systems planning

SOLID WASTE SYSTEMS PLANNING

This training course manual has been specially prepared for the trainees attending the course and should not be included in reading lists or periodicals as generally available.

Conducted by
Training Academy, Planning and Training Branch
Systems Management Division
Office of Solid Waste Management Programs

ENVIRONMENTAL PROTECTION AGENCY

Chicago, Illinois

March 1972

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SPEAKERS

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SOLID WASTE SYSTEMS PLANNING

Chicago, Illinois

March 28-30, 1972

AGENDA

Moderator: M. F. DeBonis

DAY AND TIME	SUBJECT	SPEAKER
Tuesday, March 28		
9:00 - 9:15	Registration	
9:15 - 9:30	Welcome	F.T. Mayo
9:30 - 9:45	Course Objectives	M F. DeBonis
9:45 - 10:15	Solid Waste Characteristics and Related Health Problems	J. R. Perry
10:15 - 10:30	Break	
10·30 - 11:00	Introduction to Planning	C McLaughlin
11:00 - 11:30	Solid Waste Storage	M. F. DeBonis
11:30 - 12:00	Solid Waste Collection Systems	J R. Perry
12:00 - 1:00	Lunch	
1:00 - 1:30	Solid Waste Collection Equipment	J R. Perry
1:30 - 2:00	Public Relations and Basic Studies	C. McLaughlin
2:00 - 2:30	Occupational Health and Safety	M. F DeBonis
2:30 - 2:45	Break	
2:45 - 3:45	Volume Reduction	J R. Perry
3·45 - 4:00	Film: "Where Will It All End?"	
Wednesday, March 29		
9:00 - 9:30	Problem Definitions and Objective Formulations	C. McLaughlin
9:30 - 10·00	Transfer Operations	M. F DeBonis
10·00 - 10·15	Break	
10:15 - 11:15	Incineration	J R Perry
11·15 - 12·00	Solid Waste - A Resource	M F. DeBonis
12·00 - 1·00	Lunch	
1·00 - 1·30	Alternative Determination and Evaluation	C. McLaughlin
1:30 - 2:15	Sanitary Landfill I	M F DeBonis
2·15 - 2·30	Break	
2:30 - 3:00	Sanitary Landfill II	M. F DeBonis
3·00 - 3:30	Film: "The Green Box"	
3:30 - 4·00	Alternative Selection and the Plan	C. McLaughlin

AGENDA

DAY AND TIME	SUBJECT	SPEAKER
Thursday, March 30		
9:00 - 9:30	Implementation and Feedback	C McLaughlin
9:30 - 10:00	Dump Closing and Conversion	J R. Perry
10:00 - 10:15	Break	
10:15 - 10:45	Rural and Recreational Systems	M. F. DeBonis
10:45 - 11:15	Federal Solid Waste Planning Programs	C. McLaughlin
11:15 - 11:45	Keeping the Public Informed	J R Perry
11:45 - 12:00	Course Summary and Critique	M F. DeBonis

CONTENTS

SECTION I

SOLID WASTE CHARACTERISTICS AND RELATED HEALTH PROBLEMS

Training Staff*

I INTRODUCTION

A Improper management of solid waste may lead to accidents and disease, blighted recreational and living areas, subtle cultural and environmental damage. It may mean lost money, lost enjoyment, lost resources. The problem has grown upon us in recent years through:

1 The trend toward living in cities or metropolitan regions

1900 - 40% lived in urban areas

1960 - 70% lived in urban areas

2000 - 90-95% in urban areas estimated

2 Population growth

3 Intensive production of crops, livestock, poultry - often near suburbs

4 Development and use of recreational areas

5 Continued growth of our whole industrial complex

6 Increased use of packaging, and an emerging philosophy of "use and throw" extending even to large appliances:

20 billion pounds of paper and cardboard/year, (including 70 billion grocery bags); over a billion pounds of plastic film for packaging; 48 billion cans (including 2 billion aerosols); 28 billion bottles and jars; 7 million automobiles. Composition of home refuse is changing - less ashes and garbage; more paper and plastic. Volume, rather than weight, is becoming the problem.

B Public awareness and interest in the mounting problems of solid waste storage, collection, and disposal have lagged. In recent months there has been a remarkable awakening of interest in environmental matters.

II DIRECT EFFECTS ON HUMAN HEALTH

A Insects and rodents resulting from improper refuse handling are vectors of human disease.

B Accidental injuries are a direct consequence of improper refuse handling practices.

C Air pollution through the open burning of solid wastes creates hazards.

III DIRECT EFFECTS ON THE HUMAN ENVIRONMENT

A Nuisances resulting from improper refuse handling are increasingly serious with crowding.

B Blighting of the natural scenery with scattered refuse is now too evident to ignore. This "visual pollution" now reaches out to spoil our dwindling beauty sites.

C Air pollution results from open burning at dumps or home storage sites, or from burning at makeshift incineration or salvaging operations.

D Water pollution occurs as a consequence of open dumping or improper disposal site selection or design. Untreated quench water and scrubber water from some outmoded incinerator designs add to the problem.

IV ECONOMIC LOSSES TO POOR REFUSE MANAGEMENT

A Decreased property values are a certain consequence of poor operating practices.

B Economic losses due to poor service are perhaps more common, and more often tolerated, than is the case with other municipal services.

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

V BASIC DATA

A Information on the volume and characteristics of solid waste generated within the refuse shed is needed:

1 As a basis for planning future collection and disposal operations

2 As a consideration in determining the disposal method

3 As a basis for proper administration of the collection and disposal system

a Cost data

b Proper routing

c Proper vehicle selection

B Data developed on the solid waste volumes and characteristics for residential, commercial or industrial establishments in a given area can fulfill immediate needs and can also be useful in estimating future solid waste volumes in that area.

C A knowledge of "average" municipal waste characteristics and per capita contributions would also be useful in estimating future solid waste volumes.

D The use of any published information for estimating either commercial, industrial or municipal solid wastes should be done with great caution. Basic information on actual volumes and characteristics should be developed as soon as possible.

VI DESCRIPTIONS AND SOURCES OF SOLID WASTE CONSTITUENTS

A Residential and Commercial Solid Wastes

1 Mixed garbage is separately collected in some residential and commercial collection systems. It consists of food wastes for the most part; is rapidly decomposable with ultimate residue as little as 10% of initial mass. Weight is about 600 lbs/cu.yd.

2 Rubbish includes the nonputrescible combustible or noncombustible wastes; ashes, paper, cans, yard trimmings, plastics, glass, wood, and similar materials. Weight uncompacted is about 250 lbs/cu.yd.

3 Combined garbage and rubbish is the most common municipally collected waste. Weight uncompacted is about 300 lbs/cu.yd.; in a packer truck about 500 lbs/cu.yd. Production varies greatly by area; national average in 1968 was about 5.3 lbs/person/day.

B Construction and Demolition Wastes

1 These are typically heavy, (up to 2000 lbs. or more/cu.yd.), bulky, often with low fuel value.

2 Typical composition includes wood, steel, plaster, concrete bricks. If wood is minimized the category is often called solid fill.

C Institutional Solid Wastes

Wastes from hospitals, nursing homes, prisons, schools, are often similar to residential and commercial wastes. Quantities of hospital wastes may be high, 10-20 lbs. per patient per day or more, with large amounts of paper and cloth. Contaminated materials (bandages, catheters, etc.) may be separately stored, and often are disposed of by onsite incineration.

D Industrial Solid Wastes

It is almost impossible to generalize about composition or quantities, because of the variety of industrial operations. There is usually a food waste and rubbish component from cafeteria and other personnel service which resembles home waste, but the wastes from the industry itself may be unique to the operation.

E Agricultural Solid Wastes

These are also highly variable. The two principal categories are:

1 Crop residues - that portion of the crop left in the field.

2 Animal manures

F Miscellaneous Municipal Solid Wastes

1 Street cleaning residues consist of dirt, leaves, paper. Weight is usually high - about 1000 lbs/cu.yd.

2 Digested sludge from the sewage treatment plant is sometimes buried, sometimes dewatered and burned.

SOLID WASTE STORAGE

Training Staff*

I INTRODUCTION

With the planned obsolescence in our affluent society, the statement repeated more and more often that we may well smother in our own refuse is rapidly assuming added significance. In some areas future community survival depends on today's community sanitation plans. Included in community planning must be plans for optimum refuse storage.

II COMMUNITY REFUSE STORAGE OBJECTIVES

A Good refuse storage techniques must be practiced primarily for health and sanitation reasons, to prevent:

1 Vectors

2 Odors

3 Unsightliness

B Proper storage expedites collection. Better health and better economy are interrelated.

III RESPONSIBILITY FOR STORAGE

A Refuse storage is an individual responsibility

B Government also shares a responsibility by:

1 Providing guidelines through recommendations and ordinances

2 Enforcing ordinances

IV RESIDENTIAL REFUSE STORAGE

A Factors to consider in establishing container standards:

1 Manageable size, shape

a Usually 20-30 gallon capacity

b Convenient shape, tapered for easy emptying.

2 Material

a If reusable, must be durable, cleanable; includes metals, plastics.

b Single service includes kraft paper bags, plastic liners.

3 Complete enclosure of contents

a Protection from weather

b Prevention of scattering

c Exclusion of vectors

4 Convenient hand holds

B Containers may be given proper care and protection by:

1 Wrapping refuse

2 Using racks

3 Washing cans

4 Providing sheds, storage pits, other shelter

a May improve sightliness, protection

b Add to cleaning responsibility

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

C Container placement may be:

1 In attached garage or basement

a Most convenient for householder

b Collector must enter premises unless containers are set out by householder

c Aesthetics of inside storage are usually desirable from community's viewpoint; may not be from householder's viewpoint. Nearness of containers helps householder remember to maintain them.

2 At rear or side of house

a Does not detract from neighborhood appearance

b Convenient location for householder

c Reasonably close for collection from either street or alley.

3 At rear of property line by the alley

a Convenient to collectors; less so to householder.

b Containers are apt to be damaged or stolen, and contents scattered.

c Isolation predisposes to littered storage areas and makeshift containers.

D The area surrounding the container should be kept:

1 Free from litter

2 Free from vectors

3 Free from materials not intended for collection

E Factors affecting storage include:

1 Types of refuse

2 Method of disposal

3 Per capita contribution

4 On-site processing

5 Climate

6 Seasons

7 Multifamily vs single occupancy.

F Human factors also affect storage practices

1 Attitude of homeowner

2 Socioeconomic level

3 Local customs and aesthetic standards

V COMMERCIAL AND INDUSTRIAL STORAGE

A Commercial and industrial operations share responsibility with individuals and government for good refuse storage.

B Nature and quantity of refuse generated may be of special character.

C Containers are of shape, volume, and construction to meet the particular needs of the nature and volume of waste generated.

1 Detachables

2 Compactors

SOLID WASTE COLLECTION SYSTEMS

Training Staff*

I PUBLIC HEALTH AND SAFETY

The aspects of public health and safety must not be ignored when considering refuse collection methods.

A Rats, flies and other vectors are possible sources of diseases or, more commonly, nuisances to the general public.

B The design of an adequate collection system minimizes public nuisances by recognizing their existence and preventing their occurrence.

II FACTORS AFFECTING COLLECTION METHODS

An evaluation of an interrelated set of fixed and variable factors is necessary for the proper development of a refuse collection system

A Fixed Factors May Include:

1 Type of refuse produced

2 Population density

3 Physical layout of area

4 Zoning

5 Climate

B Variable Factors May Include:

1 Responsibility for disposal

2 Disposal methods

3 Material handled and collection frequency

4 Type of equipment

5 Extent of municipal, contract and/or private collection agencies

6 Location of refuse

7 Organization of crews

III COLLECTION AGENCIES

A Municipal collection is performed by public employees and equipment under direction of a regular department or official.

1 Advantages are:

a Sanitation can be a primary motive

b Department is directly responsible to the public

2 Disadvantages are:

a Adverse political influences may exist; there may be a frequent turnover of supervisory staff.

b There is a possibility of operation by untrained officials.

c Emphasis may be on cheapness, rather than efficiency

B Contract Collection is Performed by a Private Company, Paid by the City.

1 Advantages are:

a The service is run as a business

b Political influence is less evident

c The city's part in collection is simplified

d Cost is established in advance

e Contractor must raise the capital

f The city can stipulate and enforce adequate collection standards

2 Disadvantages are:

a Profit, rather than sanitation, is the prime motive.

b Contracting permits less flexibility of service

c If contract is broken, no alternative service may be available.

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d Contractor is not necessarily assured of contract renewal.

C Private collection is performed by individuals or companies, with arrangements for service being made directly with each householder or business.

1 An advantage is that some service is offered where none may be available otherwise.

2 Disadvantages are:

a Expensive overlapping of routes occurs

b Competition may result in price cutting and lowering of sanitation or service standards.

D Regardless of the collecting agency used, refuse collection is a governmental responsibility and should be under the constant supervision of the appropriate government agency.

IV UNIT OPERATIONS

Careful analysis of the various methods available for each individual operation involved in collection is required to arrive at the most efficient and economical collection system.

A The pick-up operation is the act of transferring refuse from the householders' premises to the collection vehicle. The various types of service provided to the householder may include:

1 Curb service

2 Set-out service

3 Complete backyard service

a Set-out, set-back service

b Backyard carry service

B Method of Organizing Work

Integrated analyses of the method of refuse pick-up to be used, types of equipment available and the various methods of organizing work should be accomplished to provide efficient and economical collection.

1 Individual crews may be organized to accomplish collection by a variety of methods. These include:

a Daily route

b Large route

c Single load

d Definite working day

e Relay

2 It is sometimes advantageous to integrate the work of several crews in a collection system. The method under such circumstances may include:

a Swing crew

b Variable size crew

c Inter-relief

d Reservoir route

SOLID WASTE COLLECTION EQUIPMENT

Training Staff*

I COLLECTION

Speaking very generally, we can say that collection represents three-fourths of the whole refuse management cost; and of the collection cost, about three-fourths is labor. Most of the day-to-day management headaches involve labor, too, so the trend has been to the increasing mechanization of the collection process. This is true of rural collection as well. Labor is becoming too expensive for us to justify the use of makeshift equipment.

A Manually Loaded Compacting Bodies

1 Some economic advantages of suitable equipment over makeshift vehicles are:

- a They can carry a useful load because loose refuse is compacted
- b Low loading height and other loading conveniences are built in
- c Loads are easily emptied
  - 1) Dump bodies
  - 2) Ejector plate bodies

2 Some sanitary, safety, and esthetic advantages are:

- a Leak-proof, covered body built to withstand corrosion
- b Cleanable body and respectable appearance
- c Safety advantages
  - 1) Traffic signals, mirrors
  - 2) Handholds, steps, emergency stop bars

3 Crews and loading practices vary

- a A usual crew for a 16 to 24 cubic yard truck is a driver and one or two loaders. The driver may help load.
- b Sometimes the loaders drive motor scooters or small pickups ("Satellite System") to save walking time. This is particularly true where there are long driveways or some distance between houses.
- c The "one man" collection system usually employs a vehicle specially equipped for one-man operation. It has been used in both rural and urban situations.

B Mechanically Loaded Bodies

There are almost all detachable container systems. It is only a partially mechanized service in that the customer and collector still do something.

1 The customer puts the refuse in the container; special equipment is used to empty the containers.

2 The container may be emptied at the storage site; or it may be carried to the disposal site and emptied there.

3 The refuse may be compacted at the point of origin with a stationary packer, or in the collection vehicle, or not at all.

4 There are several types of detachable container systems:

- a Lift and Carry - usually 3 to 15 cubic yard capacity containers, trucked to the disposal site.
- b Side Loader Rollouts - usually 1 to 3 cubic yard containers, hoisted at the side of the truck and emptied at point of collection.
- c Rear Loader - similar in concept to the side loader. Some are rather makeshift accessories to the conventional manually loaded truck.
- d Front End Loader - handles containers from 1 to 10 cubic yards. Arms move the container up over the cab, dumping contents into the truck body.

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The system is fast and sparing of labor. Interesting variations include the refuse trains (bulk containers on wheels); container stations for rural collection like the Chilton County, Alabama system; and mechanical collection of household waste like "Godzilla" and the "Garbage Grabber" of Scottsdale, Arizona.

e Pull-ons - also called drop-offs. These are large detachable containers of up to 40 cubic yards or more, pulled onto a lowboy or tiltbed with cables or hydraulics and trucked to the disposal site. May have a stationary compaction unit provided. These were first used for commercial and industrial use. However, they have some good application for small communities or rural service, acting as a sort of small transfer station or "removable disposal site".

5 Detachable containers may be cleaned at the storage or disposal site, or at the truck. Truck-mounted cleaners are available.

C Other Systems or Applications

1 Small covered, compacting, side-loading bodies. These are inexpensive, designed usually for about a 1-ton chassis, and good for narrow alleys, 1-man rural collection, collection from small recreational areas, and so on. They may be provided with side-loader hoists to handle barrels.

2 Vacuum systems. These are just leaf-collection trucks adapted for cleaning out litter barrels.

3 Non-compactor, open body collection vehicles, hopefully with dumping mechanism. These have some legitimate uses for hauling bulky items like furniture, appliances, wrecked cars. They may conceivably also be used for collecting home or recreational refuse stored in plastic or paper disposable sacks.

OCCUPATIONAL HEALTH AND SAFETY

Training Staff*

I INTRODUCTION

The solid waste management business is one of the most hazardous in America. It has been criticized for the severity of its accidents, for lacking equipment standards and for having poorly trained personnel. At best, only a guess can be made of the overall number of injuries occurring annually. Usually only the spectacular type injuries are the ones we learn of through the news media.

II THE NATIONAL PROBLEM IN REFUSE COLLECTION

A Injuries Per Million Man-Hours - 1966

1	Industry	6.91
2	Federal Civil Service	7.30
3	Municipal Employees	22.20
4	Underground Mining	36.64
5	Sanitation (refuse collection)	60.77

B National Safety Council is Attempting to Create an Awareness Through:

1. Assemblage and presentation of injury data
2. The Government Refuse Collection and Disposal Association

C Reasons for Lack of Data

1. Municipalities combine functions and their records:
   - a Sanitation and health
   - b Sanitation and streets
   - c Public Works

III ANALYSIS OF ACCIDENTS IN REFUSE COLLECTION

A Types of Accidents Include:

1. Struck against
2. Struck by
3. Overexertion
4. Contact
5. Caught in
6. Falls

B Nature of Injury:

1. Back strain
2. Sprain
3. Contusion
4. Fracture
5. Bruise
6. Laceration
7. Hernia
8. Muscle spasm
9. Cuts
10. Dislocations

IV FACTORS IN CAUSES OF ACCIDENTS

A Narrow Streets

B Old or Otherwise Unsuitable Equipment

C Ordinances Not Enforced

D Haste in Completing Route

E Carrying Refuse From Home to Truck

V HAZARDS IN REFUSE COLLECTION

A Equipment Types Include:

1. Rotary blade - blade close to worker

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

2 Packer - blade travels on rollers in tracks. Edges come close to body frame and may pinch or amputate fingers or hands.

3 Ejector-Packer blade - retracted, lowered and pushed forward by hydraulic cylinders. Packing action starts ten inches from rear of hopper. In one city, nine hand losses in six years.

4 Side loader truck - high loading height

5 Front-end loader - arms close to cab

B Design Deficiencies Include:

1 Most equipment is designed for speedy reception and packing of refuse, and maximum pay load.

2 There is insufficient guarding at point of rotation or operation.

C Human Errors of Collectors (Greater than Equipment Design Errors) Include:

1 Poor physical condition

2 Insufficient rest

3 Daydreaming

4 Negligent attitude

5 Chance-taking

D Street Collection is Hazardous

1 Back-up of vehicle causes 80 percent of vehicle accidents

2 Riding on hoppers or steps is dangerous

E Unsanitary Health Conditions Include:

1 Lack of toilet facilities

2 Lack of storage place for lunches

3 Lack of shower facilities

4 Lack of drinking water

DISPOSAL INJURIES

In an environment where men are working in and around moving vehicles and machinery there is the potential for accidents resulting in injuries and even death. Compound the problems created by the moving vehicles and machinery with the presence of hazardous material and the potentials for the injuries increases. These are the working conditions for the men employed at refuse disposal facilities.

I TRAFFIC ACCIDENTS

Traffic accidents are among the most commonly occurring accidents at a disposal facility.

A Hazards to the Public

1 Collection vehicles waiting to enter disposal site

2 Collection vehicles turning off access roads

3 Private homeowner dumping waste at facility

a Stranger at site unfamiliar with operation

b Small vehicle difficult to see

B Hazards to Facility Personnel

1 Congestion of collection vehicles

2 Operation of dozer

a In marshy areas

b On steep slopes

c Over uncertain slopes of refuse

C Hazards to Collection Personnel

1 Improperly constructed access road

a Dusty roads

b Blind corners

c Uncertain terrain

2 Improperly constructed dumping area

a Backing into pits or trenches

b Falling into pits or trenches during dumping

c Unstable soil conditions giving away

II FIRES AND EXPLOSIONS

Although a properly operated disposal facility minimizes the potentials for accidents, the acceptance at the site of such materials as floor sweepings, magnesium shavings, chemical and petroleum waste products, sawdust, plastics and ground rubber presents additional hazards to the personnel.

A Hazards to the Public

1 Wind blown contaminants air borne by explosion

2 Projectiles air borne by explosion

3 Direct injury to homeowner dumping at facility

4 Children injured playing near fire

5 Spread of fire to nearby property

6 Accidents caused by smoke obscuring vision

a Highways

b Airports

B Hazards to Facility Personnel

1 Direct injury from explosion or fire

a Burns

b Punctures

c Severance

2 Inhalation of contaminants

3 Asphyxia from smoke

4 Underground fire

C Hazards to Collection Personnel

1 Dumping of unknown waste

2 Traveling over underground fire

3 Visibility obscured by smoke

4 Unloading of a "hot load".

III TOXIC OR PATHOGENIC INGESTIONS

The ingestion of toxic or pathogenic agents dispursed at a disposal facility is not of particular concern to the average homeowner, but to the facility and collection personnel and the homeowner who delivers his own waste to the disposal site, this is of grave concern.

A Hazards to the Public

1 Air-borne contaminants from burning or explosion at a disposal site

2 Water-borned contaminants from leachate

3 Children and scavengers utilizing the site

B Hazards to the Facility Personnel

1 Breathing of air-borne contaminants from:

a Explosion of empty container

b Dumping procedure

c Rehandling procedure

2 Physical transmission of contaminants

a Handling the waste

b Contaminated lunch

c Handling the residue

C Hazards to Collection Personnel

The dangers to the collection personnel of ingestion of toxic or pathogenic agents will generally be from the breathing of air-borne agents or the physical transmission by handling the waste.

D Sources of Hazardous Waste

1 Hospital

2 Sewage disposal facilities

3 Colleges

4 Dispensaries

5 Drug stores

6 Medical offices

7 High schools

8 Industries

9 Commercial laboratories

10 Home

IV MISCELLANEOUS INJURIES

A Lacerations

1 Walking on refuse

2 Children playing

3 Scavengers handling refuse

4 Flipping up or flying objects

B Bites

1 Animals

2 Vectors

V CONSTRUCTIVE PREVENTIVE STEPS

A An Aggressive Safety Program

1 A "Program Guide for Public Employee Safety" from NSC is available

2 Safety programs that have been successful:

a Dallas, Texas

b North Miami, Florida

c National Disposal Contractors

3 A safety program may be organized through committees:

a Department heads

b Selected individuals

c Should meet regularly

4 Training program essential

a Supervisory training

1) General safety

2) First aid

b Employee training

c Get help from State Industrial Commission (Ohio; Florida; California; Michigan).

5 Driver and heavy equipment operator training

a Use of collection and other heavy equipment

b Use of safety equipment

6 Safety equipment (as situation warrants)

a Leather shoulder and hip pads

b Rubber gloves and aprons

c Safety shoes

d Eye shields

e Goggles

VOLUME REDUCTION I: ONSITE SYSTEMS

Training Staff*

I DEFINITION OF ONSITE

A Onsite is any physical location where solid wastes are produced such as a factory, restaurant, institution, multiple dwelling unit or the private home.

B Some Types of Volume Reduction Are:

1 Mechanical compacting

2 Incineration

3 Pulping

4 Composting

II REASONS FOR ONSITE VOLUME REDUCTION

A For Health and Economic Reasons, Onsite Volume Reduction is Beneficial.

1 Elimination or reduction of food and harborage for mosquitos, flies, rats, roaches.

2 Smaller quantities of refuse may be stored, which generally keeps the area neater.

3 Reduces chances of accidents such as children being poisoned, or fires.

B Economic

1 With reduced volume of refuse there is correspondingly less handling of refuse and lower labor costs.

a Refuse usually goes directly into reducing mechanism at large establishments such as apartments, restaurants, factories.

b Garbage is fed directly into grinders with no secondary handling.

c Fewer items are carried from storage area to collection truck.

2 Collection costs may be reduced or better service may result from onsite volume reduction.

a Municipality might collect the smaller quantities involved from apartments which were not previously served.

b Less work is done by collectors.

c Charge by private contractors may be lower.

III METHODS OF ONSITE VOLUME REDUCTION FOR INDIVIDUAL HOMES

A Composting - Includes Standard Farm Composting and Bottomless Cans Set In Ground with Tight-Fitting Tops.

1 Advantages: in bottomless cans food wastes shrink and decompose to about $\frac{1}{4}$ of original volume.

2 Disadvantages:

a Open pile encourages breeding of flies and rats.

b With open pile it is difficult if not impossible, to do a good job without first shredding or grinding.

c Can must be cleaned out every 8 to 14 months.

d Residue is odorous, must be buried or composted elsewhere with other material such as leaves or garden wastes.

e Container rusts and is difficult to dig out.

B Dump - is not satisfactory generally and its use even on a farm or ranch is questionable for the reasons of fire hazards, rodent, fly and mosquito breeding and accident potential for humans and domestic animals.

C Backyard Burning - a simple method of refuse volume reduction by open burning on ground, in wire mesh container, drum or outdoor fireplace.

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

1 Advantages: reduces volume for collection.

2 Disadvantages:

a Produces air pollution due to low burning temperature and incomplete combustion.

b Attracts flies, rats and small animals.

c Produces odors.

d Residue remains to be disposed of.

e Safety - fire

IV METHODS OF ONSITE VOLUME REDUCTION FOR INDIVIDUAL HOMES AND MULTIPLE UNITS

A Garbage Grinders - in the mind of the housewife or whoever uses a grinder this is a true type of garbage disposal. However, it is really a means of preparing garbage for water transport to another location for treatment.

1 Advantages:

a Reduces total collected refuse volume about 10%.

b Convenient - particularly at restaurants, institutions, produce markets

c Reduces length of storage time.

d May eliminate home garbage can.

