insufficient. Subsequently, a second vacuum filter was ordered from Dorr Oliver. The Company has indicated until a second filter is installed, the underflow mud from the hydroseparator must be treated with a polymer when operating under poor harvesting conditions. This prescribed practice was not being conducted during the week of October 23, 1977. In the January 1974 evaluation report prepared by Dorr Oliver, the observation was made at that time that up to six 12 foot by 24 foot drum filters might be necessary for the Honokaa installation. Admittedly however, this requirement was based upon preliminary filtration tests and the use of filter cloth rather than stainless steel filtration media. Assuming an optimistic filtration rate of 50 lb. dry solids/hour/ft^2 using two 10 foot by 20 foot vacuum filters which would operate 20 hours during the day, a maximum of 620 TPD solids can be handled through the filter station. Two vacuum filters may not be adequate to cope with maximum soil load conditions, especially if Honokaa processing rates were to increase.

The laboratory and pilot filtration investigations showed that lime added to the hydroseparator feed would aid in flocculation of the suspended solids, decrease bacterial activity in the circuits, and also improve vacuum filtration. During the investigations, bacterial growth seemed to be a major problem. Failure of the DSM screens, for example, may have been due not only to excessive wear, but aggravated by extensive slime buildup. Liming also serves to reduce anaerobic conditions that can occur through treatment, particularly at the bottom of the hydroseparator and in the clarifier underflows. Mr. Richard Hunwick of Dorr Oliver, in his report appearing in Sugar y Azucar in March 1977 for a Honokaa type treatment system, recommends the addition of lime to increase pH levels to about 7.0 to 7.5. High liming up to pH 11 is beneficial but generally not economical. The problem of low pH levels in the Honokaa system has not yet been adequately recognized, but is roughly proportional to waste detention and the amount of food or BOD present. Secondary treatment and removal of BOD is indicated for the future. Chlorine is a possible substitute for lime in controlling bacteria at selected points in the plant, and deserves further attention.

IX. SUPPLEMENTAL REFERENCES ON TREATMENT DESIGN

Mr. Allan Duvall reported in the late-1960's that the Ewa Plantation Company and the Waialua Agricultural Company at that time were utilizing relatively large hydroseparators 120 feet in diameter for treating their sugar cane wastewaters*. The desilted waters were directed to irrigation of cane fields. The clarifier muds were conveyed to diked ponds which, when filled, were allowed to dry and subsequently planted to cane. At other factories, the desilted hydroseparator overflow was recycled for cane cleaning. Hydroseparator overflow rates at the above installations were about 3 ft. per hour, capable of removing silt particles down to the 15 micron size.

Sunn, Low, Tom & Hara, Inc., in their draft report of May 25, 1973 to the Effluent Guidelines Division of the EPA, Washington, D.C., provided design criteria on waste treatment at both irrigated (dry) and non-irrigated (wet) sugar cane plantations. For the non-irrigated plantations which typify the Hilo-Hamakua sugar companies, it was advised that the waste treatment clarifier not exceed a surface overflow rate of 1440 gsfd, and the solids loading be held to a maximum of 6 $lb/ft^2/hour$. (This same consultant, in preliminary design work for the Hilo Coast Processing Co. in 1974, specified overflows as low as 4 $lb/ft^2/hour$). Clarifier tank depth was recommended as 15 feet, which would provide 8 feet of solids slurry storage and 7 feet of clear supernatant. It was assumed there would be sufficient control of sludge withdrawal to prevent gassification in the clarifier. Sunn, Low, Tom & Hara, Inc. also recommended a holding pond for relieving the clarifier of excess mud and an emergency pond for storing incoming wastewater. A maximum design soil

* *"Hawaii's Hydroseparator Systems Transform Cane Cleaner Effluent," Allan R. Duvall, Paper believed to have been published in the late 1960's. Location and data unknown.*

load of 1,380 TPD was predicted for a factory processing 3200 TPD net cane. This soil load at a 52% moisture content equates to 660 TPD dry solids. The consultant indicated a treatment plant designed for this load would be overloaded less than 1% of the time.