2 Disadvantages:

a Does not handle all food wastes (large bones, fibrous material).

b Considerable variance in size of grind.

c Considerable difference in safety features between makes.

B Domestic Incinerators

Indoor domestic incinerators without auxiliary fuel - slightly better than outdoor types due to taller chimney.

1 Domestic incinerators using gas for auxiliary fuel are of three general types:

a Dehydrating units - provide a continuous flame (or hot plate if electric) which heats and dries refuse which then ignites. The flame is not in direct contact with refuse.

b High Btu input units - act as a storage unit until ignited when full. Often has timer on burner to turn off at preset time.

c High Btu input units with afterburner - similar in appearance to other home incinerators except that the combustion chamber is baffled so that the gases of combustion from the primary chamber must pass down and under the baffle to reach the secondary chamber. About 1/3 of gas Btu output is discharged into the primary chamber and 2/3 into the secondary chamber. Secondary flame burns smoke and oily vapors from the primary chamber.

2 Problems with domestic incinerators include:

a Limited air supply

b Small combustion chamber volume

c Low flue gas temperature

d Poor residue quality

e Odors

f Air pollution - fly ash, smoke

g Lack of proper insulation

h Danger of flashbacks

i Personal cost to homeowners usually more than municipal collection

j Householder may cut back on timer to save gas

k Householder may pile incinerator full of wet material it can not handle.

C Flue-Fed Incineration - Primarily apartment house systems which are composed of a single or multiple basement chamber with either an integral flue for both refuse delivery, and flue-gas exhaust, or a double flue comprising one flue for refuse delivery and other for flue-gas exhaust.

1 The elementary designs of single-flue incinerators have proved unsatisfactory for achieving complete combustion of refuse.

a Excess of combustibles found in residue

b Incompletely oxidized materials discharged to the atmosphere contain a wide range of hydrocarbons and other odorous and harmful emissions including:

1) Highly odorous aldehydes - acrid, citric, rancid butter

2) Organic acids and esters - fruity

3) Small amounts of oxides of nitrogen

4) Small amounts of sulfur compounds

c Fly ash, charred paper, and other particulate materials discharged to the atmosphere.

d Smoke and odorous gases from flue escape into corridors

2 Despite the disadvantages, existing apartment house flue-fed incinerators have continued in use in some communities because they are:

a Simple and convenient for the occupant

b Economical for the apartment owner

c Reduces load on municipal disposal facilities

D Home Compaction Units

V METHODS OF ONSITE VOLUME REDUCTION FOR MULTIPLE - FAMILY UNITS, HOSPITALS, OFFICE BUILDINGS

A Pulping[5] - A process in which paper wastes are ground in a water vortex then squeezed semi-dry. Originally designed for elimination of secret documents - banks use them.

1 Advantages:

a Provide fast and reduced handling of wastes

b Aid prevention of contamination of hospitals

c 80% volume reduction

d Good for "high-rise" developments

e Can have more than one service unit serving central dewatering unit

f Has trash receptacle; restaurants save silverware

2 Disadvantages:

a Expensive initial cost

b Require specialized equipment

c Chutes may plug up

d Increase water consumption

B Compaction

A method of onsite volume reduction, consisting of packaging refuse under compression into paper sacks or containers.

1 Advantages:

a High compaction ratio up to 75%

b Reduce space needed for waste storage

c Eliminate rubbish barrels

d Quieter, lighter, easier to take refuse to collection point

e Eliminate onsite incineration where air pollution legislation is in force

f Reduce manhours

g Reduce handling and hauling costs

h Can be manually operated; or automatically with chutes

2 Disadvantages:

a Require compressed air for some models

b Must have facilities for wheeling containers to collection truck

c Chutes plug

d Chutes must be sanitized

VI OTHER ITEMS CONCERNING ON-SITE VOLUME REDUCTION

A Research

B Planning for New Buildings

C Ordinances and Enforcements

D Field Evaluation Techniques

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VOLUME REDUCTION II: CENTRAL SYSTEMS

Training Staff*

I INTRODUCTION

Even with on-site volume reduction methods finding increasing use in the United States, there still exists a very real need for more centralized volume reduction systems. Some of the newer approaches to volume reduction are grinding, baling and liquid-waste pulping. All of these techniques serve to reduce the amount of land required for final disposal.

II GRINDING

To date refuse grinding has been utilized principally in conjunction with the composting process. Recently the grinding process has been considered for use with baling, sanitary landfill, and incineration. Several manufacturers are now producing or developing grinders suitable for use with municipal refuse.

A Reasons For Grinding

1 Some volume reduction achieved

2 Elimination of voids

3 Permits easier handling of material

4 Permits easier compaction of material

5 Homogenizes material somewhat

6 Promotes more complete burnout from incineration

B Disadvantages of Grinding

1 Some materials not grindable

2 Need for downtime alternative procedure

C Grinder Designs

1 Horizontal hammermills - Floating hammers on a rapidly rotating rotor strike the material. When sufficient size reduction is achieved, the material passes through grate bars. Several mills may be arranged in series to achieve even further particle size reduction.

2 Vertical hammermills - These are similar to horizontal mills except that the rotor is now vertical. Material is fed in at the top of the mill and passes down through a series of rapidly moving hammers. No grate system is used.

3 Other designs

a Impact mills

b Knife hogs

III BALING

Baling of material has been widely practiced by agriculture and industry. Balers have been developed to handle material ranging from hay to paper to metal. The refuse balers being developed now in the U. S. are generally variations of the older baler designs.

A Advantages of Baling

1 Volume reduction

2 Increased payload after transfer

3 Easy handling

4 Better dust and odor control

5 Possible use for bales

B Disadvantages of Baling

1 Non-baleable items exist

2 Too high moisture content can cause extrusion of juices

3 Need down-time alternative procedure or stand-by baler

C Baler Designs

1 Agricultural type baler - The basic baler has been "beefed-up" to withstand abrasiveness of solid waste.

a Nearly continuous operation

b Single reciprocating hydraulic ram

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c Compression is one direction only

d Tie-wires used to enclose bale

2 Scrap metal type baler - This baler is similar to junk automobile balers.

a Batch operation - one bale per cycle

b Several hydraulic rams used

c Compression in two or three directions

d Bales may or may not be enclosed

3 The Tezuka-Kosan Press - This is essentially a large scrap metal type baler. Publicity concerning this baler has been widespread.

Consists of:

a Preliminary compression system (pressure of 221 to 425 pounds per square inch)

b Main compression system - two step pressure exerted (675 psi, then 5120 psi)

c Optional 12 cylinder kneading sequence main compression system available (5, 278 psi)

d May enclose bales with chicken wire and coat with cement or asphalt

e Bale height determined by compressibility or refuse

D Grinding May Be Beneficial To Baling For the Following Reasons:

1 Increase bale densities

2 More uniform moisture distribution

3 Less loss of fines

4 Less presorting

5 Less bridging problems

IV LIQUID WASTE PULPING

Recently, wet-paper pulping equipment has been adapted to handle general municipal refuse. The addition of water to the refuse apparently makes a large portion of the wastes (particularly cardboard and paper) more readily grindable.

A The pulper consists of a drum, into which refuse and water are mixed. At the bottom of the drum is a rapidly rotating grinding blade overriding a perforated face plate. The pulped material is extruded through this plate. Other features of this pulper are:

1 Junk-chute where nongrindables are automatically ejected

2 Grit (ground glass and heavy particles) is separated from process in liquid cyclone

3 Pulp is dewatered

4 Process water is recycled

B Material From This Process Is Not Used For Baling

V GRINDING AND BALING COSTS

Grinding and baling costs are not well established yet, since most of this equipment is still in the developmental phase.

SECTION II

TRANSFER OPERATIONS

Training Staff*

I INTRODUCTION

A Background

1 Transfer stations used during horse-drawn collection era

2 Transfer stations made obsolete by faster trucks used for refuse collection

B The Need for Transfer Stations Today

1 Close-in disposal sites becoming harder to find

2 Wasting time of collection crew during haul

3 Collection agency and disposal agency may be separate

C Considerations for Use of Transfer Operations

1 Cost Analysis and engineering economics

2 Efficiency of system

3 Length of haul to disposal site

4 Time of travel to disposal site

5 Suitability of transfer operations to area

II REQUIREMENTS OF A GOOD TRANSFER STATION

A System Must be Equal to or Better Than Collection System In:

1 Capacity

2 Sanitation

3 Reliability

4 Adequacy

5 Standards of operation

B System Must Not:

1 Provide uneconomical delivery at the disposal site

2 Create confusion or loss of time

3 Create nuisances

III DESIGN CONSIDERATIONS

A Location of Transfer Stations

1 Locate near center of population it serves

2 Be convenient for supplemental modes of transportation

3 Minimize public objection

B Actual Design of System Depends On:

1 Character of refuse handled

2 Quantity of refuse handled

3 Disposal method

4 Site availability

5 Community attitude

6 Collection equipment and methods

7 Any peculiar condition of transport

C Other Design Considerations

1 Provisions for sanitation

2 Layout for efficiency

3 Accessories

IV TRANSFER EQUIPMENT

A Transportation Equipment

1 Large body motor trucks with or without compaction

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2 Water transport

a Self-propelled

b Ancillary propulsion

3 Rail haul equipment

a Adaption of existing equipment

b Specialized equipment

B Transfer Stations - General Types

1 Direct dump - utilizes gravity

2 Storage type - involves rehandling

3 Ancillary equipment

a Air pollution control devices

b Handling equipment

c Sweepers

C Mobile Transfer Equipment - Considered As Collection System

1 Train or scooter system

2 Detachable containers

V ECONOMICS OF TRANSFER

A Transfer Cost Usually Linked With Disposal Operation

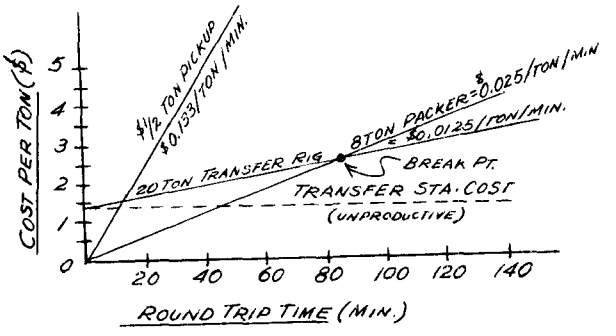
B To Justify Use of Transfer, Total Cost of Collection, Transfer and Disposal Must Be Less Than Total Cost of Collection and Direct Haul With Disposal.

C Transfer Station Costs

1 Total unproductive cost = per ton cost of owning, operating and maintaining station, plus billing and accounting expense, plus expense of extra time used at disposal site

2 Haul cost - given in dollars per ton per minute

Plot Cost per ton versus round trip driving time (minutes) for the transfer system and its alternatives.



VI TYPICAL COSTS

A Los Angeles County, California

1	Operation and maintenance	$2.49/ton
2	Amortization	0.19/ton
3	Total	2.68/ton

4 Includes transfer to sanitary landfill

B Orange County, California

1	Operation and maintenance	$0.72/ton
2	Cost of transfer haul	0.92/ton
3	Total	1.64/ton

4 Includes no collection costs

26 miles round trip; 4 stations - average 910 tons/day each

VII ASSOCIATED OPERATIONS

A Grinding and Pulverizing

B Baling

C Salvage

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INCINERATION

Training Staff*

I INTRODUCTION

A Incineration is normally used as a disposal method in favor of some other type because of:

1 Shorter haul distances because of a more central location.

2 Nonavailability of suitable sites or conditions conducive to other disposal methods.

3 In some cases community officials may feel that they have "grown up" to the point where incineration is what they need regardless of the economics or other factors, or they may have the idea that a physical structure will be easier to sell the citizens.

B The Purpose of Incineration is to Provide as Complete a Combustion Process as Possible to·

1 Reduce the volume of the solid waste to a more easily disposed of quantity.

2 Minimize environmental pollution from the process such as air, water, or land.

3 The residue should contain as little combustibles and putrescibles as possible. (Present recommendations call for a maximum of 5% combustibles and 1% putrescibles in terms of total dry weight of residues.)

C The Process Should be Planned, Designed and Operated to Reduce Such Nuisances as:

1 Traffic problems such as heavy truck travel through residential areas.

2 Dust which is generated in operations such as unloading and charging.

3 Noise which may be particularly objectionable at night.

4 Steam plume which may be aesthetically objectionable.

5 High stacks which may not be in conformance with area architecture.

II GENERAL DESIGN CONSIDERATIONS

A Site Selection

1 Population growths and trends to determine a site as close as possible to the center of generation.

2 Good access to the site is essential.

3 Incinerators require a complete range of utilities.

a Electricity for cranes, fans, grates, etc.

b Water supply for sanitary, fire protection and process purposes.

c Sewers and in some cases pretreatment facilities to handle waste waters.

d Gas for auxillary fuel and plant heating.

e Telephone communication with entire solid waste management system.

4 Topography and soil conditions can have a major effect on plant construction costs.

5 Land cost is a major consideration in many cases.

6 Residue disposal site must be considered when selecting the incinerator site.

7 Meterological conditions and the relationship to air pollution potential is particularly important.

8 Public opinion and political considerations may be one of the most difficult of all the problems associated with the selection of a site for an incinerator.

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B Selection of the Size of the Incinerator Required is Based On:

1 A design period must be selected which the incinerator is expected to serve normally 20-30 years. Bonding or amortization limits may influence this.

2 Predictions for this period must be made for:

a Population growth

b Per capita solid waste production

c What sources of solid wastes will be handled

3 Stages of construction can be used to meet greater solid waste production demands at various time periods during the expected life of the incinerator.

4 The hours of operation to meet the demands of production should be continually studied to provide the best economy of operation.

5 There are three types of capacities which must be defined and applied to each incinerator:

a Design Capacity - the quantity of solid waste expressed in tons per 24 hour period that the designer expects that the plant will handle.

b Rated Capacity - the quantity of solid waste expressed in tons per 24 hour period that the incinerator will process while meeting all environmental criteria such as air pollution, water pollution and acceptability of residue. (This may be more or less than the design capacity.)

c Actual Capacity - the quantity of solid waste expressed in tons per 24 hour period that the operator of the incinerator actually processes, e.g., the incinerator may only operate for 8 to 16 hours out of the 24 hour period.

III DESIGN AND OPERATION OF UNIT PROCESSES

A Scales - These are essential to the incineration process in order to provide information on efficiency, operational changes required, and to assist in planning for future facilities.

B Unloading Area - The area must be sufficiently large to provide easy access to vehicles and enough dumping areas to prevent a back-up of traffic.

C Storage Pit - Must be of durable construction, cleanable, and provided with a method of removing nonincinerable materials.

1 Capacity must not be less than 100% of design capacity but should be small enough that it is periodically emptied.

2 Dust control, although difficult to achieve, must be provided in this area.

D Furnace Charging Equipment

1 Types available include overhead crane and charging hopper, conveyor-fed and end-loading rams.

2 Overhead cranes have been by far the most prevalent in incinerator designs.

a Two types are used:

1) Monorail - horizontal movement in only one direction

2) Bridge - horizontal movement in both directions

b The cranes serve three important functions which must be considered in their selection and operation.

1) Charging of the furnaces

2) Casting of material from the front of the pit to the rear

3) Mixing of the solid wastes to obtain a more homogeneous mixture for burning

E Types of Furnaces

1 Batch feed - May have fixed or moveable grates

a Has the advantage of being cheaper in initial cost and smaller capacities are possible.

b Has several distinct disadvantages including very poor temperature control, high maintenance costs, poor residue quality and a high degree of air pollution potential.

2 Continuous Feed - Moveable grates required.

a Advantages over batch feed include larger capacity, better temperature and air supply control, greater flexibility in operating rate, and much less thermal shock to furnace refractories.

b The disadvantages compared to batch feed plants are actually minor compared to the advantages. They include a higher initial cost and a higher degree of skilled labor.

F Grate Types

1 Fixed grates for batch feed incinerators require hand stoking to remove the residue. This type is almost obsolete for municipal incineration.

2 Conical grates sometimes equipped with moving arms for batch or intermittent feed furnaces.

3 Traveling grates which are a continuous belt on which the burning takes place. Only mixing and breaking up that occurs is when the solid wastes falls from one grate to the next if the furnace has a series of these grates.

4 Rocking grates move the solid wastes through the combustion chamber as the grate sections alternately raise and push the material ahead. This action breaks up the material and enhances more complete combustion.

5 Reciprocating grates, by means of alternate moveable horizontal grate sections which slide back and forth, move the solid wastes through the combustion chamber and breaks up the material.

6 Rotary kilns, in addition to some type of moveable grates for drying and ignition, provide for an excellent residue with very complete burnout because of the breaking up and mixing action which the material receives while tumbling through the kiln.

7 There are other types of grates used in Europe and other places which appear to have some merit for incineration. In addition, other types are being investigated in this country.

G Combustion Chambers

1 Most present-day combustion chambers are refractory brick lined in order to maintain incineration temperature.

a One waterwall type furnace has been built in this country and the degree of success has not been determined at this time.

b Temperatures are normally maintained within a range of 1500 - 1800°F to provide for combustion of odor producing materials but not damage the refractory lining.

2 The design of the dimensions of the chamber should be done on an individual basis. The BTU content of the solid wastes must be determined and the best design based on this. Some rules of thumb which should be used only with caution are:

a Grate area based on a heat release of approximately 300,000 Btu/sq.ft./hr.

b The primary combustion chamber volume based on 20,000 - 35,000 Btu/cu.ft./hr.

c The width of the grates and the furnace are determined mainly by the grate widths available.

3 Combustion and cooling air is introduced into the furnace at various points for various purposes:

a Underfire air is used to promote burning on the grate and cool the grates. An excess of air introduced here will result in an increased particulate air pollution loading.

b Overfire air through the sidewalls and roof to provide for combustion of the gases and provide turbulence and mixing.

H Residue Handling and Disposal

1 The residue from normal incineration will be about 20-25% by weight and

10 - 15% by volume of the solid wastes charged.

2 After leaving the end of the grate the residue is quenched either by

a Water sprays before direct discharge to transport vehicle.

b Submersion in a water bath from which it is carried by conveyor to transport vehicle.

3 The residue is a corrosive and abrasive material which cause considerable wear in all the equipment used to handle the residue.

4 Residue from almost all the presently operating incinerators requires disposal in a sanitary landfill. Excessive combustible and putrescible content excludes disposal by open dumping.

5 In some cases such as rotary kiln incinerators, metals and tin cans may be salvaged from the residue.

I Air Pollution Control Equipment

1 All incinerators must be equipped with some type of properly maintained air pollution control facilities.

a State and local regulations are becoming more difficult to meet.

b The Federal code for Federal installations requires that particulate emissions not exceed 0.2 grain per standard cubic foot of dry flue gas corrected to 12% CO_2. (Very few of the incinerators in this country could meet this code.)

c As better air cleaning is required, the percentage of the construction and operating costs for air pollution control is increasing tremendously.

d At present gaseous pollutants such as SO_x and NO_x are not considered to be a problem. They may however at some future date, e.g., with high temperature burning the production of NO_x will increase significantly and may become a consideration in the future.

2 Types of particulate control equipment - a summary of some of the types available:

a Settling chamber

1) Efficiency - 40 to 60%; large particles are the only ones efficiently removed (greater than 40 microns).

2) Costs - installation costs are low ($0.10 - $.30/cfm) and operating costs are low.

b Inertial cyclones

1) Mechanical (wet cyclones are very similar)

a) Efficiency - 75 to 90%; low efficiency on small particles (less than 10 microns)

b) Costs - installation costs are medium ($0.40 - $1.20/cfm)

2) Multi-cyclones (miniature)

a) Efficiency - 90 to 98%; not too efficient on particles less than 5 microns.

b) Costs - installation costs are low ($0.20 - $0.60/cfm) and operating costs are low.

c Scrubbers

1) Flooded baffle

a) Efficiency - 90 to 99%; good removal down to 1 micron.

b) Costs - installation costs are medium ($0.35 - $1.00/cfm) and operating costs are high.

2) Venturi

a) Efficiency - 90 to 99%; removal down to submicron (less than 1 micron).

b) Costs - installation costs are medium ($0.50 - $1.50/cfm) and operating costs are high.

d Bag house filters (self-cleaning)

1) Efficiency - 98 to 99.9%; removal down to submicron

2) Costs - installation costs are medium ($0.75 - $2.00/cfm) and operating costs are medium to high.

e Electrostatic precipitator

1) Efficiency - 90 to 99.9%; removal down to submicron

2) Costs - installation costs are high ($1.00 - $5.00/cfm) and operating costs are low.

J Water Supply and Treatment

1 Water at an incinerator is used for:

a Potable sources such as drinking, toilets, etc.

b Process purposes

1) Air pollution control

2) Sluicing fly ash

3) Cooling and residue quenching

4) Heat utilization (steam production)

5) Lubrication

6) Housekeeping

c Another important use is that of fire fighting. Sufficient quantities at high pressure must be available for any fire emergencies at the incinerator.

2 The waste waters from the plant must be discharged in such a manner that no water pollution will result.

a In many cases discharge of all waste waters to a sanitary sewer for carriage to a waste water treatment plant.

b On-site treatment may be used

1) Some waste waters such as residue quenching and particulate scrubbing waters may have to be treated before disposal through a sanitary sewer.

2) Plants which practice recirculation of process will require treatment of the water before recirculation can be done.

3) Where heat utilization is done the water for boilers and other equipment may have to be treated before use and before recirculation.

IV COST AND COST ACCOUNTING

A Capital Costs

1 Cost factors

a Planning costs

b Actual construction costs

c Equipment costs

2 Capital costs for incinerators range from as low as $5000 to $10,000 or more per ton of design capacity. Because of increased mechanization, air pollution control requirements, and construction costs are increasing.

B Total Cost of Incineration - defined as the operating cost plus the capitalization (amortization) cost for the incinerator

1 Operating costs include such items as:

a Labor - including fringe benefits

b Maintenance

c Overhead

d Materials and supplies

e Utilities

2 Capitalization Costs - this is the cost to be applied for the depreciation of the building and all major equipment used in the process.

3 The total cost of incineration will range from about $4.50 to $9.00 per ton of incoming refuse processed. The capitalization cost will vary depending on the estimated life of the facilities and the interest rate.

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SOLID WASTE - A RESOURCE

Training Staff*

I INTRODUCTION

A The definition of solid waste as a "resource" implies that solid waste can be utilized as a secondary source of materials to supplement our natural raw materials. This utilization, rather than disposal of any waste material is known as salvage.

B The extent to which any salvage operation is carried on is dependent on many variables among which are:

1 Characteristics of the waste

2 Nature of material to be salvaged from the waste

a Form

b Concentration

3 Method necessary for salvage

a Physical

b Mechanical

c Chemical

4 Market studies

C The actual salvage operation could be used as:

1 A volume reduction method

2 The disposal method

D Volume reduction is utilized by some industries and could be utilized by some municipalities as a means of reducing the total volume of waste material to ultimately be disposed of.

E Industries and commercial establishments use salvage operations as a disposal method by recycling the total volume of waste material, or recovering and selling this material to the secondary industries.

II SALVAGE POTENTIALS

A Prior to utilizing any salvage operation, certain factors must be considered and a decision reached as to whether or not salvage should be practiced.

1 Does the salvage operation fit into the present method of disposal or operation?

2 What is the market value of salvaged material?

a Cost studies

b Market trends

3 From a public health standpoint, will the salvage operation be efficient and most importantly, nuisance free:

a Excess noise

b Odor

c Esthetics

B Some of the advantages of utilizing salvage are:

1 Provides a source of revenue

2 Decreases amount of refuse to be disposed of

C Some of the disadvantages of utilizing salvage are

1 Market for most salvage materials is unstable.

2 During high market value the amount to be salvaged will decrease.

3 Standby disposal facilities and/or storage facilities must be provided for periods of very low market value.

4 Salvage operations, if conducted as a part of another disposal method, may interfere with the orderly disposal of refuse.

III SALVAGE AS A DISPOSAL METHOD

A In talking about salvage as a disposal method, it must be remembered that the direct recycling or recovery of waste material is applicable only when these wastes are

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homogeneous and their recovery will not interfere with the storage-collection practices.

B The present labor and wage scales that must be adhered to by industry plus the fact that most secondary industries will only buy properly cleaned, sorted, and in some cases, prepared items limits the cyclic reuse of waste materials to those of commercial and industrial establishments.

1 Reuse if material within same industry.

2 Sold to secondary industry as source of revenue.

3 Salvage by scavenger

a Generally on bid with contract basis for one year

b Scavenger pays industry annual fee for pick-up of industrial waste and scavenger uses waste as source of revenue

c Scavenger picks up waste with industry paying scavenger for service.

IV SALVAGE FOR VOLUME REDUCTION

A With respect to municipal solid waste, salvage operations have been initiated as a volume reduction method.

1 To extend life of disposal facility.

2 With available market, to provide source of revenue.

B These salvage operations could occur at numerous areas:

1 At point of generation

2 During collection

3 At disposal facilities

C Salvage may be carried on by the householder.

1 Paper

2 Cardboard

3 Metal

D Materials may be salvaged during, or after, collection·

1 By collection personnel

2 At transfer stations

E Materials may also be salvaged at the disposal facilities.

1 Sanitary landfill

a Storage area

b Separation area

2 Incinerators

a Prior to charging

b After incineration

3 Composting plants, normally as integral part of the process.

F Industrial wastes can also be reduced in volume by utilizing salvage operations.

V SALVAGEABLE MATERIALS

A Garbage

1 The method of disposal known as reduction is a process through which garbage is converted to fats and oils with a residue called tankage.

2 This method of volume reduction was popular and productive prior to World War I.

3 In the reduction process, garbage was cooked with steam in digesters and grease was extracted and sold to soap manufacturers. The residue, tankage, was sold as feed for livestock.

4 The reduction process is now obselete due to the use of synthetic or petrochemicals in soap manufacturing.

5 Garbage has also been used as feed for livestock, notably hogs.

a All states require cooking of garbage

b One state prohibits feeding hogs garbage

B Rags

1 Rags salvaged from municipal refuse is of little use to the paper industry today as only natural fibers can be used in paper manufacturing.

2 Textile wastes (both natural and synthetic fibers) are widely used by the textile industry as a major source of revenue. These wastes not only supplement the primary raw materials used in the industry, but have a wide range of nontextile applications:

a Filler materials

b Insulating materials

c Gift box nesting used by jewelers

d Absorbent medical cotton

e Mattress manufacturing

f Papermaking

g Linoleum

3 Competition from plastics has closed some markets for textile wastes entirely, notably in the manufacture of records.

C Paper and Paper Products

1 Waste paper continues to be the most important source of the so called secondary fibers in papermaking, with 25% of the material being used by the industry coming from salvage.

2 Grading, sorting and decontaminating of waste papers has become a vital segment of the industry, as plastics, adhesives and other coatings pose numerous problems in reclamation.

3 Waste paper can be used in manufacturing:

a Container board

b Box board

c Gypsums and paper board

d Cylinder board

e Roofing materials

f Molded paper containers

D Glass

1 The trade name for broken glass is cullet, and broken glass salvaged for reheating - whatever its origin - is universally known as cullet.

2 An advantage of cullet, that has been properly sorted and segregated, is not only that it economically stretches the supply of virgin materials, but that it melts more rapidly than the virgin sands, and thus shortens the melt time of a furnace batch.

3 The trend toward throw-away "disposable" bottles has essentially eliminated the market for salvaged bottles from municipal solid waste.

4 The major source of cullet is from industrial wastes and is generally recycled within the same industry.

5 Scrap glass is also sold by the primary manufacturers to the secondary industries for various uses:

a Spun glass decorative fabrics

b Match and abrasive industry

c Flashlight lens

d Flat glass circles for gauges

E Tin Cans (Ferrous Metal)

1 Tin cans are salvaged for the ferrous metal content rather than the tin content.

2 Salvaged tin cans are used in:

a Copper precipitation

b Recovery of ferrous metal

F Rubber

1 Rubber scrap today is segregated into several hundred grades, with most of this scrap rubber being reclaimed from automobile tires.

2 Various grades of recovered rubber are ground and chemically treated by the reclaimer and processed into rubber sheets marketed for the manufacture of new rubber articles.

3 An idea of the value of secondary scrap rubber may be gained from the fact that a 20 pound tire contains the equivalent of 6 pounds crude rubber and 100 pounds of old inner tubes equals 65 pounds of crude rubber.

4 Scrap rubber can be used in the manufacturing of:

a New rubber items

b Recapping tires

G Plastics

1 Plastic wastes are almost completely recovered from the plastic industry as an in-house salvage operation.

2 Plastic scrap can be utilized in manufacturing:

a Protective coatings

b Packaging materials

c Toys

H Industrial Wastes

1 Metal scrap

a Principal nonferrous scrap metals commercially recovered in the United States are copper, brass, lead, zinc, aluminum, nickel and magnesium.

b Most collectors sell their scrap to wholesale metal dealers. The dealer segregates the scrap according to types and grades, based upon the actual metallic content and degrecs of contamination.

2 Food processing and farm animal wastes.

a Feathers can be hydrolyzed and fed back to poultry.

b Chicken manure is being fed to cattle.

c Cull fruits and vegetables are fed to stock.

d Charcoal has been made from fruit pits.

VI SPECIAL SALVAGE ITEMS

A Incineration Wastes

1 Waste heat can be used to produce steam.

a Used for heating buildings

b Conversion of salt water[2]

c Many complicating factors to consider

2 Residue - as a fill material

3 Fly ash

a Concrete Products

b Fertilizers

B Automobile Bodies[3]

1 Approximately 6 million automobiles were retired from the highway in 1965.

a All of these are not salvaged as metal scrap.

b Many are stripped at auto wrecking yards.

c Some are used to improve fishing sites or control erosion.

d Others are held in indefinite storage.

2 New changes in steel scrap processing have decreased the market for automobile scrap.

a The newer furnaces have reduced the percentage of scrap which may be added.

b Changes since advent of oxygen convertor furnaces;

1) Open hearth furnace - 35 to 50% scrap

2) Oxygen convertor - 25 to 30% scrap

3 The car body is a solid waste product, legally, administratively, and physically cumbersome to handle.

a Burning out body prepares it for later bundling, or at least accelerates the rusting process.

b Stripped cars may be flattened with a D-8 or D-9 tractor, or with a car crusher; or compressed into a bale.

c Stripped cars may be sheared into scrap, before or after burning.

d Complete processing plants reduce body into sized and sorted scrap, salvage nonferrous metals, and remove nonmetals and dirt.

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SANITARY LANDFILL I

Training Staff*

I INTRODUCTION

A Definitions and Description

1 American Society of Civil Engineers

"Sanitary landfill is a method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary."(1)

2 Training Branch, Office of Solid Waste Management Programs, EPA

"A Sanitary landfill can be defined as a system for the final disposal of solid waste on land, in which the waste is spread and compacted on an inclined, minimized working face in a series of cells and a daily cover of earth is provided so that no hazard or insult to the environment results."

B History and Development

1 Used by the Greeks over 2,000 years ago (burial without compaction)

2 Early municipal waste burial in United States

a Champaign, Illinois, 1904

b Columbus, Ohio, 1906-1910

c Davenport, Iowa, 1916

3 Mixing and covering waste in inert material (soil or ash)

a Germany

b England, called "controlled tipping"

4 Landfill practices with compaction by heavy equipment started in U.S. around 1930

a New York City

b Fresno, California; Jean L. Vincenz originated term "Sanitary Landfill"

5 Used by U.S. Army during World War II

II METHODS OF SANITARY LANDFILLING

A Area Method

1 Best suited for gently sloping land and is also used where quarries, ravines or other suitable land depressions exist.

2 Cell walls are formed by the adjacent cells.

3 Normally the earth cover material is hauled in or obtained from adjacent areas.

B Trench Method

1 Best suited for flat or gently sloping land where the water table is not near the surface.

2 A trench is cut in the ground and the solid waste placed at the bottom of a working slope.

3 Excavated earth from the cut is used as the cover material.

III PLANNING AND DESIGN CONSIDERATIONS

A Preliminary Planning - Should Include Consideration Of·

1 A competent designer and planning group

2 A public information program

3 A survey of solid waste practices

4 Financing methods

5 Use of completed site

6 Site zoning arrangements

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B Design Responsibilities and Resources

1 Planner or planning agency

a Responsible for area planning

b Extent of planning detail does vary

c Legal responsibility will vary with establishing authority

2 Design engineer

a Must collect and evaluate data, schedule implementation activities, and consider such items as landfill life, public health and personnel safety potentials, and ultimate use.

b Should have a thorough understanding of the state, county and local laws, rules or regulations concerning sanitary landfill site selection, design and operation.

c *Responsible for final site selection*

1) Each government agency having area authority should be contacted

2) Health department should not be excluded as an information source

3) State geological survey agencies may assist in site selection

4) The U.S. Soil Conservation Service may provide additional data

3 Additional resource personnel

a Land surveyor

1) Property description and location

2) Topographic description of existing conditions

3) Field layout of proposed project

4) Final topography survey and facility location

b Geologist

1) Soil types and suitability

2) Bedrock elevations and rock types

c Hydrogeologist

1) Estimated ground water table elevation

2) Surface water location and interrelationship

d Meteorologist or climatologist

1) Prevailing winds

2) Rainfall predictions

3) Frost penetration determinations

4) Temperature variations

e Health officials

1) State and local laws

2) Sanitation practices

3) Nuisance evaluations

4) Aesthetic acceptability

f Public works officials

1) Potable and fire control water supplies

2) Sewers — storm and sanitary

3) Roads — bridges and tunnels

4) Collection methods (if applicable)

g Utility officials

1) Telephone availability

2) Electricity — location and adequacy

3) Estimate of available assistance

h Equipment specialist

1) Selection of proper equipment

2) Maintenance methods

3) Proper operating techniques

4 Other public officials may be able to assist in site selection and in the solicitation of citizen support.

5 The engineer's responsibility does not end with initial design or construction of facilities but includes:

a Continuing operating evaluation

b Ultimate usage

IV SITE SELECTION

A Land Requirements

1 In place refuse densities

2 Cover material requirements

3 Per capita refuse production

B Relative Location to Generating Areas

1 Time spent in hauling refuse more important than distance

2 Highway systems available with ready access to and from the site

3 The capacities of vehicles operating in the system

4 Utilization of transfer operations

C Relationship to Community Growth

1 Direction and magnitude of projected growth

2 Redevelopment and density of refuse

3 Long-range area development

4 Commercial and industrial development

D Utilities

1 Electrical power for lights and equipment

2 Water supply for sanitary purposes, equipment washing and fire protection

3 Sewer service for sanitary waste

4 Telephone, radio communications

E Nuisances That Can Affect Site

1 Traffic to and from site

2 The noise of mechanical equipment

3 Dust is inevitable under certain weather conditions

F Soil Conditions

1 Less suitable soils can sometimes be improved.

2 Cover material may have to be brought to site

G Ground Water

1 Location of ground water table and proximity to surface

2 Leachate from fill

H Access to Site

1 Preferably over high speed, unrestricted routes with easy on-off access in both directions

2 All weather on-site roads constructed for heavy traffic

a Laid out to eliminate crossing of traffic and consequent tie-ups

b Waiting space on-site for scales

c Parking space for employee's automobiles and stand-by equipment

3 Traffic controlled by signs and, if necessary, traffic control lights

I Legal Aspects

1 Jurisdiction, or lack of same, in any area for solid waste disposal

2 State, county and/or local laws

J Public Opinion

Public opinion toward sanitary landfilling is generally negative and the term "sanitary landfill" is synonymous with open dump.

K Political Considerations

Political considerations must also be considered and may range from lack of political support to lack of authority.

L Climatic Conditions

1 Wind

2 Rain or snow

3 Temperature

M Ultimate Land Use

1 Parks and playgrounds

2 Industrial sites

3 Agriculture

V SITE PREPARATION

A Preliminary Work

1 On-site inspection, site surveys, clearance and cleanup of site

2 Construction of all weather access and on-site roads

3 Provision of utilities and drainage facilities

4 Provision of adequate employee facilities

5 Provision of weighing facilities

6 Provision of communication facilities

7 Provision of adequate fire protection

8 Provision of equipment maintenance facilities

9 Provision of adequate fencing

B Nature of Work

It must be remembered that the finished design of a sanitary landfill is an engineered project and all work undertaken to prepare the site and operate the sanitary landfill be considered as any other engineered job including:

1 Use of proper equipment

2 Use of proper construction techniques

3 Adequate supervision of all preliminary site work and actual landfill operation

C Additional Facilities

1 Guard rails or bumper logs at the top of the working face

2 Guide barrels and directional signs

3 Identification signs and information signs

4 A fence completely enclosing the landfill site

5 Drop-off boxes for after hours usage

VI SANITARY LANDFILL EQUIPMENT

The selection of equipment for sanitary landfill operations is dependent upon many variables, including (1) type of refuse to be handled, (2) compaction requirements, and (3) versatility.

A Crawler Tractor

The crawler tractor, and less commonly, the rubber-tired tractor and the steel wheel compactor, are basic pieces of equipment. The crawler tractor can use dozer blades, landfill blades, front-end loader and can pull scraper. It is versatile and can perform all operations including (1) spreading, (2) compaction, (3) covering, (4) trenching, and (5) hauling material.

B Rubber-Tired Tractor

1 Found where only one piece of equipment can be purchased

2 With bucket can rapidly carry and distribute cover material

C Steel-Wheeled Compactor

Can increase densities. Used where operation is on relatively flat terrain and normally found working in conjunction with crawler-tractor.

D Auxiliary Equipment

1 Water truck — to keep down dust

2 Sheepfoot and rubber-tired roller — additional compaction

3 Dump trucks — for hauling cover material

4 Motor graders — for finished grading of completed fill

5 Refuse shredders

6 Draglines

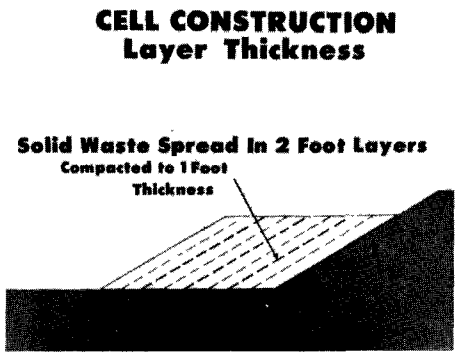
SANITARY LANDFILL II

Training Staff*

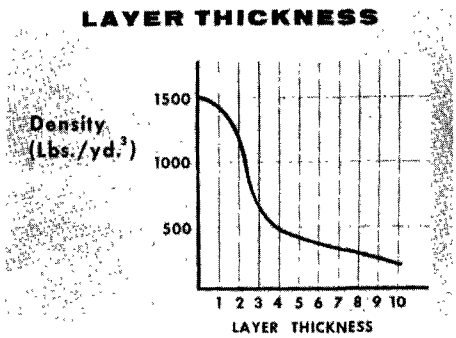
I OPERATIONAL CONSIDERATIONS

The cell concept is used in both the area and trench methods.

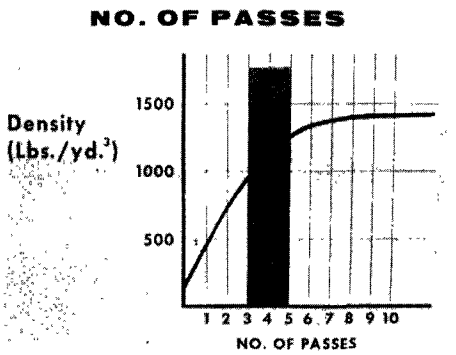
A Cell Development



1 This technique requires the initial construction of a 3:1 slope or berm. Refuse is deposited at base of slope, spread upward in two foot layers and then compacted to about a one foot thickness.



2 This recommended practice is based on field determinations which show that an optimum density is achieved by using a two foot thickness.



3 To achieve this optimum density requires about 5 passes over each layer of refuse.

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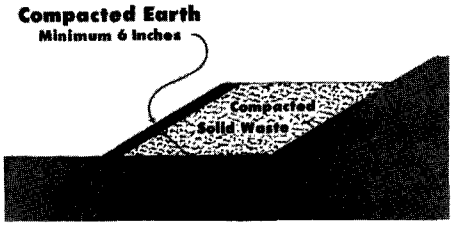
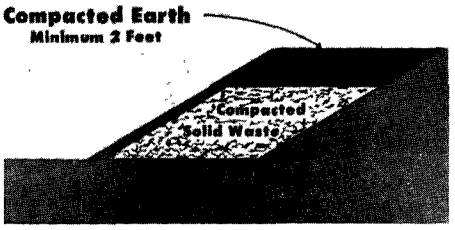
CELL CONSTRUCTION
WORKING FACE COVER



4 Building of cell continues (as outlined in step 1 above) until the day's incoming refuse is compacted in place or desired length is reached. The working face is then covered with 6" of compacted soil.

CELL CONSTRUCTION
FINAL TOP COVER

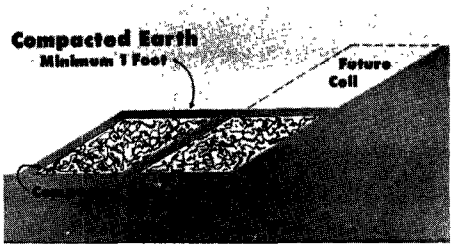


5 Top of cell is covered by no less than two feet of compacted earth. Additional mounding can be provided to allow for settlement and graded to prevent ponding on surface.

CELL CONSTRUCTION
CELL HEIGHT

6 Cell height is measured vertically and is normally 8-10 feet. This will vary and in some cases may be greater, depending on the skill of the operator and amount of refuse being handled.

CELL CONSTRUCTION
INTERMEDIATE TOP COVER



7 If additional lifts (layers of cells) are to be placed above, an intermediate cover of 1 foot of compacted earth can be provided.

8 Other considerations

a In area method, side slopes are also maintained at 3:1 slope and covered with 6" of compacted earth.

b Minimum cell width in Trench Method is about twice the width of a tractor.

c Cell width in Area Method dependent on amount of solid waste deposited and number of pieces of equipment working on slope.

d In both methods the width is maintained as narrow as possible without interfering with unloading of refuse and movement of equipment.

B Control of Dust and Blowing Litter

1 Protection of existing terrain

2 Litter fences

3 Water sprays and waste oil on on-site roads

4 Apply ground cover

C Winter Operations

1 Sanitary landfill trenches may be dug in advance of cold weather

2 Area to be excavated may be covered with leaves or straw

3 Cover materials may be stockpiled in loose fashion

D Wet Weather Operations

1 Standby disposal site near all-weather access road

2 All-weather access roads constructed to the disposal point as fill progresses

3 Cover material covered or demolition and construction materials stockpiled for this purpose

4 Surface drainage slopes and ditches

E Ground Water and Related Pollution Problems

1 High water table operational difficulties

a Inability to properly compact the refuse

b Flotation of refuse

c Limitations on the mobility and usefulness of landfill equipment and/or collection vehicles

2 Water pollution caused by direct horizontal or verticle leaching as result of:

a Chemical contaminants

b Biological contaminants

c Decomposition products

1) CO_2

2) CH_4

3) Hydrogen sulfide

4) NH_3

3 Remedial action

Sites having high water tables may be utilized by using one or more of the following methods:

a Use only that portion of the site sufficiently above the water table to preclude pollution (2' to 5' above known highwater is recommended as a minimum). Cover material may be obtained·

1) On-site, above the water table; or,

2) In an adjacent site by excavating a pond or lake; or,

3) By hauling from another location to the site

b Permanently lower the water table with·

1) Underground drains; or,

2) Drainage ditches

c Temporarily lower the water table with:

1) Well points or wells; or,

2) Direct pumping

3) Deposit only nonputrescible, relatively inert materials to a point sufficiently above the highest known water table so that possible water pollution is avoided

F Conditioning of Cover Material

1 Rock at the fill site

a The selection of a sanitary landfill site containing massive rocks may result in the following problems:

1) On-site cover may be unavailable, difficult to separate and use, or too coarse to be effective

2) Equipment operation is hindered and/or increased maintenance costs result

3) Uneven and unpredictable terrain may upset landfill equipment and/or collection vehicles

b Sites containing massive rocks may be used by employing one or more of the following methods:

1) Haul cover material from some other source

2) Remove excessively large rocks or bury them on site

2 Coarse cover materials

a Sanitary landfill cover materials which are coarse and/or permeable may result in the following conditions:

1) Surface waters may seep into the refuse fill

2) Noncohesive soils may be subject to wind erosion

3) The cover material may shift under the vibration and pressure of heavy equipment

b Sanitary landfill cover material which is too granular may be improved by adding quantities of cohesive soil during placement, spraying cover with asphalt emulsion, or simply applying a clay cover over the coarser material.

3 Clay cover material

a Cover materials containing a high percentage of clay may result in the following conditions:

1) Greasy surface, difficult to compact when wet

2) Excavation difficulties

3) Cracking in the process of drying

b Clay covers can be improved by adding coarser material; sand, cinders, etc.

G Salvaging Operations

The reuse and receiving of solid waste holds great promise as a means of reducing the nation's total waste problem. At the present time, however, a real need is seen for prohibiting salvaging operations at sanitary landfills in order to insure clean, orderly sites and to help maintain their integrity. No matter how commendable, a salvaging operation almost inevitably leads to poor sanitation and should be located elsewhere.

H Large Bulky Items

Cars, refrigerators and other white goods, etc., can be handled simply by reducing their volume and placing at the bottom of the fill.

I Animal Feeding

Hog feeding, sea gulls, etc., have no place in the sanitary landfill and should be eliminated.

J Hot Loads

Should be handled according to a preconceived plan, away from the working area, in a place where everyone should be familiar with its proper handling.

K Sewage Sludge and Reprocessed Oil Sludge

This type of waste, together with other waste such as magnesium and chromate waste, can be accommodated at a sanitary landfill provided their disposal has been anticipated and the site designed accordingly.

II LANDFILL COSTS AND ULTIMATE USE

A Total Cost of Operation

1 Generally falls between $2 - $4/ton of solid waste landfilled

2 In large operations may be less than $1/ton of solid waste landfilled

3 Consists of initial investment for land, equipment, construction features and operating costs

B Ultimate Use

1 Depends on rate of settlement (95% during first 2-5 yrs)

2 Must coincide with regional plan

3 Should consider problems with gas production

4 Must utilize effective planning, particularly when considering construction of buildings and facilities in the proximity of the sanitary landfill

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SECTION III

DUMP CLOSING AND CONVERSION

Training Staff*

I INTRODUCTION

A The closing of a dump is a planned procedure and not merely the act of abandonment.

B Plans for closure or conversion include:

1 Advising public of intended changes and enlisting their cooperation.

2 Preparing acceptable disposal facilities to replace those being closed.

3 Abating existing nuisances at the closed dump and preparing the site for its ultimate use.

II PUBLIC INFORMATION RESPONSIBILITIES

A The public needs to know, and has a right to know, your plans for the existing site and any new sites.

1 The change must be an environmental improvement; rumors to the contrary can be anticipated, particularly in the absence of factual information.

2 Location of new disposal sites must be made known.

3 New restrictions at the old site may include:

a Limited access, particularly during poisoning operations.

b Elimination of dumping, burning, rat shooting, scavanging.

4 Operating rules at the new site may include:

a Hours of operation; access limitations.

b Disposal fees.

c Nature of refuse accepted, vehicles allowed.

d Traffic regulations.

e Restrictions on scavenging, burning.

B Public support to help you do the job may be developed by:

1 Direct approach to;

a People directly involved - political figures, residents near the sites.

b Civic and social organizations.

2 News, other mass media

a Press, radio, television

b House cards, leaflets, displays

III DUMP CLOSURE

A Prepare plans for sanitary landfill operations at same or adjacent site, observing all requisites for suitable operation and/or;

B Prepare plans for abatement of existing dump, with conversion to ultimate use of site. Proper sequence of closing operations is important.

1 Fence or otherwise restrict unauthorized access.

2 Place necessary informational signs and assign dump manager to the site.

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

3 Close dump to incoming refuse or establish a specific spot on the dump for sanitary landfill operation during closing.

4 Extinguish fires.

5 Control vectors.

6 Provide necessary drainage.

7 Establish grades.

8 Compact and cover.

RURAL AND RECREATIONAL SYSTEMS

Training Staff*

I INTRODUCTION

A The principles of design and operation for a small sanitary landfill differ little from the principles for a large operation.

Many responsibilities are necessary whether the operation is large or small and certain criteria must be met for any operation to be termed a sanitary landfill.

B Types of Operation

1 Individual community

2 County

3 Small district

II INDIVIDUAL COMMUNITY

A How small can a community be and still operate a sanitary landfill?

1 Proper operation must be practiced

a Cover at end of each day's operation but may not require full time operator.

b Schedule operation to fit collection practice

c Limit operation to specific time

2 Use a plan that will utilize minimum size working face.

3 If operator is not present full time, arrange so that dumped refuse will be protected from wind until spread and compacted.

4 Close the site to public use when attendant is not present.

5 Use minimum size equipment that can handle the load, but arrange for stand-by equipment to be available in case of breakdown.

B New Hampton, Iowa - Population 3,600

1 History and background

a Prior to 1964, disposal by open, burning dump

b In 1962, City Planning Commission investigation began, without success, to locate a new disposal site.

c Search for new site began again in latter part of 1963.

d Through efforts of Mayor, City Council and interested citizens during January 1964, a new site was located on a farm 2-3/4 miles from town.

e After various meetings to convince farmer's groups a sanitary landfill would be run, on July 27, 1964, city passed an ordinance which established a sanitary landfill area and provided for its regulation.

f Subsequently, City Council passed a resolution establishing rules and regulations for the rise of landfill area.

g Consulting engineer retained to lay out basic plan for earth movement and operation of the sanitary landfill.

h The consulting engineer's plan together with State Health Department recommendations were very important in successful development of the landfill area.

2 Regulations

a Open to public on Wednesday and Saturday, one to four p.m., from April 1st to November 1st; on each Saturday from one to four p.m., from November 1st to April 1st.

b A man will be on duty whenever open to general public to direct traffic and enforce regulations

c Operating area of 7 acres fenced with no dumping outside the fenced area.

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

d Will not accept junked autos, dead animals, explosive materials or other items so large as not to be compressible for landfill operations.

e Use of sanitary landfill is restricted to residents or agencies, businesses or commercial establishments outside corporate limits but served by the City's collection service.

f All users shall deposit refuse directly into the trench for spreading, compaction and cover.

g Licensed hauler s fee is $10 per load. Residential fee for dumping is $.75, and commercial fee is $1.50 and $2.50.

3 Soil conditions and land requirements

a Soil is well graded coarse to fine sand with trace of nonplastic fines and drains well.

b Precipitation averages 31 inches per year, snowfall averages 35 inches per year; and, temperatures vary from minus 20 degrees to 100 degrees.

c Present site total 90 acres which cost $13,000.

d Original 7 acres fenced off in August 1964, will be filled by spring 1969. In November 1968, operating area expanded to include 10 more acres.

e Remainder of 90 acres rented for $800 per year for agricultural use.

4 Operating procedures

a When a city collection truck is at the site unloading, one member of the collection crew operates the track-type tractor to spread, compact and cover.

b A city sanitary landfill equipment operator is present during public disposal hours.

c If a major contractor or business within New Hampton wants to dump solid wastes when the landfill is normally closed, they must arrange for one of the equipment operators to be at the sanitary landfill.

5 Equipment

a Initially an Allis Chalmers HD-9 track-type dozer which was too small.

b Initially trench digging contracted locally to an earth-moving contractor at $100 per month.

c City operated for 15 months in this manner or until November 1965. City then purchased a 1950 model 977 Caterpillar Traxcavator with a 2 cubic yard bucket.

d Traxcavator could dig trenches but trench sides tended to cave in during excavation. In August 1967, a used 1950 model Lorain dragline was purchased, repaired and put into operation during January 1968. The dragline has proven quite effective.

e A movable garage equipped with lighting, telephone, and which can be heated is provided.

f Consideration being given to purchase of a wood chipper

6 Operational costs

a In 1967, New Hampton spent $41,930 for operating entire solid wastes management system. This includes:

1) Purchase and repair of dragline - $16,500

2) Operation and maintenance of two compactor collection vehicles - $3,680

3) Packer unit reserve - $5,000

4) Operation and maintenance of the sanitary landfill equipment - $6,180

5) Salaries of four men working 42 to 45 hours per week -$19,970.

b In 1968, the city budgeted $37,000 for the annual operation of their solid wastes management system.

7 Public acceptance

a City collection is not mandatory

b Initially 300 homeowners, businesses, and institutions subscribed to service.

c City collection vehicles now make over 800 separate stops per week.

d Collection crews pick up approximately 90 per cent of all solid wastes generated with two private collectors and individuals hauling the balance.

e The monthly service charge is $2.00 for collection and disposal.

III COUNTY SANITARY LANDFILLS

A Huron County, Ohio Sanitary Landfill

1 Location, population and type of county

a Located in north central Ohio

b Rural county with approximately 52,000 population

2 Political subdivisions include:

a Three cities

b Seven villages

c Nineteen townships

3 History and background

a Public awareness began about 1956 with a dump problem

b Dumps in adjacent northern county closed and no provisions made

c Many problems with fires, roaches, rats.

d One city tried to interest county several times, the latest in 1963, in joining forces, but was unsuccessful. This city established their own landfill in January 1964.