In conversation with Dorr Oliver, Inc. representatives in Stamford, Conn. in October 1977, it was affirmed that "some" consideration has been previously given to the possibility of two-stage waste settling at the Hilo-Hamakua Coast sugar mills in Hawaii. However, no further details were available.

ATTACHMENTS

VISIBLE EMISSION OBSERVATION RECORD

Company: Honokaa Sugar Co, Honokaa, H., Hi

Date: 10-29-77 Time First Sighted Plume: from time of arrival ± 1145

Time Start: 1332 Time Stop: 1353 (All times are Hawaiian Time)

Air Temperature: 80 Relative Humidity: 69 %

Wind Speed: 10-15 mph Wind Direction: S-SE

Sky Condition: 2/3 Overcast Background: Blue Sky

Plume Characteristics: Coning, Pluming, infreqr fuerling Continuous: (✓) yes ( ) no

Color: Black-Brown-Gray Dispersion Description: Coning, some fuerling

Stack Height: approx 70 (ft) Main Boiler Stack Observer location: approx 400 (ft) SW of stack

observer ± 70' SW of cane dump station

Sun location
(✓) Back of Observer ( ) Left Shoulder
( ) Right Shoulder ( ) Other

Emission Point:

Min	0	15	30	45
2 01	50	65	70	50
02	45	45	50	45
03	50	60	50	50
04	40	40	45	55
05	50	45	45	50
06	50	55	60	60
07	75	85	85	100
08	60	80	60	50
09	65	75	70	60
10	65	60	80	55
11	50	50	60	60
12	60	50	50	50
13	50	60	90	50
14	55	55	55	55
15	50	50	55	55
16	90	85	85	80
17	75	50	50	50
18	55	50	55	65
19	70	75	75	85
20	65	55	40	45

Min	0	15	30	45
21	45	50	75	50
1350 22	50	50	75	65
23	Had	to stop	to	move
24	car	out of	cane	
25	truck's	path		
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

Min	0	15	30	45
41				
42				
43				
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47				
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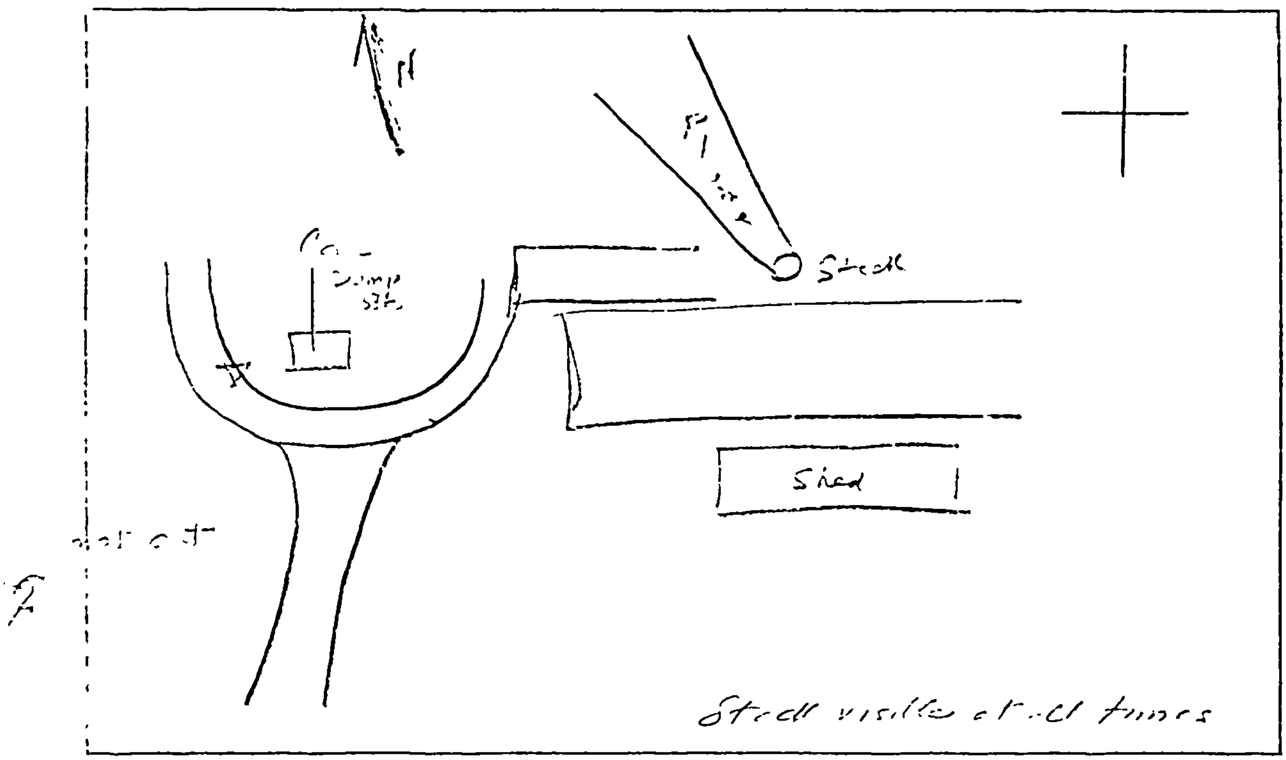
60				