4 Organization, investigation, recommendations

a At a joint meeting of county commissioners and County Board of Health on August 5, 965, committee composed of two health board members, a county commissioner and two county sanitarians appointed to study needs, existing services and make recommendations.

b Data obtained from a questionnaire sent to subdivisions representing about 22,000 residents indicated:

4,600 invested in real estate for dumps

2,667 paid annually to rent dump sites

5,643 paid annually for attendants labor

1,700 annually for equipment rental

c Costs ranged from $.50 to $1.00 per resident per year to maintain dumps which in most cases did not provide place to put garbage, combustibles or liquids.

d In addition to the one landfill and 14 remaining dumps, refuse was being hauled out of county from 5 villages and another city was in dire need of a new facility.

e The committee report, endorsed by the Board of Health and passed on to the county commissioners in January 1966, recommended that the county commissioners establish and operate a centrally located county sanitary landfill.

5 Results

a In July 1966, the county commissioners decided to proceed and appointed a committee to develop standards, recommend a method of operation, and find a site.

b A site was purchased in January 1967, and opened on a limited basis on June 1, 1967.

c Site facilities include a service building, scales, fencing and sanitary facilities.

d Equipment includes a D7E Caterpillar

e A lagoon for septic tank and other liquid wastes is provided

f One city closed their dump in July 1967

6 Initial costs in 1967 - $74,340, including:

a Land - 91 acres $13,000

b Equipment - $45,000

c Building, fence, etc. - $16,430

7 Expenditures in 1967 - $7,240, including:

a Salaries for half year - $5,900

b Other - $1,340

8 Income in 1967 - $30,910, including:

a Receipts - $ 3,635

b From general fund - $27,275

9 Expenditures in 1968 approx. -$23,260

10 Income in 1968 approximately -$14,975

11 Expenditures for 8 mos of 1969 -$20,340

12 Income for 8 mos of 1969 -$16,250

13 Fee schedule

a Minimum of $.50 for private car

b Maximum of $2 per ton

B Henry County, Ohio Sanitary Landfill

1 Rural county with 27,000 population located in north-western Ohio

2 History and background

a Each village operated open dump

b Only city in county had two to three months operating time left in their landfill.

c County commissioners declared the county a refuse district August 8, 1967.

d County commissioners purchased 87 acre farm on August 7, 1967.

3 Initial costs - $157,800 - including:

a Land - $69,600

b Caterpillar D7 - $25,000

c 1 cu. yd. dragline - $39,000

d Maintenance building - $17,000

e Scales - $7,200

4 Initial estimated volumes per year:

a One city - 3,000 tons

b Industrial plant - 3,000 tons

c Balance of the county - 4,000 tons

5 Volumes actually received during first six months from July 1, 1968 through December 1968.

a From city - 1,450 tons

b Industrial plant - 4,475 tons

c Balance of county - 1,200 tons

6 Fee schedule

a Minimum of $.75 for cars

b Scaled from $.80 for 450 pounds to $3.50 for one ton

c Total receipts for first six months were $25,000

7 Public acceptance

a The only city and at least 4 villages joined refuse district

b Farmers satisfied to use the landfill

c Neighbors satisfied with operation.

8 Additional equipment purchased

a Used air compressor

b Used road grader

IV OREGON RURAL DISPOSAL SITES

A County-wide Solid Waste Disposal

1 Counties experienced large quantities of illegal roadside dumping.

2 Goal to reduce or eliminate roadside dumping by providing free dumping sites open seven days a week.

3 In three counties responsibility of the program given to the county health department.

4 In other counties program assigned to the county road department or public works department.

5 Operation of sites

a Maintained once or twice weekly

b No caretaker on duty

c Public directed by signs

d No salvage allowed to accumulate

6 Equipment

a 7 to 9 cubic yard dump truck

b 18 ton tilt-deck trailer

c D-6 with 4 in 1 bucket

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2 Henry County, Ohio. Information obtained during on-site visits and personal communications with Robert C. Jones, Consulting Engineer, Napoleon, Ohio.

3 Huron County, Ohio. Information obtained during on-site visits and personal communications with Clarence R. Ellett, Deputy Health Commissioner, Huron County Health Department, Norwalk, Ohio.

4 Oregon Rural Landfill Disposal Sites. Information obtained from Bruce B. Bailey, Solid Waste Program, Oregon State Board of Health, Portland, Oregon.

KEEPING THE PUBLIC INFORMED

Training Staff*

I INTRODUCTION

A The solid waste system must be designed properly to work properly but the social, cultural, psychological implications of refuse must be recognized and considered for the system to work.

II THE PUBLIC HAS A RIGHT AND A NEED TO KNOW

A Support Comes Through Understanding

1 The public sits in judgment on your proposed disposal operation and will decide whether or not they want it. To judge realistically they must know.

a The need to stop improper operations

b Needed human and material resources

c The role of individuals and public and private agencies in helping with the needed changes.

2 Their cooperation is needed. It is affected by their attitudes toward your operation and their understanding of what is required on their part.

B The Public Are Customers and Partners in Your Disposal Program

1 Householders and businessman, industry, and city or private solid waste collection agencies are probably all users of your disposal site. They must learn how to use it.

2 The individuals and groups served by you want to know the benefits (or disadvantages) that your disposal system offers them.

III THE INFORMATION MUST BE APPROPRIATE

A Timing Is Important

1 Your message is weakened if it comes too early or too late.

2 The sequence of events and activities must be logical.

B The Message Should Be Clear, Sufficient, and Properly Directed.

1 Absence of information breeds mistrust. People tend to be "down on what they are not up on." Rumor and misinformation flourish when good information is lacking.

2 Always be honest, but do not stir up people unnecessarily with controversial matters.

3 Material which is not understandable, or is directed to the wrong group, just causes confusion.

4 Last minute "once over lightly" efforts to reach the public may actually just stir up misunderstanding, speculation, and resentment.

IV BARRIERS TO COMMUNICATION

A Differences In Backgrounds Hinder Understanding

1 Language is an imperfect tool. People may not understand what you mean, particularly when the subject is technical.

2 Because of interests and problems different from yours, the public may view your program differently than you do. Try to anticipate their attitudes.

3 There may be other matters (a school bond issue, a local governmental crisis, etc.) which will affect your program even though not directly related to it. Keep your eyes open for these possible conflicts.

B Solid Waste Tends To Be an Emotionally Negative Subject

1 Solid waste is unwanted, by definition. The public has to understand that money and equipment for proper disposal are not being expended on the refuse per se, but on maintaining a livable environment.

2 Solid waste is boring, useless, ugly, or degrading to some people to the point where they block their minds to rational solutions.

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C There Is Tremendous Competition for Public Attention

V ASSETS TO COMMUNICATION

A Your Cause Is Obviously Worthy in Principle

1 The open dump with its rats, flies, smoke and unsightliness is generally recognized to be evil.

2 You represent a respected agency.

B The Public is Already Somewhat Informed and Interested About Disposal Practices

1 Interest in pollutional control has already been stimulated by recent national publicity. This helps tremendously.

2 Getting heard or read is no longer so much of a problem. This makes it easier for you to proceed with the business of convincing the public that your approach to the disposal problem is the right one, and ought to be supported.

VI WHAT NEEDS TO BE TOLD

A What Is to Be Done, and Why

B Effects (Favorable and Unfavorable) on the User

1 Better environment, better service

2 Higher costs, etc.

C The User's Expected Role in Helping Improve the Disposal System

D The User's Responsibilities in Using the System

E Progress Reports on Your Program

1 Before-and-after pictures and stories of your work in eliminating dumps and establishing sanitary landfills can be most persuasive arguments in winning public support.

2 You need to update information on what is going on so the public will not lose interest or faith in you.

VII HOW TO DO IT

A Read "Getting Your Message Across" and get to work. Forget excuses that you do not speak well, or that this is not really your job. Public relations is everyone's.

B Remember that the public is a part of your operation. Work with:

1 Responsible individuals

a Those particularly affected by your proposed changes

b Generally accepted leaders

2 Social, civic, religious, fraternal, and volunteer organizations. Do not forget the school kids.

3 Mass media:

a The press

b Radio and television

c Posters, leaflets, displays

C Your Organization and Actions Can Win Public Support Directly

1 Be sure your personnel and equipment help you create a good image.

a Simple, neat uniforms

b Clean, well-maintained equipment

c Signs that look nice, help the user instead of just telling him what he cannot do.

d Courteous, informed workers

2 Early in the effort, make a few obviously desirable improvements and make sure the public knows about it.

a News coverage of dump cleanup

b Neat signs, early planting of trees and shrubs

VIII SOME FINAL THOUGHT

A Tell the whole story. Tell the good and the bad and never lie. Do not be bashful about your achievements, though. You have a concept to sell.

B Do not Expect Overnight Miracles in Changing Public Attitudes. There is much competition for individuals' attention and communication can be a slow process.

C Expect Some Opposition and Be Prepared to Overcome It. Some will misunderstand your program and some will be adversely affected despite all you can do. And a very few are opposed to any change. Answer reasonable opposition and do not wear yourself out on the others.

D Notice That This Outline is Entitled "Keeping the Public Informed." Your Efforts Must be Diversified and Sustained to be Effective.

REFERENCES

1 Air Pollution Control Association. How to Tell the Air Pollution Control Story. Pittsburgh, 12pp. 1965.

2 National League of Cities. Careers in Municipal Public Relations. Washington, D.C., 9 pp. 1965.

3 Wilcomb, M.J. Getting Your Message Across. DHEW, PHS, ECA Training Institute, Cincinnati, 15 pp. 1969.

APPENDICES

SOLID WASTE DEFINITIONS

Training Staff*

ACRE

Unit for measuring land, equal to 43,560 sq. ft.; or 4840 sq. yd.; or 160 sq.rds.

ACTINOMYCETES

A large group of microorganisms closely related to bacteria, but the cells show branching, and form masses like the fungi do, except that the cells are much smaller. Actinomycetes give the characteristic odor of rich earth, are important in giving off-tastes to food and water, and are of significance in the stabilization of solid waste (composting) and sewage.

AERATION

The process of exposing something to air or charging a liquid with gas.

AFTERBURNER

A device used to burn or oxidize the combustible constituents remaining in the effluent gases from prior combustion processes.

AGGREGATE

Crushed rock or gravel screened to sizes for use in road surfaces, concrete, or bituminous mixes.

AIR, AMBIENT

The surrounding environmental air.

AIR, COMBUSTION (EXCESS)

Air supplied in excess of theoretical air, usually expressed as a percentage of the theoretical air. Also called excess air.

AIR, COMBUSTION (OVERFIRE)

See AIR, COMBUSTION (SECONDARY)

AIR, COMBUSTION (PRIMARY)

Air admitted to a combustion system at the point of initial oxidation of the fuel. For example the air admitted through the fuel bed.

AIR COMBUSTION (SECONDARY)

Air introduced above or beyond the fuel bed by natural, induced, or forced draft. It is generally referred to as overfire air if supplied above the fuel bed through the side walls and/or the bridge wall of the primary chamber.

AIR, COMBUSTION (STOICHIOMETRIC AIR)

See AIR, COMBUSTION (THEORETICAL)

AIR, COMBUSTION (THEORETICAL)

Air, calculated from the chemical composition of waste, required to burn the waste completely without excess air. Also designated as stoichiometric air.

AIR, COMBUSTION (UNDERFIRE)

See AIR, COMBUSTION (PRIMARY)

AIR DEFICIENCY

Insufficient air, in an air-fuel mixture, to supply the oxygen theoretically required for complete oxidation of the fuel.

AIR POLLUTANT

A substance when present in the atmosphere in concentrations large enough to interfere directly or indirectly with man's comfort, safety, health, or full use or enjoyment of his property. The substance source may be natural or man-made.

AIR POLLUTION

The presence of contaminants in the air to such a degree that the normal self-cleansing or dispersive ability of the atmosphere cannot cope with them.

AIR QUALITY STANDARDS

Levels of atmospheric contamination by specific pollutants or combinations of pollutants prohibited under laws or ordinances enforced by municipal or state governments or regional agencies.

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ALKALINITY

A quantitative measure of the capacity of liquids or suspensions to neutralize strong acids or to resist the establishment of acidic conditions. Alkalinity results from the presence or bicarbonates, carbonates, hydroxides, volatile acids, salts, and occasionally of borates, silicates and phosphates. Numerically it is expressed in terms of the concentration of calcium carbonates that would have an equivalent capacity to neutralize strong acids.

ALGAE

Plants found in sunlit situations on land as well as in fresh and salt water over a wide range of latitude. They grow as individual cells, small clumps or large masses.

ANGLE OF REPOSE

The maximum angle which the inclined surface of a pile of loosely divided material can make with the horizontal.

AQUIFER

Underground water-bearing geologic formation or structure.

ARCH, DROP

Any vertical refractory wall supported by arch construction which serves to deflect gases in a downward direction. (Sometimes referred to as a curtain wall.)

ARCH, FURNACE

A substantially horizontal structure extending into the furnace to serve as a deflector of gases.

ASHES

The residue from the burning of wood, coal, coke, and other combustible material.

AUXILIARY-FUEL FIRING EQUIPMENT

Equipment to supply additional heat by the combustion of an auxiliary fuel for the purpose of attaining temperatures sufficiently high (a) to dry and ignite the waste material, (b) to maintain ignition thereof, and (c) to effect complete combustion of combustible solids, vapors, and gases.

BACKFILL

The material used in refilling a ditch or other excavation or the process of such refilling.

BACKHOE

A mechanical hoe or pull shovel.

BACTERIA

Single-celled organisms, microscopic in size, which possess rigid cell walls and when motile have flagella. The cell nucleus is not surrounded by a membrane. There are three major groups true bacteria, actinomycetes, and budding bacteria. Some are capable of causing human, animal, or plant diseases. Some are important in sewage or refuse stabilization.

BACTERIA, AEROBIC

Bacteria which require the presence of free (dissolved or molecular) oxygen for their metabolic processes. Oxygen in chemical combination will not support aerobic organisms.

BACTERIA, ANAEROBIC

Bacteria that do not require the presence of free or dissolved oxygen for metabolism. Strict anaerobes are hindered or completely blocked by the presence of dissolved oxygen and in some cases by the presence of highly oxidized substances such as sodium nitrates, and perhaps sulfates.

BACTERIA, FACULTATIVE

Bacteria which can exist and reproduce under either aerobic or anaerobic conditions.

BAFFLE

Any refractory construction intended to change the direction of flow on the products of combustion.

BAFFLE CHAMBER

A device designed to promote the settling of fly ash and/or coarse particulate matter by changing the direction and/or reducing the velocity of the gases produced by combustion.

BAFFLE, WATER-COOLED

A baffle composed essentially of closely spaced boiler tubes.

BEARING CAPACITY

Maximum ability of a material to support an imposed load before failure.

BECCARI PROCESS

Composting process developed by Dr. Giovanni Beccari in 1922. Initial anaerobic fermentation is coupled with a final stage in which decomposition proceeds under partially aerobic conditions. Later modifications were the Verdier and Bordas processes.

BEDDING, ANIMAL

Material, usually organic, which is placed on the floor surface of livestock buildings for animal comfort to absorb urine and other liquids and thus promote cleanliness.

BEDDING, PIPE

Ground or supports in which pipe is laid.

BEDROCK

The solid rock underlying soils and the regolith, or exposed rock at the surface without a cover.

BENCH MARK

A point of known or assumed elevation used as a reference in determining and record ing other elevations

BERM

An artificial ridge of earth.

BITUMINOUS

Containing asphalt or tar

BLADE

Steel plate, concave in vertical plane, affixed to a tractor used for excavation and spreading.

BLADE (SANITARY LANDFILL)

A U-blade with extension fabricated on top to increase volume of solid waste that may be pushed and spread.

BLADE (U)

A dozer blade with extension on both sides, protruding forward at an obtuse angle to the blade, enabling handling of a larger volume of solid waste.

BLUE TOPS

Grade stakes whose tops indicate finish grade level.

BOGIE (TANDEM) (TANDEM DRIVE UNIT)

A two axle driving unit in a truck. Also called tandem drive unit or a tandem.

BOOM

In a revolving shovel, a beam hinged to the deck front, supported by cables. Any heavy beam which is hinged at one end and carries a weight-lifting device at the other.

BORING

Rotary drilling.

BORROW PIT

An excavation from which material is taken to a nearby job.

BOULDER

A rock which is too heavy to be lifted readily by hand.

BREECHING OR STOCK CONNECTION

A passage for conducting the products of combustion to the stack or chimney.

BRICK, ALUMINA - DIASPORE FIRECLAY

Brick made essentially of diaspore or nodule clay, and having an alumina content of 50, 60, or 70 per cent plus or minus $2\frac{1}{2}$ percent.

BRIDGE WALL

A partition wall between chambers over which pass the products of combustion. (see CURTAIN WALL).

BTU (BRITISH THERMAL UNIT)

The quantity of heat required to increase the temperature of one pound of water from 59.5^{o} to 60.5^{o}F.

BUCKET

An open container affixed to movable arms of a loader to move and spread solid waste and soil, and also to excavate soil.

BULKY WASTE

Large items of refuse such as appliances, furniture, large auto parts, trees and branches, palm fronds, stumps, flotage, etc.

BULL CLAM

A bulldozer fitted with a curved bowl hinged to the top of the front of the blade.

BULLDOZER

A tractor equipped with a front pusher blade.

BURNER, PRIMARY

A burner installed in the primary combustion chamber to dry out and ignite the material to be burned.

BURNER,REFUSE

A device of simple construction for either municipal or on-site volume reduction of refuse by burning. Not to be confused with incinerator which, properly designed and operated, can produce an acceptable emission and residue.

BURNER, SECONDARY

A burner installed in the secondary combustion chamber to maintain a minimum temperature and complete the combustion process. (Sometimes referred to as an afterburner.)

BURNING AREA (INCINERATOR)

The horizontal projected area of grate, hearth, or combination thereof on which burning takes place.

BURNING RATE, INCINERATOR

The amount of heat released (Btu) per unit size (ft^2, ft^3) per unit of time (min., hr., day) e.g. Btu per ft^3 of furnace volume per hour. Another, though less exact, expression may be by quantity of solid waste (pounds, tons) per unit or unit size (furnace or ft^2, ft^3) per unit of time e.g. (tons per furnace per day).

BYPASS (BREECHING)

An arrangement of breechings or flue connections and dampers to permit the alternate use of two or more pieces of equipment by directing or diverting the flow of the products of combustion.

CAPACITY, INCINERATOR

a) Design Capacity — the capacity at which the designer expects that the incinerator will be capable of operating; the number of tons of solid waste per 24 hour period, which is anticipated that the plant can process.

b) Rated Capacity - tons of waste per 24 hour day which can be processed, according to specified criteria. Trend is to use criteria relating to residue quality and air pollution standards.

c) Dependable Capacity - plant capacity considering nonoperating time (maintenance, down-time etc.) - usually expressed as a percentage of the rated capacity.

d) Actual Output - actual amount of material processed per day even though the plant may be operated for only a portion of the day.

CAPILLARY ATTRACTION

The tendency of water to move into fine spaces, as between soil particles, regardless of gravity.

CAPILLARY WATER

Underground water held above the water table by capillary attraction.

CARBON DIOXIDE

An odorless, colorless, and nonpoisonous gas. One source is from sanitary landfills undergoing aerobic and/or anaerobic microbial decomposition which is highly soluble in water, forming carbonic acid.

CARBON MONOXIDE (CO)

A colorless gas characterized by an exceedingly faint metallic odor and taste. It is extremely poisonous, inducing asphyxiation. As much a 0.2% in air is poisonous and 0.43% will induce asphyxiation.

CARBON NITROGEN RATIO

The ratio of carbon to nitrogen. Abbreviated C/N.

CARRIER

A person who harbors a specific infectious agent in the absence of discernible clinical disease and serves as a potential source or reservoir of infection for man.

CARRY-CLOTH

A large canvas or burlap cloth square used in transfer of refuse from homes by collectors in backyard carryout service. Serves as a carrying container (see CARRYING CONTAINER).

CARRYING CONTAINER

A transfer container carried by the collector in backyard carryout service. Usually of 30-50 gallon capacity and especially constructed of plastic or aluminum. In England these are called skips.

CAT

A trademark designation for any machine made by the Caterpillar Tractor Company. Widely used to indicate a crawler tractor or mounting of any make.

CATALYTIC COMBUSTION SYSTEM

A catalytically active substance, interposed in the exhaust gas stream to burn or oxidize vaporized hydrocarbons or odorous contaminants.

CELL

The volume of compacted solid waste enclosed by natural soil and/or cover material in a sanitary landfill.

CELL DEPTH

Vertical thickness of compacted solid waste enclosed by natural soil and/or cover material in a sanitary landfill.

CELL THICKNESS

Perpendicular distance between cover material placed over the last working faces of two successive cells in a sanitary landfill.

CHARGING CHUTE

A passage through which waste materials are charged into an incinerator from above by gravity.

CHARGING RAM

A reciprocating device to meter and force refuse into a furnace.

CHECKER WORK

A pattern of multiple openings in refractory through which the products of combustion pass to promote turbulent mixing of the gases.

CHIMNEY (STACK, FLUE)

See STACK.

CHIPPER

A size reduction device relying primarily on the shearing, cutting, or chipping action produced by sharp-edged blades attached to a rotating shaft (mandrel) which shaves or chips off pieces of the charged object.

CLAMSHELL

A shovel bucket with two jaws which clamp together by their own weight when it is lifted by the closing line.

CLAY

Soil particles less than 0.002 mm in diameter according to USDA classification.

CLEANER BARS

Metallic bars affixed to wheeled equipment to remove mud and solids from wheel area.

CLIMATE

Long-term manifestations of weather. More rigorously, the climate of a specific area is specified by the statistical collection of its weather conditions during a specified interval of time (usually several decades).

COLLECTION

The act of picking up refuse at home, business or industrial site and putting it in a truck.

COLLECTION, CONTRACT

City pays a contractor for doing collection work.

COLLECTION METHODS (CREW ORGANIZATION)

a) Daily Route Method

A collection crew is assigned a weekly route, divided into daily routes. The crew is then responsible for refuse pickup at all collection points on the assigned daily routes. Weather, refuse quantities and other variables will cause the elapsed time for completion of each daily route to vary. The crew is allowed to go home after completion of the day's route, whether it takes less or more than the established work day to complete.

b) Definite Working Day

A variation of the large route method. Definite routes are laid out and a crew assigned to each. Collection proceeds along a route for the length of time adopted for a working day. The next day, collection begins where the crew stopped the day before. This continues until the route is completely collected, whereupon the crew starts collection again at the beginning of the route without interruption.

c) Large Route Method

A variation of the task system in which work is laid out for a normal week's activity for a single crew. The crew may work each day without a fixed stopping point or number of hours, but the route must be entirely completed within the working week.

d) Single Load Method

A variation of the task system whereby areas or routes are laid out and under normal conditions each provides a full load of refuse. Each crew usually has two or more such routes for a day's work. The crew quits for the day when the assigned number of routes are completed. See also TASK SYSTEM.

COLLECTION METHODS (CREW INTEGRATED)

a) Inter-Route Relief Method

A collection method in which regular crews help collect other routes when their own assignments are completed.

b) Reservoir Route Method

The use of several crews to pick up a central route after having collected marginal routes around the central route.

c) Swing Crew Method

The provision of one or more extra crews to help out at any point where they are needed.

d) Variable Size Crew Method

System which provides a variable number of collectors for the individual crews, depending on the amount and conditions of work on particular routes.

COLLECTION METHODS (PICK UP OPERATIONS)

a) Backyard Carry Service

The collection personnel proceed to the place on a householder's premises where the refuse is regularly stored and transfer the accumulated material from the householder's containers to a carrying barrel. The carrying barrel is then taken to the collection vehicle and emptied. A number of premises may be served before barrel has to be emptied.

b) Curb Service

The householder sets the refuse container at the curb where it is then emptied into the collection truck by the collection personnel. The householder then takes the empty container back to the regular storage area.

c) Set-out Service

A special set-out crew carries the full refuse containers to the curb a few minutes before the collection vehicle arrives. The refuse is then emptied into the truck and the empty containers are left at the curb. The householder has the responsibility to take back the empty containers.

d) Setout, Setback Method

Full refuse containers are carried by a special set-out crew from back doors or other places on the householder's premises to curbs or alleys a few minutes before the collection vehicle arrives. Refuse is loaded in the same manner as when it is placed at curbs or alleys by the householders, leaving empty containers at the curbs or alleys. A special set-back crew returns the empty cans to their regular locations within a short time after they are emptied.

COLLECTION, MUNICIPAL

City pays employees; operation by city departments.

COLLECTION, PRIVATE

Citizens or firms, individually or in limited groups, pay collectors or private operating agencies.

COLLECTION STOP

Stop made by the collection vehicle and crew on the route to collect refuse from one or more service stops.

COLLECTION TIME (PICK-UP TIME)

Elapsed or cumulative time spent by the refuse collection crew in collecting refuse from a collection stop. Does not include travel time between collection stops on the route.

COLLECTOR, BAG-TYPE

A filter wherein the cloth filtering medium is made in the form of cylindrical bags.

COLLECTOR, CYCLONE

A structure without moving parts in which the velocity of an inlet gas stream is transformed into a confined vortex from which centrifugal forces tend to drive the suspended particle to the wall of the cyclone body.

COLLECTOR, FILTER FABRIC

A device designed to remove solid dispersoids from a carrier gas by passage of the gas through a porous medium.

Two basic types of filters are presently employed. In one,a fibrous medium is used as the collecting element and in the other,a medium is utilized as a support for a layer of collected particles, relying on the coat of collected particles to serve as the principal collecting medium.

COMBUSTION CHAMBER (PRIMARY)

Chamber where ignition and burning of the waste occurs.

COMBUSTION CHAMBER (SECONDARY)

Chamber where combustible solids, vapors, and gases from the primary chamber are burned and settling of fly ash takes place.

COMBUSTION, COMPLETE

The complete oxidation of the fuel, regardless of whether it is accomplished with an excess amount of oxygen or air or just the theoretical amount required for perfect combustion.

COMMERCIAL OPERATOR (OHIO'S DEFINITION)

All persons, firms,or corporations who own or operate stores, restaurants, industries, institutions, and other similar places, public or private, charitable or non-charitable, including all responsible persons other than householders, upon the premises of which garbage or other refuse or both is or are created.

COMMUNICABLE DISEASE

An illness due to an infectious agent or its toxic products which is transmitted directly or indirectly to a well person from an infected person or animal, or through the agency or an intermediate host, vector, or inanimate environment.

COMMUNICABLE PERIOD

The time or times during which the etiologic agent may be transferred from an infected person or animal to man.

COMPACTED YARDS

Cubic yard measurement of material after it has been placed and compacted in a fill.

COMPACTION

Reduction in bulk of fill by rolling and tamping.

COMPACTOR COLLECTION TRUCK

Enclosed vehicle provided with special mechanical devices for loading the refuse into the main compartment of the body, for compressing the loaded materials, and for distributing the refuse within the body.

COMPACTOR (STEEL WHEEL)

A gas or diesel powered machine equipped with steel wheels to provide good compaction and crushing effort, used to spread and compact soil and solid waste.

COMPOSTING

A controlled microbial degradation of organic waste yielding a nusiance-free product of potential value as a soil conditioner.

COMPRESSION

For steel wheel rollers, the compacting effect of the weight at the bottom of the roll, measured in pounds per linear inch of roll width.

CONDUIT

A pipe or tile carrying water, wire, or pipes.

CONSTRUCTION AND DEMOLITION WASTE

Waste building materials and rubble resulting from construction, remodeling, repair, and demolition operations on houses, commercial buildings, pavements, and other structures.

CONTAINER, CARRYING

A transfer container carried by the collector in backyard carryout service. Usually of 30-50 gallon capacity and especially constructed of plastic or aluminum. In England these are called skips.

CONTAINER, STORAGE (DETACHABLE)

A partially mechanized self-service refuse removal procedure with specially constructed containers and vehicles. It is mechanized in that special equipment is used to empty the containers and haul refuse to the disposal site. It is self-service in that the customer puts the refuse in the container.

CONTAINER, STORAGE (DISPOSABLE)

Specially designed plastic or paper sack refuse storage containers which are intended for disposal along with its contents.

CONTAINER STORAGE (LIFT AND CARRY)

Detachable container system in which service vehicle has lifting arms to pick up container and contents together for transportation to disposal site.

CONTAINER STORAGE (PULL-ON)

Detachable container system in which large container (approximately 20-40 cubic yards) is pulled onto service vehicle mechanically and carried to disposal site for emptying.

CONTAINER STORAGE (REAR LOADER, DETACHABLE)

Detachable container system in which roll-out containers, typically 1 to 3 yard capacity are hoisted at the rear of the collection vehicle and mechanically emptied. Container is left with the customer.

CONTAINERS, STORAGE (REUSABLE, INDIVIDUAL)

Galvanized metal or plastic containers specifically intended for use to store solid waste. Sizes normally vary from 20 to 82 gallons. The container has tight fitting cover and suitable handles.

CONTAINER STORAGE (SIDE LOADER, DETACHABLE)

Detachable container system similar to rear loader (which see) except loaded at side of collection vehicle.

CONVEYOR

A device that transports material by belts, cables, or chains.

CONVEYOR, SCREW

A revolving shaft fitted with auger-type flights that moves bulk materials through a trough or tube.

CORE

A cylindrical piece of an underground formation cut and raised by a rotary drill with a hollow bit.

COVER MATERIAL

Granular material, generally soil, that is used to cover compacted solid waste in a sanitary landfill, generally free of large objects that would hinder compaction and free of organic content that would be conducive to vector harborage, feeding and/or breeding.

CRANE

A mobile machine used for lifting and moving loads without use of a bucket.

CRANE, BRIDGE

A crane consisting of a lifting unit that hangs from, and can travel along, a movable horizontal rail which rides between two parallel, horizontal rails.

CRANE, MONORAIL

A crane consisting of a lifting unit that hangs from a suspended, horizontal rail in such a way that the unit can travel the length of the rail.

CRAWLER

One of a pair of roller chain tracks used to support and propel a machine, or any machine mounted on such tracks.

CUT

Portion of land surface or area from which earth or rock has been removed or will be removed by excavation. Thedepth below original ground surface to excavated surface.

DAMPER

A manually or automatically controlled device to regulate draft or the rate of flow of air or other gases.

DAMPER, BAROMETRIC

A hinged or pivoted balanced blade, placed so as to admit air to the breeching, flue connection or stack,thereby automatically maintaining a constant draft in the incinerator.

DAMPER, BUTTERFLY

A plate or blade installed in a duct, breeching, flue connection or stack, which rotates on an axis in its plane to regulate flow of gases.

DANO BIOSTABILIZER SYSTEM

Aerobic, thermophilic composting process in which conditions of moisture, air, and temperature are maintained in a single slowly revolving cylinder that retains the compostable refuse for one to five days. The refuse is later windrowed.

DEAD ANIMALS

Those that die naturally or from disease or are accidentally killed. Condemned animals or parts of animals from slaughter houses or similar places are not included in this term, but are regarded as industrial refuse.

DEADHEADING

Traveling without load, except from the dumping area to the loading point.

DECOMPOSITION (AEROBIC)

Reduction of the net energy level and change in chemical composition of organic matter by aerobic microorganisms.

DECOMPOSITION (ANAEROBIC)

Reduction of the net energy level and change in chemical composition of organic matter caused by microorganisms in an anaerobic environment.

DEGLASSER

See OSBORNE SEPARATOR.

DENSITY

The ratio of the weight of a substance to its volume.

DEPTH OF FILL

Total distance between undisturbed earth or bottom of solid waste in the sanitary landfill and top of final cover material.

DESIGN RUNOFF RATE

Maximum runoff rate (occurring expected) in a given period of time, during and immediately following rainfall.

DESTRUCTIVE DISTILLATION

The heating of organic matter when air is not present, resulting in the evolution of volatile matter and leaving solid char consisting of fixed carbon and ash.

DIKE

Bank of material, normally earth, constructed to form a barrier.A levee.

DISEASE AGENT

Any organism or material capable of causing disease.

DISINFECTION

Killing of pathogenic agents outside the body by chemical or physical means directly applied.

DISPOSAL AREA

A site, location, tract of land, area, building, structure or premises used or intended to be used for partial and/or total refuse disposal.

DISPOSAL, OCEAN

A sea dumping process which had been used extensively in the past, but which lost considerable popularity after the U.S. Supreme Court in 1933 outlawed dumping off the New Jersey shore by the city of New York.

DISPOSAL, ON-SITE

Includes all means of disposal of refuse on premises before collection. Examples are garbage grinding, burning or incineration, and burial.

DISPOSAL, WASTE

The final deposition of waste by man. This does not include its ultimate dessemination by forces other than man.

DOZER

Abbreviation for bulldozer or shovel dozer.

DOZER SHOVEL (SHOVEL DOZER)

A tractor equipped with a front-mounted bucket that can be used for pushing, digging, and truck loading.

DRAFT

The pressure difference between the incinerator or any component part and the atmosphere which causes the products of combustion to flow through the gas passages of the incinerator to the atmosphere

Natural: The negative pressure created by stack or chimney due to its height and the temperature difference between the flue gases and the atmosphere.

Induced: The negative pressure created by the action of a fan, blower, or ejector, which is located between the incinerator and the stack.

Forced: The positive pressure created by the action of a fan or blower, which supplies the primary or secondary air.

DRAGLINE

A revolving shovel which carries a bucket attached only by cables, and digs by pulling the bucket toward itself.

DRAWBAR

In a tractor, a fixed or hinged bar extending to the rear; used as a fastening for line and towed machines or loads.

DRAWBAR HORSEPOWER

A tractor's flywheel horsepower minus friction and slippage losses in the drive mechanism and the tracks or tires.

DREDGE

To dig under water. A machine that digs under water.

DRUM MILL

A long, inclined steel drum that rotates and grinds solid waste in the rough interior of the drum, the smaller ground material falling through holes near the end of the drum and the larger material dropping out the end.

DUCT

A pipe, tube, or channel that conveys a substance.

DUMP

See (OPEN DUMP)

ECOLOGY

The science that deals with the study of the interrelationships of living organisms to their environment.

EFFLUENT SEEPAGE

Diffuse discharge of ground water to the ground surface.

EFFLUENT (STACK)

The gas and particulates that reach the atmosphere from the burning process.

EMISSION (STACK)

See EFFLUENT (STACK)

ENDEMIC

The regular occurrence of a fairly constant number of cases of a disease within an area.

ENERGY SOURCE

The source from which an organism derives the energy for metabolic activities, e.g., sunlight, sulfur, cellulose, hydrogen, etc.

ENGINE SIDESCREEN

A rugged fabrication to fit on engine housing o' a tractor or other machine to prevent accumulation of paper and protect the engine from damage.

ELECTROSTATIC PRECIPITATOR

A device for collecting dust, mist, or fume from a gas stream by placing an electrical charge on the particle and removing that particle to a collecting electrode.

EPIDEMIC

The occurrence in a community or region of a group of illnesses of a similar nature, clearly in excess of normal expectancy and derived from a common or propagated source.

EPIDEMIOLOGY

The study of the causes, transmission, and incidence of diseases in communities or other population groups.

EROSION, SOIL

The wearing away of the land surface normally by wind or running water.

ETIOLOGICAL AGENT

The pathogenic organism causing a specific disease in a living body.

EVAPO-TRANSPIRATION

The sum of water removed by vegetation and that lost by evaporation for a particular area during a specified time.

EXCESS AIR

See (COMBUSTION AIR (EXCESS))

EXPANSION CHAMBER

See (SETTLING CHAMBER)

EXPANSION JOINT (REFRACTORY)

An open joint left for thermal or permanent expansion of refractories. Also, small spaces or gaps built into a refractory structure to permit sections of masonry to expand and contract freely and to prevent distortion or buckling of furnace structures from excessive expansion stresses.

FAIRFIELD-HARDY DIGESTER (COMPOST)

A patented product of Fairfield Engineering Company, Marion, Ohio, which decomposes garbage, sewage sludge, industrial and other organic waste by a controlled continuous aerobic-thermophilic process.

FAN, INDUCED-DRAFT

A fan exhausting hot gases from the heat-absorbing equipment, dust collector or scrubber.

FAN, OVERFIRE AIR

A fan used to provide air to a combustion chamber above the fuel bed.

FERMENTATION

Any energy-yielding oxidation in which the oxidant is organic.

FIELD CAPACITY (SEE MOISTURE-HOLDING CAPACITY)

Quantity of water held by compacted solid waste where application of additional water will cause it to drain rapidly to underlying material.

FILL DEPTH

See DEPTH OF FILL.

FIREBRICK

Refractory brick of any type.

FLUE (CHIMNEY, STACK)

See STACK.

FLUE GAS

Waste gas from combustion processes which may contain water vapor or dilution air added after the combustion chambers.

FLUE GAS SCRUBBER (WASHER)

Equipment for removing fly ash and other objectionable materials from the flue gas by means of sprays, wet baffles, etc. Also reduces excessive temperatures of effluent.

FLUIDIZING

Causing a mass of finely divided solid particles to assume some of the properties of a fluid, as by aeration.

FLUME

An artificial channel, often elevated above the ground, used to carry fast flowing water.

FLY ASH

All solids including ash, charred paper, cinders, dusty soot, or other partially incinerated matter carried in the flue gases.

FLY ASH COLLECTOR

Equipment for removing fly ash from the products of combustion.

FOMES (PLURAL, FOMITES)

An inanimate object not supporting bacterial growth but serving to transmit pathogenic organisms from human to human.

FOMITE

See FOMES.

FOOD WASTE DISPOSER

See GARBAGE GRINDING.

FOOT

In tamping rollers, one of a number of projections from a cylindrical drum.

FRONT END LOADER (COLLECTION)

Detachable container system in which collection vehicle has arms which engage container (usually 1-10 yard capacity) move it up over the cab and empty it into the vehicle body. Container is left with the customer.

FUNGI

Simple plants without photosynthetic pigment. The cells have a nucleus surrounded by a membrane, and the cells are connected together in long filaments called hyphae, which may grow together to form a visible body. Simpler fungi are involved in stabilization of solid waste (composting) and sewage.

FURNACE

The chambers of the incinerator into which the refuse is charged, ignited and burned.

GARBAGE

Animal and vegetable waste resulting from the handling, preparation, cooking and serving of foods. It does not include food wastes from industrial processing.

GARBAGE GRINDING

A method of uniformly reducing food waste or garbage and placing the reduced product in sewer systems. The reducing device may bea home sink grinder, or a large central grinder which serves industry or the community. It is noted that the ground garbage, which should pass through a sewage treatment plant, must still be disposed of as sewage sludge after treatment.

GARBAGE GRINDING (CENTRAL)

The grinding by mechanical means of garbage accumulated by municipal, commercial, or private delivery vehicles.

GARCHEY (GANDILLON)

A patented system for the water carriage and temporary storage of household wastes by means of a storage and flushing device mounted under the sink and tubing to convey the refuse to a central holding tank.

GAS BARRIER

Any device or material used to divert the flow of gases through soil from a sanitary landfill or other land disposal technique.

GASES

Normally formless fluids which occupy the space of enclosure and which can be changed to the liquid or solid state only by the combined effect of increased pressure and decreased temperature.

GASES (COMBUSTION)

Mixture of gases produced in the combustion chambers.

GASES, (FLUE)

Waste gas from combustion process, which may contain water vapor or dilution air added after combustion chambers.

GASIFICATION

The process or processes whereby solid or liquid matter is converted to such gases as carbon dioxide, methane, or ammonia through biological activity.

GRADER

A gas or diesel pneumatic wheel machine equipped with a centrally located blade that can be angled to cast to either side, with independent hoist control on each side.

GRADE STAKE

A stake indicating the amount of cut or fill required to bring the ground to a specified level.

GRADIENT

Slope along a specific route, as of a road surface, channel or pipe.

GRAPPLE

A clamshell-type bucket having three or more jaws.

GRATE

Surface with suitable openings, to support the refuse and permit passage of air through the burning fuel.

GRATE, DEAD PLATE

A stationary grate through which no air passes.

GRATE, FIXED

A grate which does not have movement. A stationary grate.

GRATE, RECIPROCATING

A forced-draft grate whose sections move continuously and slowly, forward and rearward, for the purpose of agitating and moving the burning refuse material from the charging to the discharge ends of an incinerator furnace.

GRATE, ROCKING

An incinerator stoker with moving (and stationary) grate bars which are trunnion supported. In operation, the moving bars oscillate on the trunnions, imparting a rocking motion to the bars, and thus agitating and moving the burning refuse along the grate.

GRATE, STATIONARY

See GRATE FIXED

GRATE, TRAVELING GRATE

A traveling grate stoker consists of an endless grate similar to a chain grate, but with grate keys mounted on transverse bars. The lead nose of each key on one bar overlaps the rear end of the keys on the preceding bar. The transverse bars are mounted on chains and are driven by sprockets.

GRAVEL

Rock fragments from 2 mm to 64 mm (.08 to 2.5 inches) in diameter. Or a mixture of such gravel with sand, cobbles, boulders, and not over 15 percent of fines.

GROUND PRESSURE

The weight of a machine divided by the area in square inches of the ground directly supporting it.

GROUNDWATER

Water occurring in the zone of saturation in an aquifer or soil.

GROUNDWATER FLOW

Flow of water in an aquifer or soil. That portion of the discharge of a stream which is derived from groundwater.

GROUNDWATER, FREE

Groundwater in aquifers not bounded or confined by impervious strata.

GROUNDWATER RUNOFF

That part of the groundwater which is discharged into a stream channel as spring or seepage water.

GROUSER

A ridge or cleat across a track shoe which improves its grip on the ground.

GROUT

A cementing or sealing mixture of cement and water, to which sand, sawdust, or other fillers may be added.

HAMMERMILL

A grinding machine that operates by impaction of material against heavy metal hammers loosely pinned to a shaft rotating at a high velocity.

HAMMERMILL SYSTEM

A composting process similar to the rasping system (which see), except that a rapidly spinning hammermill shreds the refuse, instead of a slowly turning rasping machine which serves the same purpose.

HARDPAN

Hardened, compacted or cemented soil horizon.

HAUL DISTANCE

a) Distance which cover material must be transported to the working face.

b) Distance collection truck must travel from its last pick-up stop to the working face of a sanitary landfill or tipping floor of a solid waste volume reduction or disposal facility.

c) Distance transfer vehicle must travel from solid waste processing station to point of final disposal.

HAUL TIME

Elapsed or cumulative time spent hauling collected refuse from the route or from transfer station to the disposal point.

HEARTH, DRYING

A solid surface upon which waste material with high moisture content, or liquids or waste material which may turn to liquid before burning, is placed for drying or burning.

HEAT, AVAILABLE

The quantity of useful heat per unit of fuel available from complete combustion after deducting dry-flue-gas and water-vapor losses.

HEAT BALANCE

An accounting of the distribution of the heat input and output, usually on an hourly basis.

HEAT EXCHANGER

A set of tubes to accommodate exhaust gases with means for passing room air over outside of tubes such that heat of gases is transferred to room air used for heating ventilation air supply to room or process equipment.

HEAT OF COMBUSTION

See HEAT VALUE

HEAT RELEASE RATE

The amount of heat liberated during the process of complete combustion and expressed in BTU per hour per cubic foot of the internal furnace volume in which such combustion takes place.

HEAT VALUE, HIGH

The heat liberated per pound of refuse when burned completely and the products of combustion are cooled to the initial temperature, as in a calorimeter.

HEAT VALUE, LOW

The high heat value minus the latent heat of vaporization of the water formed by burning the hydrogen in the fuel.

HOG FEEDING

A conservation process in which the food waste or garbage portion of refuse is disposed of by feeding to hogs. State regulations throughout the country require that garbage be treated prior to feeding.

HORSEPOWER

A measurement of power that includes the factors of force and speed. The force required to lift 33,000 pounds one foot in one minute.

HORSEPOWER, DRAWBAR

Horsepower available to move a tractor and its load, after deducting losses in the power train.

HORSEPOWER, SHAFT (FLYWHEEL OR BELT HORSEPOWER)

Actual horsepower produced by the engine, after deducting the drag of accessories.

HOST

The living body, human or animal, that provides food and shelter for the disease organisms.

HUMUS

Decayed organic matter. A dark fluffy swamp soil composed chiefly of decayed vegetation, that is also called peat.

HYDRAULIC GRADIENT

Change in the hydraulic head per unit distance.

HYDRAULIC HEAD (WATER IN SOIL)

The elevation with respect to a standard datum at which water stands in a riser or manometer connected to the point in question in the soil.

HYDROGEN SULFIDE

Gas product of the reduction of sulfate, odorous in concentrations as small as parts per billion.

HYDROGRAPHER

Person who measures and analyzes discharge, precipitation and runoff, etc.

HYDROLOGY

Science dealing with the properties, distribution and flow of water on or in the earth.

IDLER

A wheel or gear which changes the direction of rotation of shafts, or the direction of movement of a chain or belt.

IMPACTMILL

A grinding machine that operates by impaction of material against heavy metal projections rigidly attached to a shaft rotating at a high velocity.

IMPERVIOUS

Resistant to penetration by fluid.

INCINERATION

The controlled combustion process of burning solid, liquid, or gaseous combustible wastes to gases and to a residue containing little combustible material.

INCINERATOR

Any device used for the burning of refuse where the factors of combustion, i.e., temperature, retention time, turbulence; and combustion air, can be controlled.

INCINERATOR, BATCH FED

An incinerator which is charged with refuse periodically; the charge being allowed to burn down or burn out before another charge is added.

INCINERATOR, COMMERCIAL

A predesigned, shop-fabricated unit, possibly shipped assembled as a package for general refuse.

INCINERATOR, CONTINUOUS FEED

An incinerator into which refuse is charged in a nearly continuous manner so as to maintain a steady rate of burning.

INCINERATOR, INDUSTRIAL

A specifically designed, site-erected unit for disposal of a particular industrial waste.

INCINERATOR, MULTIPLE CHAMBER

An incinerator consisting of two or more refractory-lined chambers, interconnected by gas passage ports or ducts and designed in such a manner as to provide for complete combustion of the material to be burned. Depending upon the arrangement of the chambers, multiple-chamber incinerators are designated as in-line or retort types.

INCINERATOR, MUNICIPAL

A specifically designed, site-erected unit for disposal of refuse collected from residential, commercial, and industrial sources.

INCINERATOR, RESIDENTIAL

A predesigned, shop-fabricated unit, shipped assembled as a package for individual dwellings.

INCUBATION PERIOD

The time interval between the infection of a susceptible person or animal and the appearance of signs or symptoms of the disease.

INDORE PROCESS

Anaerobic composting method originating in India in the 1920's. Organic waste such as garbage, straw, and leaves is placed in alternate layers with night soil, sewage sludge or animal manure into pits or trenches 2 or 3 feet deep or piled on open ground to a height of about 5 feet. Pile is turned twice in six months; drainage is used to keep compost moist. Similar to Bangalore process. The Van Mannen process is a recent modification.

INFECTION

The entry and development or multiplication of a particular pathogen in the body of man or animal.

INFECTION (RESERVOIR OF)

Man, animals, plants, soil or inanimate organic matter in which an infectious agent lives and multiplies and depends primarily for survival, reproducing itself in such manner that it can be transmitted to man. Man himself is the most frequent reservoir of infectious agents pathogenic to man.

INFLUENT STREAM

Stream or portion of stream that contributes water to the groundwater supply.

INOCULUM

Material such as bacteria placed in a culture medium, soil, compost, etc. in order to initiate biological action.

INTERFLOW

That portion of rainfall which infiltrates the soil and moves laterally through the upper soil horizons until intercepted by a stream channel or until it returns to the surface at some point down slope from its point of infiltration.

ISOTROPIC SOIL

Soil having the same property (or properties) such as permeability, in all directions.

JUNK

A collection of secondary materials; sorted but unprocessed.

LANDFILL

Deposition of refuse on land with earth cover applied on a weekly or more frequent basis so that no nuisance or insult to the environment results.

LANDFILL, SANITARY

a) A method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation or at such more frequent intervals as may be necessary. ASCE

b) A sanitary landfill is a system for final disposal of solid waste on land, in which the waste is spread and compacted on an inclined, minimized working face in a series of cells and a daily cover of earth is provided so that no hazard or insult to the environment results. Environmental Protection Agency, Office of Solid Waste Management Programs, Training Branch.

LANTZ PROCESS

A destructive distillation process in which combustible fractions of solid waste are converted to combustible gas, charcoal, and a variety of distillates.

LEACHATE

Liquid emanating from a land disposal cell that contains dissolved, suspended and/or microbial contaminants from the solid waste.

LIFT

A layer of cells covering a designated area of a sanitary landfill.

LIFT DEPTH

Vertical thickness of a compacted volume of solid waste plus thickness of cover material immediately above the same volume of solid waste in a sanitary landfill.

LIQUID LIMIT

Minimum moisture content which will cause soil to flow if jarred slightly.

LOAM

A soft, easily worked soil containing sand, salt, and clay.

LOAMY

A broad grouping of soil texture classes; includes all sandy loams, clay loams, loam, silt, and silt-loam textures. Sometimes subdivided into moderately coarse-textured, medium-textured, and moderately fine-textured groups.

LYSIMETER

Device to measure the quantity or rate of water movement through or from a block of soil, usually undisturbed and in situ, or to collect such percolated water for analysis.

MANOMETER

A u-shaped tube or an inclined tube filled with a liquid used to measure pressure difference.

MANURE

The fecal and urinary defecations of livestock and poultry. Manure may often contain some spilled feed, bedding or litter.

MEMBRANE BARRIER

Thin layer or thickness of material impervious to the flow of gas or water.

METALS

In the secondary materials industry, includes all nonferrous materials, copper, brass, aluminum, zinc, lead, etc.; not iron and steel.

METHANE

An odorless, colorless, nonpoisonous and explosive gas. One source is from sanitary landfills undergoing anaerobic microbial decomposition.

MICROORGANISMS

Generally any living things microscopic in size and including the bacteria, actinomycetes, yeasts, simple fungi, some algae, rickettsiae, spirochaetes, slime molds, protozoans, and some of the simpler multicellular organisms. Some produce disease in man, animals, or plants; some are involved in stabilization of solid waste (composting) and sewage.

MIXING CHAMBER

Chamber usually placed between the primary combustion chamber and the secondary combustion chamber where thorough mixing of the products of combustion and air is accomplished by turbulence created by increased velocities of the gases, checker-work and/or turns in direction of the gas flow.

MOISTURE PENETRATION

Depth to which moisture penetrates following irrigation or rainfall before the rate of downward movement becomes negligible.

MULTICYCLONE

A dust collector consisting of a number of cyclones, operating in parallel through which the volume and velocity of gas can be regulated by means of dampers in order to maintain dust-collector efficiency over the load range.

MUNICIPAL COLLECTION

See COLLECTION, MUNICIPAL

MULTIPLE CHAMBER INCINERATOR

See INCINERATOR, MULTIPLE CHAMBER.

NITROGEN OXIDES (NO_x)

Gases formed from atmospheric nitrogen and oxygen whenever anything is burned in air. Usually NO_x breaks down to oxygen and nitrogen except when NO_x is cooled suddenly from a high temperature.

OCEAN DISPOSAL

See DISPOSAL, OCEAN

ODORANT

A gaseous nuisance which is offensive or objectionable to the olfactory senses.

ODOR THRESHOLD

The lowest concentration of an odor in air that can be detected by a human.

OFFAL

Intestines and discarded parts from the slaughter of animals.

OPACITY RATING

The apparent obscuration of an observer's vision to a degree equal to the apparent obscuration of smoke of a given rating on the Ringelmann Chart.

OPEN BURNING

Uncontrolled burning of wastes in the open or in an open dump.

OPEN DUMP

The consolidation of waste from one or more sources at a central disposal site which has little or no management. Some of the problems associated with open dumps are: vector breeding, fires, air pollution, water pollution, unsightliness, wasted land, disease and accident potentials.

ORGANIC

Containing carbon. Organic materials oxidize or burn easily and, when they contain nitrogen or sulfur, or both, they give off odorous by-products. See METHANE, HYDROGEN-SULFIDE.

ORGANIC ACID

A product of biochemical activity containing the carboxyl group which readily reacts with other compounds.

ORGANIC CONTENT

Synonymous with volatile solids except for small traces of some inorganic materials such as calcium carbonate which will lose weight at temperatures used in determining volatile solids.

ORSAT

An apparatus used for analyzing flue gases volumetrically by measuring the amounts of carbon dioxide, oxygen, and carbon monoxide.

OSBORNE SEPARATOR

Device to effect the efficient removal from compost of small particles of glass, metals, and other products. Patented by R.G. Osborne Laboratories, Los Angeles. Utilizes a pulsed rising column of air to separate heavy items contained in compost. Also called deglasser.

OVERFIRE AIR

See AIR, COMBUSTION (SECONDARY)

OXIDATION

Removal of electrons from an atom or molecule.

OXYGEN RECORDER

An instrument for continuously monitoring the percentage oxygen content of flue gas.

PARTICLE CONCENTRATION

Concentration expressed in terms of number of particles per unit volume of air or other gas. (Note: On expressing particle concentration, the method of determining the concentration should be stated; that is, number/vol. or wt./vol.)

PARTICLES

A small, discrete mass of solid or liquid matter. Included under particles are aerosols, dusts, fumes, mists, smokes, and sprays.

PARTICLE SIZE

An expression of the size of liquid or solid particles expressed as the average or equivalent diameter.

PARTICLE SIZE DISTRIBUTION

The relative percentage by weight or number of each of the different size fractions of particulate matter.

PARTICULATE MATTER

Material which is suspended within or discharged to the atmosphere in finely divided liquid or solid form at atmospheric temperature and pressure.