NOTES: Company meter reading at same time as above VEO's at 2 1/8 - 2 1/4 Ringlemann. The Co. meter shows however very little variance from one minute to the next & over the entire period of VEO rdgs which was not the case with the VEO's.

Inspector: E. Shuzeck, Jr Date: 10-29-77

TSB-A-8 · HA-IH-FORM 298



Symbols

Sun =

Plume direction =

Point where plume observed = ...

Observer =

Water Vapor Condensate None.

Photographs: S&A File ( ) Enclosed ( ) None ( )

Comments

Signature [illegible] Date 10-27-77

VISIBLE EMISSION OBSERVATION RECORD

Company: Honokaa Sugar Co, Honokaa Hi H.

Date: 10-29-77 | Time First Sighted Plume: From time of arrival around 1145

Time Start: 1410 | Time Stop: 1423 (All Times are Hawaiian Time

Air Temperature: 77.5°F | Relative Humidity: 77%

Wind Speed: 15-20 mph | Wind Direction: SE

Sky Condition: 3/4 Overcast | Background: Blue Sky, some clouds

Plume Characteristics: Continuous: (✓) yes ( ) no

Color: Ultra Black @ 100 / E Black | Dispersion Description: Coning

Stack Height: approx 70 (ft) Main boiler stack | Observer location: ± 400 (ft) SW of stack — Observer ±70' SW of cane dump station

Sun location
(y) Back of Observer
( ) Right Shoulder
( ) Left Shoulder
( ) Other

Sun was under cloud cover ~~all through~~ ~~time of ...~~

Emission Point ______

Min	0	15	30	45	Min	0	15	30	45	Min	0	15	30	45
01	100	100	100	100	21					41				
02	100	100	100	100	22					42				
03	100	100	100	100	23					43				
04	100	100	100	100	24					44				
05	100	80	70	70	25					45				
06	65	55	55	60	26					46				
07	60	60	60	60	27					47				
08	60	60	55	60	28					48				
09	55	60	55	60	29					49				
10	60	65	55	60	30					50				
11	55	55	60	60	31					51				
12	55	60	55	50	32					52				
23 13	65	60	50	45	33					53				
14					34					54				
15					35					55				
16					36					56				
17					37					57				
18					38					58				
19					39					59				
20					40					60				

NOTES: Company meter reading 1 2/3 - 1 3/4 Ringlemann which makes little or no sense since at the earlier readings of 1332 to 1350 this day when the smoke was lighter the Company meter was reading 2 1/8 - 2 1/4. The Company meter appears to be badly in need of calibration