PATHOGEN

Any infective agent capable of producing disease; may be a virus, rickettsia, bacterium, protozoan, etc.

PEAT (HUMUS)

A soft light swamp soil consisting mostly of decayed vegetation.

PERCHED WATER TABLE

Underground water lying over dry soil, and sealed from it by an impervious layer.

PERCOLATION

A qualitative term applying to the downward movement of water through soil.

PERMEABILITY (QUALITATIVE)

The quality or state of a porous medium relating to the readiness with which it conducts or transmits fluids.

pH

Negative log of Hydrogen Ion concentration.

PICKING TABLE OR BELT

Table or belt at which solid waste is sorted by removing certain items. Normally associated with composting and salvaging operations.

PIN, TRACK

A hinge pin connecting two sections or shoes or a crawler track.

PITOT TUBE

An instrument which will sense the total pressure and the static pressure in a gas stream. It is used to determine gas velocity.

PLASTICITY (SOIL)

Property of a soil which allows it to be deformed without appreciable volume-change or cracking.

PLASTIC LIMIT

The minimum amount of water in terms of percent of oven-dry weight of soil that will make the soil plastic.

POLLUTANTS, AIR

Any solid, liquid or gaseous matter in the effluent which tends to pollute the atmosphere.

POLLUTION

The presence in a body of water (or soil or air) of substances of such character and in such quantities that the natural quality of the body of water (or soil or air) is degraded so it impairs the water's usefulness or renders it offensive to the senses of sight, taste, or smell. Contamination may accompany pollution. In general, a public health hazard is created, but in some cases only economy or esthetics are involved as when waste salt brines contaminate surface waters, and when foul odors pollute the air.

POLYVINYL CHLORIDE - (PVC)

A common plastic material (general formula $CH_2 = CHCl$) which releases HCl when burned.

POROSITY

Ratio of the space in any porous material (such as a soil) that is not filled with solid matter, to the total space occupied; generally expressed as a percentage. The porosity of an aquifer is equal to the sum of the specific yield and the specific retention.

POWER TAKEOFF

A place in a transmission or engine to which a shaft can be so attached as to drive an outside mechanism.

POWER TRAIN

All moving parts connecting an engine with the point or point where work is accomplished.

PREMISES

A tract or parcel of land with or without habitable buildings.

PRESSURE

Total load or force acting upon a surface expressed as a weight per unit area i.e. pounds per square inch (psi).

PRIMARY AIR

(See PRIMARY COMBUSTION AIR)

PRIMARY COMBUSTION CHAMBER

See COMBUSTION CHAMBER (PRIMARY)

PRIVATE COLLECTION

See COLLECTION, PRIVATE

PROCESS WEIGHT

The total weight of materials introduced into an incinerator including solid fuel charges but excluding liquid or gaseous fuels and combustion air.

P.S.I. (PSI)

Pressure in pounds per square inch.

PULVERIZATION

The crushing of brittle material, such as glass, to a small size.

PUTRESCIBLE

Capable of being decomposed by micro-organisms with sufficient rapidity as to cause nuisances from odors, gases, etc. Kitchen wastes, offal, and dead animals are examples of putrescible components of solid waste.

PUTRESCIBLE MATTER IN RESIDUE

Unburned organic matter in the residue that is fermentable, or capable of decaying, or of assimilation by animals and micro-organisms.

PYROMETER

An instrument for measuring and/or recording temperature.

QUARRY

A rock pit. An open cut mine in rock chosen for physical rather than chemical characteristics.

RADIATION PYROMETER

A pyrometer which determines temperature by measuring the intensity of radiation from a hot body.

RASPING MACHINE

A grinding machine consisting of a large verticle drum containing heavy hinged arms which rotate horizontally over a rasp and sieve floor.

RASPING SYSTEM

A composting procedure in which refuse is ground through a screen partly covered with steel pins that have the effect of a rasp. Compost piles are turned during a three to six week period. Developed in the Netherlands in 1951.

RATED LOAD

The maximum load which a crane is designed to handle safely.

REDUCTION (IN CHEMISTRY)

Addition of electrons to an atom or molecule.

REFRACTORY (REFRACTORIES)

Nonmetallic substances capable of enduring high temperatures and used in linings of furnaces. While their primary function is resistance to high temperature, they are usually called upon to resist one or more of the following destructive influences: abrasion, pressure, chemical attack and rapid changes in temperature.

REFUGE

A hiding place or shelter for rats, mice, and insects. It is important to distinguish between refuge and refuse, the latter being synonymous with solid waste. The confusion comes about because refuse frequently serves as a refuge for vermin.

REFUSE

Comprises all solid waste of the community and semi-liquid or wet waste with insufficient liquid content to be free flowing. Synonym Solid Waste.

REFUSE, COMMERCIAL

All solid waste which orginates in businesses operated for profit even as office buildings, stores, markets, theaters and privately owned hospitals and other institutional buildings.

REFUSE, DOMESTIC

All those types which normally originate in the residential household or apartment house. Does not include bulky wastes requiring special pickup.

REFUSE FILL

A systematic and periodic operation conducted to compact and cover the refuse, on less than a daily basis. (See OPEN DUMP)

REFUSE, INDUSTRIAL

All solid waste which results from industrial processes and manufacturing operations such as factories, processing plants, repair and cleaning establishments, refineries and rendering plants.

REFUSE, MOISTURE CONTENT

The weight loss on drying a sample to constant weight under standard conditions, tentatively 70°C for refuse.

REFUSE (RESIDENTIAL)

See REFUSE (DOMESTIC)

REFUSE SHED

A region or area which for reasons of topography, contiguous population and/or other common features, includes refuse sources which may be considered collectively in general planning. Usually synonymous with the general populated or metropolitan area and not necessarily limited by lines of political jurisdiction.

REFUSE, STREET

Material picked up by manual and mechanical sweeping of streets and sidewalks, litter from public letter receptacles and dirt removed from catch basins.

REFUSE TRAIN

A number of open carts hitched in series and pulled by a motor vehicle, its purpose being to collect solid waste.

RENDERING

A process of salvaging fats and oils, animal feed, and other products from animal waste by cooking. Dead animals, fish, and waste from slaughter houses and butcher shops are commonly used.

RESIDUE

All of the solid material collected from the process of incineration, consisting of grate siftings, material from off the end of the grates and particulate collected from air pollution control devices.

RESPIRATION

Any energy-yeilding oxidation in a living organism in which the oxidant is an inorganic compound. Oxygen need not be involved, though it is the most common oxidant.

RESPIRATION, AEROBIC

Oxidation of organic compounds by oxygen. (See also RESPIRATION).

RESPIRATION, ANAEROBIC

A type of respiration among some bacteria in which an inorganic oxidant (NO_3, SO_4) other than oxygen is used. (See also RESPIRATION)

RETAINING WALL

A wall separating two levels.

RINGELMANN CHART

A printed or photographically reproduced series of four shades of gray, by which density of smoke emissions from an incinerator may be estimated. A clear stack is recorded as 0, and 100% black smoke as 5. No. 1 smoke is 20% dense; No. 2, 40% dense; No.3, 60% dense; No. 4, 80% dense.

RIPARIAN RIGHTS

Rights of a land owner to water on or bordering his property, including right to prevent diversion or misuse of upstream water.

RIPPER

A towed machine equipped with teeth, used primarily for loosening hard soil and soft rock.

ROLL BAR

Steel protection over the cab of a tractor or loader to prevent injury to the operator.

ROLLER, SUPPORT

In a crawler machine, a roller that supports the slack upper part of the track.

ROLLER, TRACK

In a crawler machine, the small wheels that rest on the track and carry most of the weight of the machine.

RUBBISH

Non bulky domestic and commercial solid waste exclusive of garbage.

RUBBISH CHUTE

A pipe, duct or trough through which waste materials are conveyed by gravity from the upper floors to a storage area preparatory to burning or compaction.

RUBBISH, COMBUSTIBLE

Miscellaneous burnable materials. In general, the combustible component of rubbish.

RUBBISH, NONCOMBUSTIBLE

Miscellaneous refuse materials that are unburnable in ordinary incinerators.

RUBBISH, YARD

Prunings, grass clippings, weeds, leaves, and general yard and garden waste.

RUBBLE

Broken pieces of masonry and concrete.

RUNOFF

The portion of precipitation or irrigation water which is returned to the stream as surface flow.

SAND

Soil particles ranging from 0.05 to 2.0 mm in diameter. Soil material containing 85 percent or more particles of this size.

SALVAGING

The controlled removal of reusable materials.

SANITATION

The control of all those factors in man's physical environment which exercise or may exercise a deleterious effect on his physical development, health, and survival.

SATURATE

To fill all the voids in a material with fluid, to form the most concentrated solution possible under a given set of physical conditions in the presence of an excess of the substance.

SCARIFIER

See RIPPER

SCAVENGING

The uncontrolled picking of materials.

SCOOTER

A small, usually single-passenger, 3-wheeled vehicle with body of 1 cubic yard capacity, used in refuse collection especially to negotiate long driveways and narrow alleys. Collected refuse is emptied into a collection truck. Some have dump bodies, others have a stationary bed which holds the collector's carry-cans.

SCRAP

In the secondary materials industry, applies to iron and steel scrap only.

SCRUBBER, FLUE GAS

See FLUE GAS SCRUBBER (WASHER)

SECONDARY AIR

(See COMBUSTION AIR (SECONDARY)

SECONDARY COMBUSTION CHAMBER

(See COMBUSTION CHAMBER SECONDARY)

SECONDARY MATERIALS

Those materials which might go to waste if not collected and processed for reuse. Includes scrap, metals, waste, and junk. (See under definitions of each).

SECTION

An area equal to 640 acres or 1 square mile.

SEEPAGE

Movement of water through soil without formation of definite channels.

SEPARATOR, BALLISTIC

A separating device that operates by dropping mixed material onto a high speed rotary impeller so that materials of different physical characteristics are hurled off at different velocities and subsequently land in several separate collecting bins.

SEPARATOR, INERTIAL

A material separation device that relies on ballistic or gravity separation of materials having different physical characteristics.

SEPARATOR, MAGNETIC

Any separating device that removes metals by means of magnets.

SEMI-GROUSER

A crawler track shoe with one or more low cleats.

SERVICE STOP

Residence, commercial establishment, or other living or business unit receiving periodic refuse collection service.

SETTLEMENT

A gradual subsidence of material.

SETTLEMENT, DIFFERENTIAL

A subsidence of material that is not uniform throughout the plane of the material.

SETTLING CHAMBER

Any chamber designed to reduce the velocity of the products of combustion to promote the settling of fly ash from the gas stream.

SETTLING VELOCITY

The velocity at which a given dust will fall out of dust-laden gas under the influence of gravity only. Also known as "terminal velocity".

SEWAGE SLUDGE

A semiliquid substance consisting of suspended sewage solids combined with water and dissolved material in varying amounts.

SEWAGE TREATMENT RESIDUES

Coarse screenings, grit, and dewatered or air-dried sludge from sewage treatment plants, and pumpings of cesspool or septic tank sludges which require disposal with municipal solid waste.

SHALE

A rock formed of consolidated mud.

SHEARS

A size reduction machine that operates by cutting material between large blades.

SHEEPSFOOT

A tamping roller with feet expanded at their outer tips.

SHOE

A ground plate forming a link of a track, or bolted to a track link. A support for a bulldozer blade or other digging edge to prevent cutting down.

SHORING

Temporary bracing to hold the sides of an excavation from caving.

SHOVEL

A digging and loading machine or tool.

SHOVEL, DIPPER (SHOVEL) (DIPPER STICK)

A revolving shovel that has a push type bucket rigidly fastened to a stick that slides on a pivot in the boom.

SHOVEL DOZER (DOZER SHOVEL)

A tractor equipped with a front-mounted bucket that can be used for pushing, digging, and truck loading.

SHOVEL, HOE (DRAGSHOVEL, PULLSHOVEL, DITCHING SHOVEL, BACKHOE)

A revolving shovel having a pull-type bucket rigidly attached to a stick hinged on the end of a live boom.

SHOVEL-OFF

Any collection vehicle lacking a mechanical emptying device, and which must be unloaded by hand.

SHOVEL, REVOLVING

A digging machine that has the machinery deck and attachment on a vertical pivot so that it can swing independently of its base.

SHOVEL-UP

Refuse which is not stored in containers for collection and must be laboriously hand loaded with forks or shovels into a carrying container or collection vehicle.

SHREDDERS

Chops up discarded automobiles and other ordinarily low-grade sheet and coated scrap in continuous operation producing premium grade fistsized pieces that are 99 per cent steel.

SHRINKAGE

Loss of bulk of soil when compacted in a fill. Usually is computed on the basis of bank measure.

SILT

Small, 0.05 to 0.002 mm in diameter, mineral soil grains intermediate between clay and sand. Waterborne sediment with diameters of individual grains approaching that of silt. Soil material containing 80 percent or more silt and less than 12 percent clay.

SINTERING

A heat treatment which causes adjacent particles of material to cohere at a temperature below that of complete melting.

SLAG

A liquid mineral substance formed by chemical action and fusion at furnace-operated temperatures.

SLAGGING OF REFRACTORIES

Destructive chemical action upon refractories at high temperatures, resulting in the formation of slag. Also the coating of refractories by ash particles, which form a molten or viscous slag on the refractories.

SLOPE

Degree of deviation of a surface from the horizontal, usually expressed in percent or degrees.

SLOUGH

Wet or marshy area.

SLURRY

Cement grout.

SMOKE

An aerosol consisting of all the dispersible particulate products from the imcomplete combustion of carbonaceous materials entrained in flue gas as gaseous medium.

SMOKE ALARMS

Instruments that provide an objective method of continuous measurement and recording of smoke density by measuring the amount of light obscured by smoke when a beam of light is shone through the smoke in a flue. Most of the instruments have on them a scale, graded according to Ringelmann shades. They can be fitted with an alarm that operates when the smoke is above a preset density.

SMOKE DENSITY

The amount of solid matter contained in smoke and often measured by systems that relate the grayness of the smoke to an established standard.

SOIL

Natural body, developed from weathered minerals and decaying organic matter, covering the earth. Theupper layer of the earth in which plants grow.

SOIL EROSION

Detachment and movement of soil from the land surface by wind or water, including normal soil erosion and accelerated erosion.

SOIL, (HEAVY)

A fine grained soil, made up largely of clay or silt.

SOIL, ISOTROPIC

Soil having the same property (or properties) such as permeability, in all directions.

SOIL, TIGHT

Soil that is relatively impermeable to water movement.

SOLID WASTE MANAGEMENT

The purposeful systematic control of the storage, collection, transportation, processing and disposal of solid waste.

SPARK ARRESTER

A screen-like device to prevent sparks, embers, or other ignited materials above a given size from being expelled to the atmosphere.

SPECIFIC GRAVITY (SOLIDS OR LIQUIDS)

The ratio of the mass of a body to an equal volume of water.

SPOIL

Dirt or rock which has been removed from its original location.

SPOT LOG

A log or marker placed to show a truck driver the spot where he should stop to be loaded.

SPOTTER

In truck use, the man who directs the driver into loading or dumping position.

STABILIZE

To make soil firm and to prevent it from moving.

STACK (CHIMNEY, FLUE)

A vertical passage for conducting products of combustion to the atmosphere.

STACK EFFECT

The phenomenon of vertical movement of hot gases in a stack because of the temperature (density) difference between the gases and the atmosphere.

STADIA

Measurement of distance by proportion to the space on a vertical rod seen between upper and lower instrument cross hairs, usual proportion is one vertical to 100 horizontal.

STAKE, SLOPE

A stake marking the line where a cut or fill meets the original grade.

STATION

Any one of a series of stakes or points indicating distance from a point of beginning or reference.

STATIONARY PACKER

An adjunct of a refuse container system which compacts refuse at the site of generation into a pull-on detachable container (see PULL-ON CONTAINER).

STEERING BRAKE

A brake which slows or stops one side of a tractor.

STEERING CLUTCH

A clutch which can disconnect power from one side of a tractor.

STERILIZATION

Destruction of all microorganisms and their spores outside the body by chemical or physical means.

STOCKPILE

Material dug and piled for future use.

SUBSIDENCE

To settle or sink. Usually applied to peat and muck soils and refers to the settling due to oxidation, compaction, shrinkage, and wind erosion.

SUBSOIL

That part of the soil beneath the topsoil, usually that not having an appreciable organic matter content.

SULFUR, OXIDES OF

Compounds of sulfur combined with oxygen. Those of significance in air pollution include sulfur dioxide (SO_2) and sulfur trioxide (SO_3).

SUMP

Pit, tank, or reservoir in which water is collected or stored.

SURFACE COMPACTION

Molding together and collapse of structure of surface soil when subjected to pressure.

SURFACE CRACKING

Creation of discontinuities in the cover material of a sanitary landfill as a result of settlement and decomposition of solid waste and/or a change in moisture content of the cover material which may result in exposure of solid waste, entrance or egress of vectors and entrance of water.

SURFACE WATER

A body of water whose top surface is exposed to the atmosphere including a flowing body as well as a pond or lake.

SURVEYING

To find and record elevations, locations, and directions by means of instruments.

SWILL (SLOPS)

Semiliquid waste material consisting of garbage and free liquids.

TAILINGS

Second grade or waste material separated from pay material during screening or processing.

TAMP

Pound or press soil to compact it.

TAMPING ROLLER

One or more steel drums fitted with projecting feet and towed by means of a box frame.

TANDEM

A double-axle drive unit for a truck or grader. (A bogie).

THEORETICAL AIR

(See COMBUSTION AIR - THEORETICAL)

THERMAL CONDUCTIVITY

The specific rate of heat flow per hr. through refractories, expressed in BTU per sq. ft. of area, for a temperature difference of one degree Fahrenheit, and for a thickness of one inch. BTU/(sq. ft.)(hr)(deg. F)(in.)

THERMAL SHOCK RESISTANCE

The ability to withstand sudden heating or cooling, or both, without cracking or spalling.

THERMOCOUPLE

Two lengths of wire made from different homogeneous metals, connected to form a complete electric circuit which develops an electromotive force (emf) when one junction is at a different temperature than the other.

THERMOPHILS

Bacteria or other microorganisms which grow best at temperatures of roughly 45° to 60°C. Not to be confused with thermodurics, which resist high temperatures. Others: mesophils - grow best at medium temperature, 25° to 40°C; psychrophils - grow best at colder temperatures, below 20°C.

TIDAL MARSH

Low flat marshlands traversed by interlaced channels and tidal sloughs and subject to tidal inundation. Vegetation usually consists of bushes, grasses, and other salt-tolerant plants.

TILTH

Soil condition in relation to lump or particle size.

TILTING DOZER

A bulldozer whose blade can be pivoted on a horizontal center pin to cut low on either side.

TIPPING FLOOR

Unloading area for vehicles that are delivering refuse to an incinerator.

TOE

The projection of the bottom of a face beyond the top.

TONS PER DAY (INCINERATION)

Denotes the weight of refuse which can be properly processed by an incinerator within a 24 hour period.

TOPSOIL

The topmost layer of soil, usually refers to soil containing humus which is capable of supporting a good plant growth.

TOPOGRAPHIC MAP

A map indicating surface elevation and slope.

TORQUE, FULL LOAD

The torque necessary for a motor to produce its rated horsepower at full-load speed.

TOTAL COST OF BIDDING

A method of establishing the purchase price for movable equipment whereby the buyer is guaranteed that maintenance shall not exceed a set maximum amount during a fixed period of time (normally 5 years) and that the equipment will be repurchased by the seller at a set minimum price at the end of the fixed time period.

TRACK

A crawler track.

TRACK, CRAWLER

One of a pair of roller chains used to support and propel a machine. It has an upper surface which provides a track to carry the wheels of the machine, and a lower surface providing continuous ground contact.

TRACK ROLLER

In a crawler machine, the small wheels which are under the track frame and which rest on the track.

TRACTOR (CRAWLER)

See TRACTOR TRACK

TRACTOR LOADER (TRACTOR SHOVEL OR SHOVEL DOZER)

A tractor equipped with a bucket which can be used to dig and to elevate to dump at truck height.

TRACTOR, PNEUMATIC WHEEL

A gas or diesel powered machine equipped with 4 pneumatic tires, used to spread, excavate and compact soil and solid waste.

TRACTOR, RUBBER-TIRED

See pneumatic wheel tractor.

TRACTOR, TRACK

A gas or diesel powered machine equipped with continuous roller belt over cogged wheels for moving over rough or low bearing capacity terrain, used to spread, excavate and compact soil and solid waste.

TRANSFER STATION

A fixed facility used for removing refuse from collection trucks and placing it in long-haul vehicles.

TRASH

Exact meaning is vague but it is usually synonomous with rubbish.

TRAVEL TIME

The elapsed or cumulative time of travel between collection stops on the route.

TREAD

The ground contact surface on a tire or track shoe.

TROUGHING

Making repeated dozer pushes in one track, so that ridges of spilled material hold dirt in front of the blade.

TRUCK, BOTTOM DUMP (DUMP WAGON)

A trailer or semitrailer that dumps bulk material by opening doors in the floor of the body.

TRUCK, COMPACTOR COLLECTION

Enclosed vehicle provided with special mechanical devices for loading the refuse into the main compartment of the body, for compressing the loaded materials, and for distributing the refuse within the body.

TRUCK CAPACITY

Volumetric capacity for refuse.

TRUCK, DUMP

A truck or semitrailer that carries a box body with a mechanism for discharging its load.

TRUCK, PLATFORM (RACK BODY TRUCK)

A truck having a flat open body.

TRUCK, REAR DUMP (END DUMP)

A truck or semitrailer that has a box body that can be raised at the front so the load will slide out the rear.

UNDERGROUND RUNOFF (SEEPAGE)

Water flowing toward stream channels after infiltration into the ground.

UTILITY (PRIVATE)

Firm providing service under a government license or monopoly franchise. May collect or dispose of solid waste.

VAN MANNEN PROCESS

Anaerobic composting process which is a modification of the Indore method (which see). Used in the Netherlands from about 1932. City refuse is heaped in long rows and moistened. Decomposition takes about six months.

VAPOR PLUME

The stack effluent consisting of flue gas made visible by condensed water droplets or mist.

VAPORS

The gaseous form of substances which are normally in the solid or liquid state and which can be changed to these states either by increasing the pressure or decreasing the temperature alone.

VECTOR (OF DISEASE)

A living insect or other arthropod, or animal (not human) which transmits infectious diseases from one person or animal to another.

VEHICLE, ABANDONED

Motor vehicles and trailers that are discarded on public or private property longer than a specified time.

VEHICLE (OF INFECTION)

Water, food, milk, or any substance or article serving as an intermediate means by which the pathogenic agent is transported from a reservoir and introduced into a susceptible host through ingestion, through inoculation or by deposit on the skin or mucous membrane.

VOLATILE MATTER OF REFUSE

The weight loss of a dry sample on heating to red heat in a closed crucible.

VOLATILE SOLIDS

The sum of the volatile matter and fixed carbon of a refuse sample as determined by allowing a dried sample to burn in a heated and ventilated furnace.

WALL, AIR-COOLED

A wall in which there is a lane for the flow of air directly in back of the refractory.

WALL, CURTAIN

A partition wall between chambers, which serves to deflect gases in a downward direction. (Sometimes referred to as a drop arch.)

WALL, SUPPORTED

A furnace wall that is anchored to and has its weight transferred to a structure (usually steelwork and castings) outside of the high temperature zone.

WALL, WATER-COOLED

A furnace wall containing water tubes.

WASTE

Useless, unwanted, or discarded materials resulting from normal community activities. Waste includes solids, liquids, and gases. Solid waste is classed as refuse.

WASTE HANDLING

The manipulation or transportation of waste.

WASTE, PROCESSING OF

An operation in which the physical or chemical characteristics of the waste are changed. Example of this would include compaction, composting and incineration.

WATERSHED

Total land area above a given point on a stream or waterway which contributes runoff to that point.

WASTE, SOLID

See REFUSE

WATER TABLE

The surface of underground, gravity-controlled water.

WET DIGESTION

A solid waste stabilization process proposed by Dr. William Oswald of the University of California on the basis of experience with anaerobic sewage lagoons. A wide variety of mixed solid organic waste is placed in an open digestion pond to decompose anaerobically. Much of the carbonaceous matter is converted into carbon dioxide and methane. The soluble and suspended fraction is converted aerobically by algae in a biooxidation pond.

WET MILLING

Mechanical size reduction of solid waste after it has been wetted to soften the paper and cardboard constituents.

WETTING AGENT

A chemical that reduces the surface tension of water so that it soaks into porous material more readily. Example - synthetic soap powder.

WORKING DRAWING

Any drawing showing sufficient detail so that whatever is shown can be built without other drawings or instructions.

WORKING FACE

That portion of the compacted solid waste at a sanitary landfill which will have more waste placed on it and/or is being compacted prior to placement of cover material.

ZOONOSIS

A disease of animals transmissible to man. Some examples are anthrax, bubonic plague, murine typhus, some of the salmonellae.

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REFUSE MATERIAL BY KIND, COMPOSITION, AND SOURCES[1]

Kind		Composition	Sources
REFUSE	GARBAGE	Waste from preparation, cooking, and serving of food; market waste; waste from handling, storage, and sale of produce.	Households, restaurants, institutions, stores, markets.
	RUBBISH	Combustible: paper, cartons, boxes, barrels, wood, excelsior, tree branches, yard trimmings, wood furniture, bedding, dunnage.	
		Noncombustible: metals, tin cans, metal furniture, dirt, glass, crockery, minerals.	
	ASHES	Residue from fires used for cooking and heating and from on-site incineration.	
	STREET REFUSE	Sweepings, dirt, leaves, catch basin dirt, contents of litter receptacles.	Streets, sidewalks, alleys, vacant lots.
	DEAD ANIMALS	Cats, dogs, horses, cows.	
	ABANDONED VEHICLES	Unwanted cars and trucks left on public property.	
	INDUSTRIAL WASTE	Food processing waste, boiler house cinders, lumber scraps, metal scraps, shavings.	Factories, power plants.
	DEMOLITION WASTE	Lumber, pipes, brick, masonry, and other construction materials from razed buildings and other structures.	Demolition sites to be used for new buildings, renewal projects, expressways.
	CONSTRUCTION WASTE	Scrap lumber, pipe, other construction materials.	New construction, remodeling.
	SPECIAL WASTE	Hazardous solids and liquids: explosives, pathological waste, radioactive materials.	Households, hotels, hospitals, institutions, stores, industry.
	SEWAGE TREATMENT RESIDUE	Solids from coarse screening and from grit chambers; septic tank sludge	Sewage treatment plants; septic tanks.

(1) American Public Works Association, Committee on Refuse Collection. Municipal Refuse Disposal. Chicago: Public Administration Service. 2nd Edition, 1966. 528 pp.

PRELIMINARY ENGINEERING SURVEY FOR SANITARY LANDFILL SITES

Richard W. Eldredge*

I SITE IDENTIFICATION_____

II SITE LOCATION_____

_____

III ACREAGE_____ACRES

LENGTH_____ WIDTH_____

(Provide Sketch of Irregular Sites)

IV OWNER OF RECORD_____

OWNER'S REPRESENTATIVE (IF ANY)_____

_____

A AVAILABILITY_____

B PRESENT USAGE_____

C TERMS AND CONDITIONS

1 LEASE: PRICE PER ACRE_____PER YEAR;

TOTAL COST_____PER YEAR

2 SALE: PRICE PER ACRE_____;

TOTAL COST_____

V LAND CHARACTERISTICS

A GENERAL DESCRIPTION_____

_____

_____

B DRAINAGE

NATURAL_____ _____ACRES

STORM SEWERS_____ _____ACRES

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FARM TILE_____ _____ACRES

OPEN DITCH_____ _____ACRES

(Provide Sketch of Drainage Facilities if Other Than Natural)

C RAINFALL

Quantity Estimate

SPRING _____INCHES

SUMMER_____INCHES

FALL_____INCHES

WINTER_____INCHES

D OUTFALL (DESCRIBE CRITICAL CONDITIONS UP TO ONE MILE DOWNSTREAM OF OPEN DRAINS, ETC.)

_____

_____

E GROUND COVER

Estimated Acreage

1 HEAVILY WOODED _____

LIGHT BRUSH _____

GRASSES OR PASTURE _____

CULTIVATED_____

2 ESTIMATED CLEARING COST _____PER ACRE

(REDUCE CLEARING COST BY ANY AMOUNTS RECEIVED FROM SALE OF TIMBER)

3 SUGGESTED METHOD OF CLEARING _____

_____

F AGRICULTURAL SOIL CLASSIFICATION

_____% SAND

_____% SILT TEXTURE CLASSIFICATION _____

_____% CLAY _____

(See Page 209 - Soil Survey Manual USDA)

G ATTACH BORING LOGS OF REPRESENTATIVE TEST HOLES, BORED TO DETERMINE WATER TABLE AND SOILS PROFILE (Logs of Nearby Wells May Be Used In Lieu of Test Borings - If The Area Presents a Generally Consistant Soils Pattern)

F IF COVER MATERIAL IS NOT AVAILABLE AT THE SITE - WHERE WILL IT BE OBTAINED? _____

_____

WHAT COSTS ARE INVOLVED? _____

_____

OWNER (COVER MATERIAL) _____

VI OPERATIONAL SUPPORT

A FIRE PROTECTION

1 WHO IS RESPONSIBLE FOR FIRE PROTECTION? _____

_____

2 WHAT ARE THE COSTS, IF ANY? _____

_____

3 WHERE IS THE NEAREST WATER SOURCE FOR FIRE-FIGHTING? _____

_____

4 FOR DRINKING WATER? _____

_____

B ARE THERE ANY OTHER SOURCES OF WATER WHICH MIGHT BE ADVERSELY AFFECTED BY A LANDFILL?

_____

_____

C UTILITIES

	On Site	Nearby (State Where)
WATER	_____	_____
GAS	_____	_____

ELECTRICITY _____ _____

TELEPHONE _____ _____

SANITARY
SEWERS _____ _____

STORM
SEWERS _____ _____

VII PHYSICAL AND GOVERNMENTAL CONSIDERATIONS

A OPERATIONAL REQUIREMENTS

1 CITY _____

2 COUNTY _____

3 STATE _____

4 WATER BOARD _____

5 HEALTH DEPARTMENT _____

6 PLANNING COMMISSION _____

7 OTHER _____

PROVIDE COMMENTARY ON EXTENT OF CONTROL
AND COPY OF SPECIFIC REQUIREMENTS

B ZONING

1 ZONING CLASSIFICATION _____

2 ENFORCEMENT AGENCY _____

3 RESTRICTIONS - IF ANY _____

_____

4 ACTIONS NECESSARY TO USE SITE _____

_____

C EXISTING OPERATIONS

1 DISPOSAL TECHNIQUES SERVING THE SAME AREA _____

_____

2 SUMMARY OF REFUSE DISPOSAL HISTORY IN THE AREA
(Include Adjacent Areas if Pertinent)

_____

_____

D LAND USE OF ADJACENT PROPERTIES

		South	West	North	East
1	RESIDENTIAL				
2	COMMERCIAL				
3	LIGHT INDUSTRIAL				
4	HEAVY INDUSTRIAL				
5	RURAL				
6	MIXED				

IF LAND IS NOT ZONED MARK USE "O"
IF LAND USE AGREES WITH ZONING MARK "Z"
IF LAND USE AND ZONING DO NOT AGREE MARK "V"

VIII SITE ACCESS

A ROADS MAINTAINED BY:

1 CITY _____

2 TOWNSHIP _____

3 COUNTY _____

4 STATE _____

5 INTERSTATE _____

6 OTHER _____

EXPLAIN: _____

_____

B TYPES OF ROAD SURFACE

1 CONCRETE _____

2 ASPHALT _____

3 SEAL COAT _____

4 SOIL CEMENT _____

5 GRAVEL _____

6 CRUSHED STONE _____

7 DIRT _____

8 OTHER _____

C BRIDGES

1 LOCATION _____

2 LOAD LIMIT _____

3 CONDITION _____

(Include Information on All Bridges in Immediate Vicinity)

D RAILROAD CROSSINGS

1 GRADE CROSSING _____ VISIBILITY _____.

2 ELEVATED _____ CONDITION _____.

3 UNDERPASS _____ HEIGHT _____.

E DISTANCE TO COMMUNITY CENTER

1 PROBABLE MAXIMUM HAUL DISTANCE _____ (ONE WAY)

2 PROBABLE MINIMUM HAUL DISTANCE _____ (ONE WAY)

3 PROBABLE AVERAGE HAUL DISTANCE _____ (ONE WAY)

4 AVERAGE TIME OF AVERAGE HAUL _____ (ONE WAY)

5 CHARACTERISTICS OF AREA ADJACENT TO MAJOR HAUL ROUTES ____

_____

IX RECOMMENDED PROCEDURE

A PROPOSED LANDFILL METHOD

1 TRENCH _____

2 CUT AND COVER _____

3 AREA _____

4 RAMP _____

5 OTHER OR COMBINATION _____

(Attach Detailed Recommendations)

B PROPOSED COMPLETED SITE USE

1 PARKS _____

2 PLAYGROUNDS _____

3 AGRICULTURE _____

4 PARKING _____

5 LIGHT INDUSTRIAL _____

6 OTHER _____

DESCRIBE _____

_____

_____

C PROPOSED MAXIMUM FINISHED ELEVATION: _____

_____

D ESTIMATED CAPACITY OF SITE: _____

_____

X POPULATION DATA

A POPULATION SERVED BY LANDFILL

1 NOW _____

2 NEXT TEN YEARS _____

B TOTAL AREA POPULATION

1 NOW _____

2 NEXT TEN YEARS _____

XI SUMMARY: _____

Report Submitted By: _____

Date _____

PRELIMINARY ENGINEERING SURVEY FOR INCINERATOR SITES

I SITE IDENTIFICATION _____

II SITE LOCATION _____

III ACREAGE _____ ACRES

LENGTH _____ WIDTH _____

(Provide Sketch of Irregular Sites)

IV OWNER OF RECORD _____

OWNER'S REPRESENTATIVE (IF ANY) _____

_____

A AVAILABILITY _____

B PRESENT USAGE _____

C TERMS & CONDITIONS _____

1 LEASE _____

a PRICE PER ACRE _____ PER YEAR

b TOTAL COST _____ PER YEAR

2 SALE _____

a PRICE PER ACRE _____

b TOTAL COST _____

V LAND CHARACTERISTICS

A GENERAL DESCRIPTION _____

_____

_____

B DRAINAGE

NATURAL _____ _____ ACRES

STORM SEWERS _____ _____ ACRES

FARM TILE _____ _____ ACRES

OPEN DITCH _____ _____ ACRES

(Provide Sketch of Drainage Facilities if Other Than Natural)

*Formerly Assistant Bureau Director for Program Development, BSWM, Cincinnati, Ohio.

C ATTACH BORING LOGS OF REPRESENTATIVE TEST HOLES BORED TO DETERMINE BEARING ABILITY OF SOILS

D THE DISPOSAL SITE FOR THE RESIDUE FROM THE INCINERATOR SHALL BE EVALUATED BY FURNISHING THE INFORMATION AS REQUIRED IN THE PRELIMINARY "ENGINEERING SURVEY - SANITARY LANDFILL SITES"

E WEATHER

1 ANNUAL RAINFALL _____

2 PREDOMINANT WIND DIRECTION _____

VI OPERATIONAL SUPPORT

A FIRE PROTECTION

1 WHO IS RESPONSIBLE FOR FIRE PROTECTION? _____

_____

2 WHAT ARE THE COSTS, IF ANY? _____

_____

3 WHERE IS THE NEAREST WATER SOURCE FOR FIRE-FIGHTING? _____

_____

4 FOR DRINKING WATER? _____

_____

B UTILITIES

	ON SITE	NEARBY	SIZE OR ESTIMATED QUANTITY AVAILABLE
WATER	_____	_____	_____
GAS	_____	_____	_____
ELECTRICITY	_____	_____	_____
TELEPHONE	_____	_____	_____
SANITARY SEWERS	_____	_____	_____
STORM SEWERS	_____	_____	_____

VII PHYSICAL & GOVERNMENTAL CONSIDERATIONS

A OPERATIONAL REQUIREMENTS

1 CITY _____

2 COUNTY _____

3 STATE _____

4 WATER BOARD _____

5 HEALTH DEPARTMENT _____

6 PLANNING COMMISSION _____

7 OTHER _____

(Provide Commentary on Extent of Content and Copy of Specific Requirements)

B ZONING

1 ZONING CLASSIFICATION _____

2 ENFORCEMENT AGENCY _____

3 RESTRICTIONS - IF ANY _____

_____

4 ACTIONS NECESSARY TO USE SITE _____

_____

C EXISTING OPERATIONS

1 DISPOSAL TECHNIQUES SERVING THE SAME AREA _____

_____

2 SUMMARY OF REFUSE DISPOSAL HISTORY IN THE AREA

(Include Adjacent Areas if Pertinent)

_____

_____

D LAND USE OF ADJACENT PROPERTIES

	South	West	North	East
1 RESIDENTIAL	____	____	____	____
2 COMMERCIAL	____	____	____	____
3 LIGHT INDUSTRIAL	____	____	____	____
4 HEAVY INDUSTRIAL	____	____	____	____
5 RURAL	____	____	____	____
6 MIXED	____	____	____	____

IF LAND IS NOT ZONED MARK USE "0"
IF LAND USE AGREES WITH ZONING MARK "Z"
IF LAND USE AND ZONING DO NOT AGREE MARK "V"

VIII SITE ACCESS

A ROADS MAINTAINED BY:

1 CITY _____

2 TOWNSHIP _____

3 COUNTY _____

4 STATE _____

5 INTERSTATE _____

6 OTHER _____

EXPLAIN: _____

_____

B TYPES OF ROAD SURFACE

1 CONCRETE _____

2 ASPHALT _____

3 SEAL COAT _____

4 SOIL CEMENT _____

5 GRAVEL _____

6 CRUSHED STONE _____

7 DIRT _____

8 OTHER _____

C BRIDGES

1 LOCATION _____

2 LOAD LIMIT _____

3 CONDITION _____

(Include Information on All Bridges in Immediate Vicinity)

D RAILROAD CROSSINGS

1 GRADE CROSSING _____ VISIBILITY _____

2 ELEVATED _____ CONDITION _____

3 UNDERPASS _____ HEIGHT _____

E DISTANCE TO COMMUNITY CENTER

1 PROBABLE MAXIMUM HAUL DISTANCE _____ (ONE WAY)

2 PROBABLE MINIMUM HAUL DISTANCE _____ (ONE WAY)

3 PROBABLE AVERAGE HAUL DISTANCE _____ (ONE WAY)

4 AVERAGE TIME OF AVERAGE HAUL _____ (ONE WAY)

5 CHARACTERISTICS OF AREA ADJACENT TO MAJOR HAUL ROUTES

_____

_____

_____

IX RECOMMENDED PROCEDURE FOR RESIDUE DISPOSAL

A RECOMMENDED METHOD OF RESIDUE DISPOSAL (AND ITEMS WHICH MAY NOT BE INCINERATED) _____

_____

_____

_____

_____

B DISTANCE FROM THE PROPOSED INCINERATOR SITE TO THE LOCATION OF PROPOSED RESIDUE DISPOSAL _____

_____

_____

_____

_____

X POPULATION DATA

A POPULATION SERVED BY INCINERATOR

1 NOW _____

2 NEXT TEN YEARS _____

3 NEXT TWENTY YEARS _____

B TOTAL AREA POPULATION

1 NOW _____

2 NEXT TEN YEARS _____

3 NEXT TWENTY YEARS _____

XI SUMMARY:

Report Submitted By:

Date:

RATING METHOD FOR SANITARY LANDFILLS*

This rating method is an approach to measuring the level of acceptability of the various operations taking place at a given land disposal site, as well as an overall comparison of its suitability with that of other rated sites. The rating consists of two subsets of criteria. The first subset is a series of eight Requirements. These must be satisfied for the site to qualify as a sanitary landfill. If the operation meets all eight requirements a score of 72 is given for the subset. If the operation fails to meet all of the requirements it is not a sanitary landfill.

If the operation is a sanitary landfill, the second subset is completed. Fourteen Items are rated on the basis of a maximum of two points each to determine the level of performance attained at the operation. Although not shown, an item could receive a rating of one point if the operation is only partially deficient in one of the recommended provisions. A "perfect" sanitary landfill would achieve a score of 100. No sanitary landfill will ever rate below 72 since this is the score obtained to qualify in the first subset of the rating.

Each Requirement and Item in the rating has a statement of what is needed to qualify, the reasoning for the statement, and the criteria to meet the rating. The sanitary landfill should be visited and inspected in detail in order to complete the rating. Some categories will require that the operator or supervisor supply answers to certain questions and precautions should be taken to assure that the questions are understood and the answers reliable. If possible, written documentation should support the answers.

PART I
REQUIREMENTS FOR SANITARY LANDFILL

REQUIREMENT A: Open Burning Prohibited. No solid waste shall be burned at the sanitary landfill.

Basis: Open burning of solid waste creates odors, air pollution and fire and safety hazards. Such burning adversely affects public acceptance of the operation and proper location of future sanitary landfill sites. Local laws which allow or require the open burning of select materials (such as diseased elm trees or condemned dry foods) are outmoded. Such materials can either be incorporated within the sanitary landfill or disposed of in such a manner as to prevent health hazards or nuisances. Open burning at a sanitary landfill site for any reason converts the operation to that of an open dump.

Burning of Solid Waste on the Site is Never Permitted:

Yes_____ No_____

REQUIREMENT B: Spreading and Compaction. Solid Waste to be compacted shall be spread on a slope of approximately 3:1 in uniform layers not to exceed an average depth of two feet prior to compaction.

Basis: Successful operation and maximum utilization of a sanitary landfill depends upon adequate compaction of the solid waste. In addition, settlement will be excessive and uneven when the solid waste is not well compacted. Such settlement permits invasion by insects and rodents and severely limits the usefulness of the finished area.

Compaction is best initiated by spreading the solid waste evenly in shallow layers on a slope rather than placing the material in a single deep layer. Further compaction is provided by the repeated travel of equipment over the layers and, if necessary, by the use of special compacting equipment. Additional compaction also can be achieved by routing collection trucks so that they travel over the finished fill area.

Solid Waste is Properly Spread and Compacted on a Slope:

Yes_____ No_____

REQUIREMENT C: Daily Cover. A uniform compacted layer of at least six inches of suitable earth cover shall be placed on all exposed solid waste by the end of each working day.

Basis: Daily covering of the solid waste is necessary to prevent insect and rodent infestation, blowing litter, fire hazards and

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

an unsightly appearance. Fly emergence generally is prevented by six inches of compacted soil. Daily covering also divides the fill into "cells" that will limit the spread of underground fires should one occur. The soil should have good workability and compaction characteristics and be able to serve the stated needs.

A Uniform, Compacted Layer of at Least Six Inches of Suitable Earth Cover is Used for Daily Cover:
Yes_____ No____

REQUIREMENT D: Final Cover. A uniform layer of suitable earth cover compacted to a minimum depth of two feet shall be placed over the entire surface of each portion of the final lift, not later than one week following the placement of solid waste within that portion.

Basis: A minimum final cover of two feet of compacted suitable earth cover will prevent emergence of insects from the compacted solid waste, minimize escape of odors, prevent rodent burrowing, support plant growth and provide for an aesthetically acceptable finished site. This cover also provides an adequate bearing surface for vehicles and sufficient thickness for cover integrity in the event of settlement or erosion. Workability and compaction characteristics should be at least equal to those provided for daily cover.

A Minimum Final Cover of Two Feet of Compacted, Suitable Earth Cover is Used as Stated:
Yes_____ No____

REQUIREMENT E: Contamination Control. There shall be no existing contamination of ground or surface waters by deposited solid wastes or their products of decomposition, nor hazard or nuisance caused by gases or other products generated by the biologically or chemically active wastes. Furthermore, in locations where a potential for such contamination or hazard may be reasonably considered to occur, both the location and the operation must have the approval of the appropriate governmental agency such as the State Department of Health.

Basis: Circumstances of location, nature of waste deposited and operational procedure may lead to pollution of underground aquifers. Offensive and dangerous concentrations of gases may occur in the soil or aboveground and cause undesirable influences upon the environment. It may be necessary to provide special construction techniques or alter operations to control these conditions.

Solid Waste is Placed so that the Environment is not and will not be Adversely Affected, as Determined by Competent Authority:
Yes_____ No_____

REQUIREMENT F: Blowing Litter Controlled. Blowing litter shall be controlled by providing fencing near the working area or by use of earth banks or natural barriers. The entire sanitary landfill site shall be policed constantly and unloading shall be performed so as to minimize scattering of the solid waste.

Basis: The purpose of the sanitary landfill is to dispose of solid waste in a sanitary nuisance-free manner. If papers and other light materials are scattered and the area is not policed, fire hazards, nuisances and unsightliness result.

Blowing Litter is Controlled and the Site and Surrounding Area Routinely Policed:
Yes_____ No_____

REQUIREMENT G: Salvage Prohibited. Salvaging shall not be permitted at the sanitary landfill.*

Basis: Nothing can be tolerated that interferes with the prompt sanitary disposal of solid waste. Salvaging on the sanitary landfill delays the filling operation and creates insanitary conditions. The accumulation of salvaged materials at the sanitary landfill also provides harborage for vectors and promotes an unsightliness which can be detrimental to public acceptance of the operation.

Salvaging is Never Allowed at the Site:
Yes_____ No_____

*Any salvage or reclamation of solid waste materials must take place in a systematic and controlled manner at some site other than the sanitary landfill operating area. If such a facility is physically located on the same land plat or nearby, it should not be considered to be part of the sanitary landfill operation and should be rated by some other means.

REQUIREMENT H: Operational Considerations. Provision shall be made for all-weather access roads leading to the working face and written provisions and guarantees shall be made for the replacement of operating equipment during periods when the normal operating equipment is down for a period of more than 24 hours.

Basis: The purpose of a sanitary landfill is the immediate disposal of solid waste, resulting in the elimination of nuisances and producing an aesthetically acceptable operation. The major breakdown of operating equipment resulting in equipment down time of more than 24 hours reverts the sanitary landfill operation to an open dump. Access roads, which are not negotiable by collection vehicles, cause unnecessary delays in the disposal operation.

Sanitary landfills utilizing more than one piece of equipment normally are able to operate effectively even when or ? piece of equipment has a major breakdo' n and thus may already have sufficient res. rve capacity. Smaller operations, which utilize only one piece of equipment, require some type of prior written agreement which guarantees the equivalent of standby equipment within a 24-hour period after any major breakdown.

Due to heavy duty use of equipment, a schedule of inspection and maintenance must be followed to keep equipment operational under normal conditions. (See Recommended Item #6)

Provisions Have Been Made to Assure All-Weather Access Roads and to Guarantee the Equivalent of Standby Equipment Within a 24-Hour Period Following Major Breakdowns to Normal Operating Equipment:

Yes____ No____

PART II
RECOMMENDED ITEMS FOR SANITARY LANDFILL

ITEM 1: Public Information. The sanitary landfill shall have posted signs which clearly indicate the purpose of the operation; the owner or operator of the site; hours of operation; instructions for after hours delivery; materials accepted and/or excluded; fees charged and emergency telephone numbers.

Basis: The site is typically intended to include use by the general public, and guidance must be given as to the location and purpose of the activity, and its relationship to the user. Proper use of the site is not guaranteed by clearly instructing the public, but it is an essential step in gaining compliance.

A sanitary landfill may sometimes be called a "land reclamation project" or other such terms but never a "dump" since this term connotes an unacceptable operation. Provision of some method of storage, such as a bulk container near the gate, is an added service for the small hauler or householder who arrives after hours. Persons arriving at the site should quickly be able to determine if their material will be accepted and if so, the cost per unit (ton, cu.yd., etc.). If there should be an emergency such as a fire, either during or after working hours, or a person injured, the clearly posted emergency telephone numbers will expedite obtaining the proper assistance.

1 If suitable informational and directional signing is provided at the entrance and/or other appropriate locations.
2 points

2 If the site is not marked with appropriate signs.
0 points

ITEM 2: Limited Access. Access to a sanitary landfill shall be limited to those times when an attendant is on duty and only to those authorized to use the site for disposal of solid waste.

Basis: If public use of a sanitary landfill is allowed when no attendant is on duty, scavenging, burning and indiscriminate dumping commonly occur. Men and equipment must then be diverted from operations to restore sanitary conditions. When access to the site during operating hours is limited to those authorized, traffic and other accident hazards are minimized.

1 If access by unauthorized vehicles or pedestrians is controlled.
2 points

2 If access is uncontrolled.
0 points

ITEM 3: Measuring Facilities. Provision shall be made for weighing or adequately measuring all solid waste delivered to the sanitary landfill.

Basis: A suitable method of measuring incoming and/or deposited solid waste is desirable to provide a reliable quantity of data, to determine trends and to estimate future needs. Estimates of volumes based on truckloads rather than weights are misleading. Weighing provides the best basis for establishing fees requiring scales as an integral part of the sanitary landfill operation. Weighing discourages trips to the site with half-filled trucks. Determination of the volume increments in deposited solid waste may be done by periodic volumetric surveys, permitting evaluation of the use-rate and remaining capacity of the site.

1 If suitable fixed or portable scales have been installed at the sanitary landfill and are used continuously or if the sanitary landfill is routinely "cross-sectioned" at least every 30 days to determine volumes in place.
2 points

2 If neither weighing is accomplished nor routine (30 days minimum) measurements of volume in place are taken.
0 points

ITEM 4: Communications. Telephone or radio communications shall be provided at the sanitary landfill site.

Basis: Communications are desirable at the generally remote sanitary landfill sites, in case of emergency. If the sanitary landfill is part of a combined collection and disposal system, good communications will result in better performance throughout the system.

1 If reliable telephone or radio communications are installed at the site.
2 points

2 If communications are not available at the site.
0 points

ITEM 5: Employee Facilities. Suitable shelter and sanitary facilities shall be provided for personnel.

Basis: Shelter is a desirable protection of the sanitary landfill employees during inclement weather. Toilet and handwashing facilities are desirable for good personal hygiene for sanitary landfill employees and collection personnel.

1 If permanent or temporary shelter of adequate size is provided, along with safe drinking water, sanitary handwashing and toilet facilities, suitable heating facilities, screens and electricity (if needed).
2 points

2 If no shelter and/or toilet facility is furnished.
0 points

ITEM 6: Equipment Maintenance Facilities. Provisions shall be made for the routine operational maintenance of equipment at the sanitary landfill site and for the prompt repair or replacement of equipment.

Basis: Equipment breakdowns of a day or more result in the accumulation of uncovered solid waste (as in an open dump) with all the attendant health hazards or nuisances. Systematic, routine maintenance of equipment reduces repair costs, increases life expectancy, and helps to prevent breakdowns that interrupt sanitary landfill operations. In the event of breakdown, prompt repair of equipment will materially reduce down time and insure continuity of operations.

1 If facilities for routine maintenance are available on site, and if adequate provisions for major maintenance and repair have been made.
2 points

2 If maintenance facilities and repair provisions are not provided or are inadequate; or if equipment is inoperable or of limited capability because of poor maintenance.
0 points

ITEM 7: Unloading Area and Working Face. The unloading of the solid waste shall be controlled and restricted to an area such that the material can easily be incorporated into the working face with the available equipment.

Basis: Proper operation requires systematic placement of the solid waste in a restricted unloading area. Unloading must be coordinated with spreading and compacting. Controlled unloading reduces work, conserves landfill volume, permits better compaction, minimizes scattering of solid waste and expedites unloading of collection vehicles.

The type and size of the unloading area is dependent on the type of operation and the size of the working face. A large working face increases the area to be compacted and covered, with resulting high cost, delays and unnecessarily exposed solid waste.

1 If unloading is controlled at all times by signs and/or an unloading supervisor, and the size of the unloading area is balanced with the size of the working face allowing collection vehicles to unload promptly.
2 points

2 If the unloading is uncontrolled and/or the working face is much larger than necessary.
0 points

ITEM 8: Fire Protection. Suitable measures shall be taken to prevent and control fires which may accidently start.

Basis: Fires endanger life and property. Smoke and odors create nuisances to surrounding property owners, endanger disposal personnel and interfere with sanitary landfilling operations. Deliberate burning on sanitary landfills causes them to revert to a status equivalent to open dumps.

1 If an adequate supply of water under suitable pressure is available with necessary hose, etc.; a stockpile of earth is maintained reasonably close to the working face of the fill for smothering fires; and a suitable fire extinguisher is maintained on all equipment and in all buildings.
2 points

2 If adequate fire protection is not present.
0 points

ITEM 9: Special Waste Handling. Large or bulky items, sewage solids or liquids (septic tank or cesspool pumpings, sewage sludge and grit), and other materials which are either hazardous or hard to manage shall be disposed of in a sanitary landfill only if special provisions are made for such disposal.

Basis: Sewage solids or liquids are hard to handle, potentially infectious and capable of creating health hazards or nuisances if not properly handled. Other materials, such as oil sludges, chemical wastes, magnesium shavings and empty insecticide containers may present special hazards. Unless properly handled these wastes can be dangerous to sanitary landfill employees. When the sanitary landfill design includes special provisions for disposal of hazardous materials and large or bulky items such as car bodies, refrigerators, water heaters, demolition wastes, tree stumps, logs and branches, these materials can be disposed of safely and need not be excluded.