Inspector: E. Struzeck, Jr. | Date: 10-29-77

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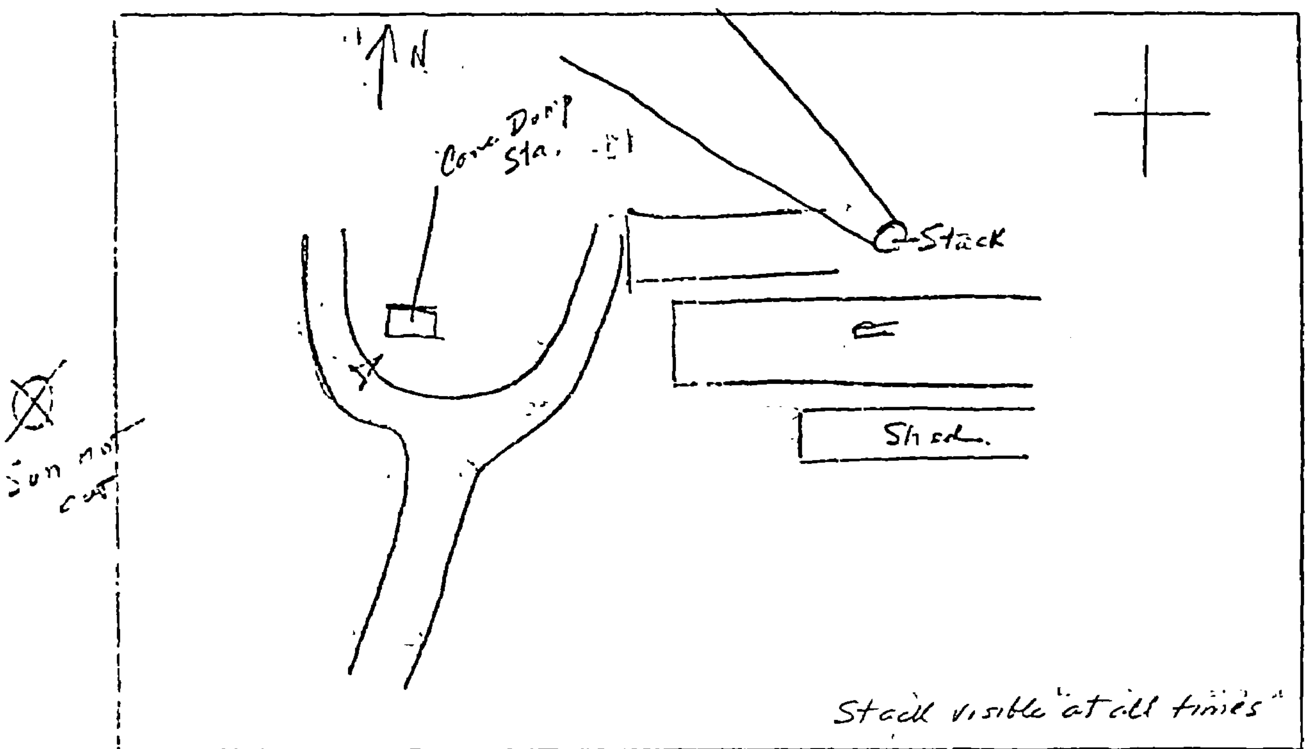
MAP



Symbols

Sun = ☒ Point where plume observed = ...
Plume direction = ⟶ Observer = ⊀

Water Vapor Condensate *None*

Photographs: S&A File ( ) Enclosed ( ) None ( )

Comments *It is believed Hamilton was changing sources & transporting from same dry cone to storage house because load cold again* [illegible]

Signature *[signature]* Date *10-29-77*

VISIBLE EMISSION OBSERVATION RECORD

Company Honokaa Sugar Co., Honokaa, Hi

Date 12 - 31 - 77 Time First Sighted Plume 1107

Time Start 1109 Time Stop 1121 (All times are Hawaiian Time)

Air Temperature 84 Relative Humidity 78 %

Wind Speed approx 10 mph Wind Direction SE

Sky Condition ½ Cloud Cover (White clouds in BG) Background White Clouds [illegible]

Plume Characteristics: Continuous: (✓) yes ( ) no

Color Black-Brown ([illegible]) Dispersion Description Coning

Stack Height approx 70 (ft) Observer location: 400ft 450 (ft) west of stack

Sun location
( ) Back of Observer ( ) Left Shoulder
(×) Right Shoulder ( ) Other

Emission Point

Min	0	15	30	45
01	[illegible]	55	60	55
02	[illegible]	[illegible]	60	50
03	[illegible]	65	65	55
04	55	60	55	60
05	60	65	60	60
06	55	55	60	60
07	50	65	65	65
08	60	50	65	60
09	50	65	55	60
10	60	55	55	70
11	55	50	45	55
12	50	50	45	50
13	50			
14				
15				
16				
17				
18				
19				
20				

Min	0	15	30	45
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

Min	0	15	30	45
41				
42				
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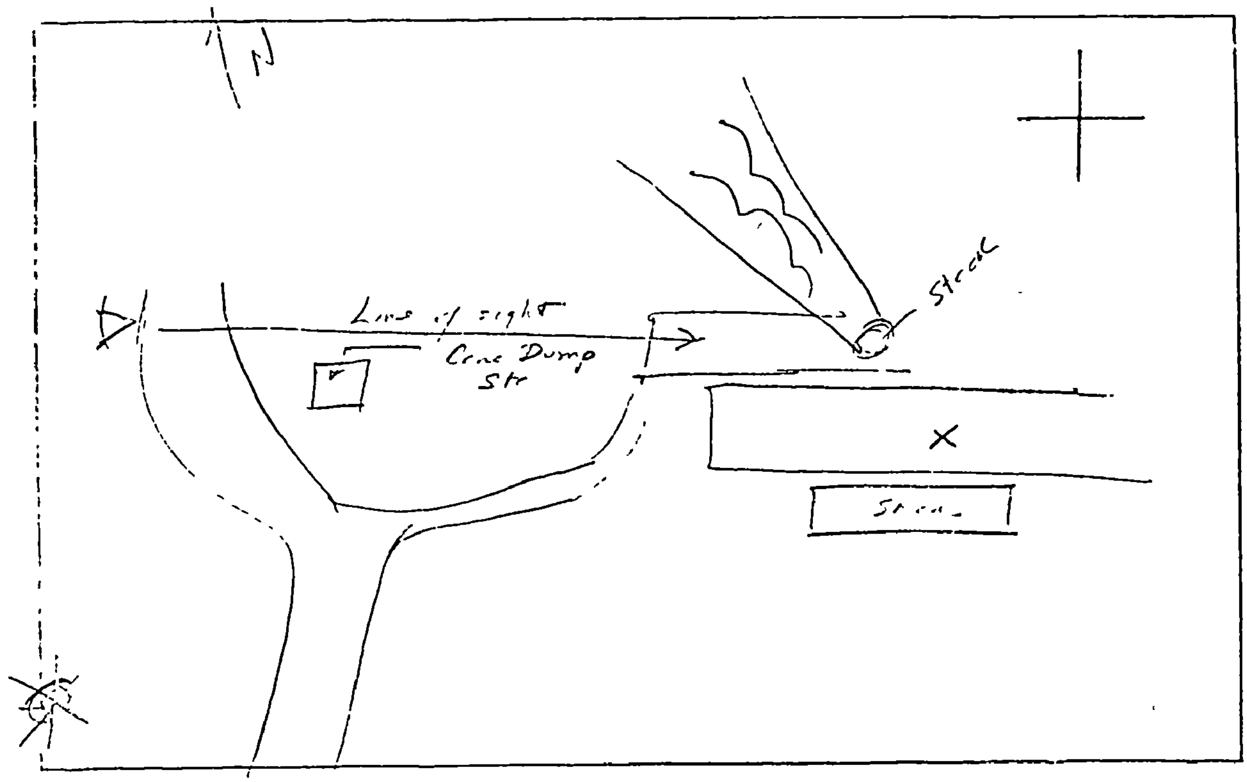
60				

NOTES:

Inspector [illegible] Date 12-31-77

TSB-A-8 FIA-IX-[illegible] 298

MAP



Symbols

Sun = ☼   Point where plume observed = ...

Plume direction = —⤚   Observer = ⊲

Water Vapor Condensate *None*

Photographs: S&A File ( )   Enclosed ( )   None ( )

Comments *Very difficult to select a[n] viewing location because [illegible] X [illegible] view of stack when observer is south of stack for the more desirable location. Observer is forced to move north and negotiate with the [illegible]*

Signature [signature]   Date *10-31-77*