1 If suitable procedures are established and followed for disposal of special materials.
2 points

2 If all hazardous and bulky materials are accepted without provision for suitable disposal; or if hazardous or bulky materials are excluded without provision for disposal elsewhere.
0 points

ITEM 10: Vector Control. Conditions unfavorable for the production of insects and rodents shall be maintained by carrying out routine sanitary landfill operations promptly in a systematic manner. Supplemental vector control measures shall be instituted whenever necessary.

1 If vector control is not needed or is adequately provided.
2 points

2 If vector control is needed and is not promptly furnished.
0 points

ITEM 11: Dust Control. Suitable control measures shall be taken wherever dust is a problem at the sanitary landfill.

Basis: Excessive dust at the sanitary landfill can cause or create a slowdown of operations, accident hazards, excessive equipment wear, aesthetic problems and eye irritation or other injury to sanitary landfill personnel.

1 If dust control is not required or if suitable control measures are applied as needed.
2 points

2 If dust control is necessary and is not applied.
0 points

ITEM 12: Accident Prevention and Safety. Employees shall be instructed in the principles of first aid and safety and in the specific operational procedures necessary to prevent accidents. Accident precautionary measures shall be employed at the site. An adequate stock of first-aid supplies shall be maintained at the site.

Basis: The use of heavy earth-moving equipment; the maneuvering of collection trucks and other vehicles; and the infectious, explosive or flammable items that may be in the solid waste can create accident hazards at sanitary landfills. The remote location of some sites makes it particularly important that personnel be oriented to accident hazards, trained in first aid and provided first-aid supplies. For reasons of safety, access should be limited to those authorized to use the site for the disposal of solid waste.

1 If employees are given periodic safety training; and if an adequate first-aid kit, and at least one employee, trained in first aid, is available on the site at all times.

2 points

2 If employees are not given periodic safety training; or if neither an on-site first-aid kit nor trained first-aid assistance is available.

0 points

ITEM 13: Drainage and Grading. The entire site shall be graded and/or provided with drainage facilities to minimize run-off onto the sanitary landfill, to prevent the erosion of earth cover and to drain rain water falling on the surface of the sanitary landfill. The final surface of the sanitary landfill shall be graded to a slope of at least one percent, but no surface slope shall be so steep as to cause erosion of the cover. The surface drainage shall be consistent with the surrounding area and shall in no way adversely affect proper drainage from these adjacent lands.

Basis: Run-off from lands adjacent to the site, unless diverted, and rain falling on the surface of the site may percolate into the sanitary landfill and may contaminate either ground or surface waters. Cover material may also be removed by erosion and standing water may permit mosquito breeding or interfere with access, unloading, compacting of placement of cover. To promote sanitary landfill as an acceptable solid waste disposal practice it is important that the complete sanitary landfill blend with its surroundings and not impair adjacent land usage.

1 If the sanitary landfill is properly graded and permits proper drainage.

2 points

2 If the sanitary landfill has evidence of scouring of cover, ponding or other evidence of improper drainage or grading.

0 points

ITEM 14: Operational Records and Plan Execution. A daily log shall be maintained by the sanitary landfill supervisor to record operational information, including the type and quantity of solid waste received, the portion of the site used, and any deviations made from the plans and specifications. A copy of the original plans and specifications, a copy of the daily log, and a plan of the completed sanitary landfill shall be filed with the local governmental agency responsible for maintaining titles to land.

Basis: Completed sanitary landfill sites are ultimately utilized for a variety of purposes. When the ultimate use of the site is known beforehand, the operation can be planned so that suitable building sites, roads and utilities can be provided. Final grades can be established and allowances made for landscaping and adequate drainage. A record of the construction of the sanitary landfill is necessary for the most efficient utilization of the completed site and for the prevention of health hazards or nuisances.

1 If complete records are maintained as delineated above.

2 points

2 If there are no records or the records are inadequate.

0 points

CHECK LIST FOR SANITARY LANDFILL EVALUATION

LANDFILL _____ POINTS _____

LOCATION _____ RATING _____

RATER _____ DATE _____

CONTACTS _____

_____

BASICS OF OPERATION

REQUIREMENTS	YES	NO
A Open Burning Prohibited	____	____
B Spreading and Compaction	____	____
C Daily Cover	____	____
D Final Cover	____	____
E Contamination Control	____	____
F Blowing Litter Controlled	____	____
G Salvage Prohibited	____	____
H Operational Continuity	____	____

If all above Requirements are met (Require all YES)	72	____
If all of the above are not met (Comment as to why Requirement(s) is/are not met)	0	____

Comments: _____

_____

_____

ITEM		POINTS ALLOCATED
1	Public Information	
	Complete signs	2
	Inadequate	0
2	Limited Access	
	Controlled	2
	Uncontrolled	0
3	Measuring Facilities	
	Scales or cross-sections	2
	No measurement	0
4	Communications	
	Adequate	2
	None	0
5	Employee Facilities	
	Satisfactory	2
	None	0
6	Equipment Maintenance Facilities	
	Adequate	2
	Inadequate	0
7	Unloading Area and Working Face	
	Adequate	2
	Inadequate	0
8	Fire Protection	
	Satisfactory	2
	Inadequate	0

ITEM		POINTS ALLOCATED
9	Special Waste Handling	
	Special Provisions	2
	No Provisions	0
10	Vector Control	
	Not needed or provided	2
	Needed	0
11	Dust Control	
	Not needed or provided	2
	Needed	0
12	Accident Prevention and Safety	
	Adequate	2
	Inadequate	0
13	Drainage and Grading	
	Adequate	2
	Inadequate	0
14	Operational Records and Plan Execution	
	Adequate	2
	Inadequate	0
	TOTAL FOR REQUIREMENTS	
	TOTAL FOR PROVISIONS	
	TOTAL RATING	

COMMENTS: _____

_____

_____

TENTATIVE RATING METHOD FOR INCINERATOR OPERATION [1]

Training Staff*

ITEM 1: Access Roads. Access roads shall be designed and constructed so that traffic will flow smoothly and will not be interrupted by ordinary inclement weather. Refuse collection vehicles shall not interfere with normal traffic operation while waiting for access to the disposal facility.

Reason. Delays at the disposal facility may impede local traffic, hamper unloading of refuse, result in unproductive time for collection crews and delay collection schedules. These delays result in on-site refuse storage facilities becoming overtaxed.

This item shall be rated as follows:

If an all-weather access road, negotiable by loaded collection vehicles, with proper on-site parking areas for vehicles waiting for access to the unloading area has been provided: 2 points

If the access road provided is negotiable by loaded collection vehicles in any weather, but parking facilities for vehicles awaiting access to the unloading area are not provided: 1 point

If the road is negotiable in good weather only: 0 points

ITEM 2: Employee Facilities. Suitable shelter and sanitary facilities shall be provided for personnel.

Reason. Private handwashing and toilet facilities are desirable for the good personal hygiene of incinerator employees as well as the collection personnel. Under inclement weather conditions, theemployees' desire for comfort results in lack of attention to the operational requirements for the plant. Employee morale and efficiency are enhanced by provision of adequate sanitation facilities.

This item shall be rated as follows:

If all operational areas provide adequate shelter, are screened (if required), and are adequately ventilated and personnel are furnished with adequate safe drinking water, sanitary handwashing, toilet, locker and shower facilities: 2 points

If shelter, ventilation and screening are provided in all operational areas but only minimal handwashing and toilet facilities are available. 1 point

If shelter, sanitation and ventilation facilities are not adequate: 0 points

ITEM 3: Communications. Telephone or radio communications shall be provided at the incinerator plant.

Reason. Communications are necessary at incinerators in case of emergency. If the incinerator is part of a combined collection and disposal operation, better service and sanitary conditions can be rendered through good communications.

This item shall be rated as follows:

If a reliable telephone or radio communication system is installed at the incinerator: 2 points

If no communications are installed at the incinerator: 0 points

[1] Not for general distribution
Subject to revision

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio.

ITEM 4: Fire Protection. On-site fire protection shall be provided and arrangements shall be made with a responsible agency to provide adequate fire-fighting forces in an emergency.

Reason. Combustion in the refuse storage pits or malfunction of the incineration equipment may generate fires which could endanger men and equipment.

This item shall be rated as follows:

If sufficient approved water hose stations (adequate to fight localized large fires), are available at appropriate locations throughout the structure; sufficient approved fire extinguishers are so located to extinguish smaller fires immediately, and arrangements have been made with the local fire-fighting agency to assist in an emergency: 2 points

If the incinerator must rely upon hand-operated extinguishers for fire-fighting while awaiting assistance which has been arranged for from the local fire-fighting agency: 1 point

If fire-fighting techniques to be used in case of fire have not been developed, or if an adequate water supply under pressure is not available for use by fire-fighting agency, or if a local fire-fighting agency is not available: 0 points

ITEM 5: Accident Prevention and Safety. Employees shall be instructed in first-aid and safety principles and in the procedures necessary to prevent accidents or control dangerous situations. Accident precautionary measures and suitable safety equipment shall be employed at the site. An adequate stock of first-aid supplies shall be maintained at the site.

Reason. The complexity of incineration equipment, the continual handling of flammable (sometimes explosive) materials, and high temperatures create potential accident hazards for incinerator employees.

This item shall be rated as follows:

If a periodic safety-training program is employed, safety equipment is provided, an adequate first-aid kit is available, and at least one employee, trained in first-aid, is available on the site at all times: 2 points

If a periodic safety-training program is employed, safety equipment is provided, an adequate first-aid kit is available, and trained first-aid assistance is available at locations within three miles of the site and if Item 3, Communications, is rated 2 points: 1 point

If a periodic safety-training program is not employed, no safety equipment is provided, an on-site first-aid kit is not available, a person trained in first-aid is not available within three miles, or communications to the trained first-aid assistant are not available at all times: 0 points

If no positive accident prevention program is employed, or if unsafe practices are carried on at the site: Deduct 5 points

ITEM 6: Operation Records. A daily log shall be maintained by the incinerator supervisor to record operational information, including the type and quantity of refuse received, hours of operation, maximum and minimum temperatures of the furnaces during operation, and quantities of both rejected refuse and incinerator residue with the disposal method used therefore.

Reason. An incinerator is designed to burn specific quantities of refuse under controlled conditions including rate, temperature, air supply, etc. It is essential that enough data be maintained in the operational records to determine if satisfactory destruction of the refuse material is accomplished. Operational records will help establish the need for additional men and/or equipment and will indicate when changes in operating methods, or hours, should be made to accomplish adequate incineration.

This item shall be rated as follows:

If adequate operational records are accurately maintained, correlated, and used to review and improve operational procedures: 6 points

If the operational records are inadequate, or are not used for operational control:
2 points

If there are no operational records:
0 points

ITEM 7: Operational Maintenance. Provisions shall be made for the routine operational maintenance of the incinerator. Repair or replacement of operational equipment shall be made efficiently and quickly. The incinerator shall be so designed and maintained that the operational failure of one furnace and/or component part will not result in a complete shutdown of the incinerator. Should extenuating circumstances result in a situation whereby the incoming wasteload exceeds the plant capacity, an approved temporary alternate disposal plan should be available and used.

Reason. Routine maintenance of mechanical equipment reduces repair cost, increases life expectancy, and helps to prevent breakdowns. Advance arrangements for making major repairs will materially reduce down time. Complete equipment breakdown of a day or more results in accumulations of refuse, creating health hazards and nuisances at the plant and throughout the collection system. A temporary disposal method insures protection against these health hazards and nuisances until corrective measures have been made at the incinerator.

This item shall be rated as follows:

If routine maintenance is employed and if a decrease in plant capacity caused by malfunction of a component part can be overcome by extending the hours of operation or by alternate disposal in a properly operated sanitary landfill or other approved facility:
14 points

If no routine maintenance is employed and if a decrease in plant capacity caused by malfunction of a component part can be overcome by extending the hours of operation or by alternate disposal in a properly operated sanitary landfill or other approved facility:
10 points

If routine maintenance is employed but no alternate disposal method is available, or an extension of the operating hours to adequately incinerate all refuse generated from the community is not possible:
4 points

If no routine maintenance is employed and no alternate disposal method is available, or an extension of the operating hours to adequately incinerate all refuse generated from the community is not possible:
0 points

ITEM 8: Limited Access. Access to an incinerator shall be limited to those times when operational employees are on duty. Only those authorized to visit or to use the disposal facility shall be allowed access.

Reason. When only authorized persons are permitted access to the incinerator during operating hours, traffic, fire, and accident hazards are minimized.

This item shall be rated as follows:

If all access is controlled so that neither vehicles nor pedestrians have access to the incinerator at other than working hours:
2 points

If uncontrolled or partially controlled access is allowed:
0 points

ITEM 9: Area Sanitation. All refuse shall be confined to the dumping area within the building. The entire incinerator site shall be policed regularly as necessary.

Reason. The purpose of an incinerator is to dispose of refuse in a sanitary nuisance-free manner. If scattering of papers and other light materials is not controlled and if the area is not policed, fire hazards and nuisances are created.

This item shall be rated as follows:

If all refuse unloading is done within a suitable enclosure or within the building,

and if policing of the area is practiced so that the incinerator site is neat and clean:
4 points

If scattering of paper and refuse is allowed at the incinerator site and policing is not done or is inadequate:
0 points

ITEM 10: Building Sanitation. All areas within the building shall be maintained free of paper, refuse, dirt, and debris.

Reason. A well-maintained building will improve working conditions and the general acceptability of the operation, thus attracting a better class of labor, improving the occupational environment, and maintaining a better health and safety record for the employees.

This item shall be rated as follows:

If the interior of the building is maintained free of paper, refuse, dirt and debris:
4 points

If the interior of the building is usually free of paper, refuse, dirt, and debris, with only occasional lapses:
2 points

If the interior of the building shows general lack of good housekeeping practices:
0 points

ITEM 11: Weighing facilities. Provisions shall be made for weighing all refuse delivered to the incinerator.

Reason. An accurate method of measuring and recording the quantity of incoming refuse and outgoing residue is necessary to measure operating capacity and efficiency in relationship to the design capacity. Weighing provides an equitable basis for establishing fees, and is an integral part of the incinerator operation.

This item shall be rated as follows:

If suitable fixed or portable scales have been installed and are used continuously for recording the weight of incoming refuse and outgoing residue:
4 points

If no weighing is accomplished, only partial weighing is accomplished, or quantities are established in volume estimates only:
0 points

ITEM 12: Unloading Area. The unloading area shall be adequate in size and design to facilitate the rapid unloading of all refuse in collection trucks with a minimum of delay or confusion.

Reason. Delays at the unloading area reduce the efficiency of collection. Uncontrolled use of the unloading area will reduce the safety and efficiency of the incinerator operation.

This item shall be rated as follows:

If the unloading area is adequate for the prompt discharge of refuse from the trucks as they arrive and traffic is well-organized and supervised:
4 points

If the unloading area is too small for proper, rapid unloading of collection trucks or unloading operations are poorly supervised so that delays are caused:
0 points

ITEM 13: Dust Control at Unloading and Charging Area. Dust resulting from the unloading and furnace charging operations shall be controlled at all times.

Reason. The dust generated by the unloading and furnace charging operations is a health hazard to both incinerator and collection personnel.

This item shall be rated as follows:

If adequate dust control is in effect during the unloading and charging operations and personnel continually exposed to dust are supplied with proper protective equipment:
2 points

If control of dust during the unloading or charging operations is inadequate but personnel are furnished protective equipment:
1 point

If neither dust control nor protective equipment is adequate:
0 points

ITEM 14: Capacity and Operation of Storage Pit. The capacity of the storage pit shall be equivalent to at least the rated capacity of the incinerator for one day's operation. The unloading operation shall be organized so that pit capacity is conserved for use in the event of breakdown or temporary overload.

Reason. In the event of incinerator malfunction, the storage pit will furnish interim storage of refuse until the incinerator can be operated. Care in the loading of the storage pit will conserve capacity so that it will be readily available in an emergency. Refuse should not be stacked high enough to impede unloading of vehicles.

This item shall be rated as follows:

If the storage pit will hold at least one day's collection volume, and an unused volume equivalent to one day's refuse collection remains at the end of each working day, and no more than three days collection volume will be stored at any time:
2 points

If the storage pit will hold one day's volume of refuse, but less than one day's volume remains at the end of each working day, and no more than three days collection volume will be stored at any time:
1 point

If the storage pit will hold less than one day's volume and no other provisions are made for storage or emergency capacity, or if more than three days collection volume is stored at any time:
0 points

ITEM 15: Segregation of Refuse. If the incinerator cannot incinerate bulky items or certain materials must be excluded, such items shall be removed from the incoming refuse and disposed of by sanitary landfill or by other means acceptable to the local health authority.

Reason. Attempting to incinerate items for which the incinerator is not designed serves no purpose and interferes with proper incineration of the normal refuse charge. Segregated materials need to be disposed of in a satisfactory manner as they are removed, and should not be stored.

This item shall be rated as follows:

If appropriate items are separated from the refuse prior to furnace charging and are disposed of each working day by sanitary landfill or other means satisfactory to the local public health authority:
2 points

If all appropriate items are removed prior to incineration but are stored on-site and/or not disposed of by means satisfactory to the local public health authority:
0 points

ITEM 16: Furnace Temperature Control. Operating temperatures at the combustion chamber exit in the furnaces of most incinerators shall be maintained between 1300°F to 1800°F, or according to the limits established by the design engineer. The furnace shall not be consistently operated at temperatures lower than 1300°F.

Reason. To insure best combustion and minimize gaseous and particulate emissions, furnace temperatures must be maintained between 1300°F and 1800°F. Furnace temperatures in excess of 1800°F in most incinerators may damage furnace refractories, requiring expensive repairs and causing shutdowns. In incinerators of special design, temperatures exceeding 1800°F may be permitted.

This item shall be rated as follows:

If furnace charts or records indicate that temperatures above 1500° F are successfully maintained, and that furnace temperatures are maintained within the upper range established by the designer:
10 points

If the furnace chart or records indicate that temperatures above 1300° F are successfully maintained, and upper temperature design limits are not exceeded:
5 points

If furnace charts or records are not maintained, or furnace temperatures are consistently lower or higher than those required for proper incineration:
0 points

ITEM 17: Residue and Fly Ash Disposal. The residue from the incinerator shall contain less than four percent volatile solid or disposition shall be made in a properly operated sanitary landfill.

Reason. The purpose of incineration is to reduce the volume of refuse to an inert residue without creating air pollution, water pollution, odor, insect, or rodent vector problems. If residue is not organically inert, public health hazards are caused.

This item shall be rated as follows:

If residue contains less than four percent volatile solids by weight (as determined by the standard procedure listed in APWA Publication "Municipal Refuse Disposal," page 375, for the determination of volatile solids in residue) or if incinerator residue is disposed in a properly operated sanitary landfill and not used as cover material. (See "PHS Tentative Rating Methods for Sanitary Landfill Operations"):
8 points

If the incinerator residue containing more than four percent of volatile solids by weight or the fly ash disposition is by improper means:
0 points

ITEM 18: Emission Quality. Gaseous and particulate emissions from an incinerator shall be of a quality acceptable in the community and in the area in which the incinerator is established.

Reason. Gaseous and particulate emissions beyond certain levels from improperly incinerated refuse are aesthetically unacceptable and may create public health hazards.

This item shall be rated as follows:

If the gaseous and particulate emissions are maintained within the Federal Standards (Executive Order 11282):
8 points

If the gaseous and particulate emissions are maintained within the standards established for the area. (In lieu of local air pollution standards, use recommended standards from the National Center for Air Pollution Control):
6 points

If emissions are not maintained within local air pollution standards. (In lieu of local air pollution standards, use recommended standards from the National Center for Air Pollution Control)
0 points

ITEM 19: Sewage Solids, Liquids, and Other Hazardous Materials. Sewage solids or liquids (septic tank or cesspool pumpings, sewage sludge and grit) and other hazardous materials shall be disposed of in an incinerator only if special provision has been made for such incineration.

Reason. Sewage solids or liquids are infectious and create health hazards if not properly handled. Other materials ing oil sludges, waste chemicals, magnesium shavings, explosives and empty insecticide containers may also present special hazards. Unless properly handled, incineration of these wastes can be dangerous to incinerator employees. When the design and operation of an incinerator includes special provisions for disposal of these materials, they can be disposed of safely and need not be excluded.

This item shall be rated as follows:

If suitable procedures are established and followed for the disposal of hazardous materials, or if all hazardous materials are excluded from the incinerator charge:
2 points

If hazardous materials are incinerated without special provisions or precautions:
0 points

ITEM 20: Salvage. Salvaging, if permitted, shall not interfere with the prompt incineration of refuse, nor create unsightliness or health hazards. Scavenging shall not be permitted.

Reason. No activity that interferes with prompt, sanitary disposal of refuse can be tolerated. Improperly conducted salvaging delays incineration and creates unsanitary conditions. Accumulation of salvaged materials at the incinerator results in vector problems and unsightliness. Scavenging is an unhealthy, aesthetically objectionable practice which interferes with the orderly, efficient operation of an incinerator.

This item shall be rated as follows:

If no salvaging is allowed: 2 points

If salvaging is controlled and all salvaged items are removed from the site each working day: 1 point

If scavenging is allowed or salvaged materials are allowed to accumulate beyond the end of a working day: 0 points

ITEM 21: Open Burning. No refuse shall be burned except in the incinerator. Burning of items too large for the incinerator shall be done elsewhere and materials segregated for this purpose shall be removed from the site daily.

Reason. Garbage can not be burned without nuisance except in high-temperature incinerators. Any other method of combustion creates odors, air pollution, fire and safety hazards, and such burning adversely affects public acceptance of the operation. Controlled burning of certain combustible materials not readily incorporated into the incinerator (such as lumber, tree stumps, and brush) may provide a satisfactory means of disposal. Burning of such materials should be done at an alternate site so that the public will not associate this practice with operation of the incinerator.

This item shall be rated as follows:

If no burning outside of the incinerator furnaces is allowed at any time and items segregated for burning elsewhere are removed from the site daily: 4 points

If on-site burning of combustible materials is allowed outside of the furnaces at any time or if such items are accumulated beyond the end of the work day: 0 points

ITEM 22: Vector Control. Conditions permitting insect and rodent attraction or production shall be minimized by handling and incinerating all refuse in a systematic manner. Supplemental insect and rodent control measures shall be instituted whenever necessary.

Reason. Proper operation of an incinerator will minimize insect and rodent problems, but any lapse in proper operation may result in attraction and rapid production of insects and rodents, especially in the storage pit. Frequent emptying and cleansing of the storage pit, proper disposal of residue and off-site disposal of segregated items are key factors in minimizing vector problems.

This item shall be rated as follows:

If vector-preventive operation activities are maintained and supplementary vector control is rarely required: 4 points

If vector-preventive operation activities are not maintained and supplementary vector control is provided frequently: 2 points

If no vector-preventive operational activities are maintained and no vector control activities are provided: 0 points

ITEM 23: Disposal of Quenching and Scrubbing Waters. Water used to quench the incinerator residue or scrub the flue gases shall be discharged into a sanitary sewer or disposed of as required by the

local health authority. Vehicles for transporting quenched residue shall be watertight.

Reason. The residue quenching operation may contain considerable chemical and bacteriological contamination (especially when used to quench poorly-incinerated residue) and should be considered a potentially hazardous liquid waste. Scrubbing water presents the same problems. Improper disposal of these waste waters may pollute surface or underground water supplies in the area. Leaking of quenching water from residue trucks may also pose health hazards and unaesthetic conditions.

This item shall be rated as follows:

If quenching and scrubbing water is disposed of in a sanitary sewer or as directed by the local health authority, and quenched residue when transported on public roads is contained in watertight trucks:
8 points

If quenching and scrubbing water is improperly disposed of, or water drains from residue trucks:
0 points

Incinerators rated by the foregoing schedule shall be classified as follows:

A-Rated Incinerator - For Industrial Areas The following items must score as follows:

Item	7 (Operational Maintenance)	- 10 points
	16 (Furnace Temperature Control)	- 5 points
	17 (Residue Quality)	- 8 points
	18 (Emission Quality)	- 6 points
	21 (Open Burning)	- 4 points
	23 (Disposal of Quenching and Scrubbing Waters)	- 8 points

Total rating must equal 80 or more points.

B-Rated Incinerator - For heavy industrial or rural areas. The following items must score as follows:

Item	7 (Operational Maintenance)	- 10 points
	16 (Furnace Temperature Control)	- 5 points
	17 (Residue Quality)	- 8 points
	18 (Emission Quality)	- 6 points
	21 (Open Burning)	- 4 points
	23 (Disposal of Quenching and Scrubbing Waters)	- 8 points

The sum of all item points scored should equal 60 or more points.

C-Rated Incinerator - For rural areas or remote sites. The following items must score as follows:

Item	7 (Operational Maintenance)	- 10 points
	16 (Furnace Temperature Control)	- 5 points
	17 (Residue Quality)	- 8 points
	18 (Emission Quality)	- 6 points
	21 (Open Burning)	- 4 points
	23 (Disposal of Quenching and Scrubbing Waters)	- 8 points

Total rating must equal 40 or more points.

Any rating less than 40 points, regardless of rating of Item 16, 17, 18, 21 and 23 is unsatisfactory.

CHECK LIST FOR INCINERATOR EVALUATION

INCINERATOR _____ POINTS _____

LOCATION _____ RATING _____

RATER _____ DATE _____

CONTACTS _____

ITEM	POINTS ALLOTTED
1. Access Roads	
all-weather with parking	2
all-weather, no parking	1
undesirable	0 _____
2. Employee Facilities	
satisfactory	2
limited	1
none	0 _____
3. Communications	
reliable on-site	2
none on-site	0 _____
4. Fire Protection	
satisfactory	2
limited	1
none	0 _____
5. Accident Prevention and Safety	
training, on-site aid	2
training, near-by aid	1
no training, remote aid	0
unsafe practices	DEDUCT 5 _____
6. Operational Records	
satisfactory	6
limited	2
none	0 _____
7. Operational Maintenance	
routine maintenance and alternate plan	14
alternate plan only	10
routine maintenance only	4
neither	0 _____
8. Limited Access	
controlled	2
uncontrolled	0 _____

ITEM	POINTS ALLOTTED
9. Area Sanitation	
neat and clean	4
littered	0 _____
10. Building Sanitation	
neat and clean	4
occasional lapses	2
littered	0 _____
11. Weighing Facilities	
scales continually used	4
no scales	0 _____
12. Unloading Area	
spacious and supervised	4
limited and uncontrolled	0 _____
13. Dust Control at Unloading	
controlled, personnel protected	2
uncontrolled, personnel protected	1
no control or protection	0 _____
14. Capacity and Operation of Storage Pit	
remaining capacity > 1 day; amount stored < 3 day's collection.	2
remaining capacity < 1 day; amount stored < 3 day's collection.	1
available capacity < 1 day; amount stored > 3 day's collection.	0 _____
15. Segregation of Refuse	
satisfactory disposal	2
indiscriminate handling	0 _____

PAGE TOTAL _____

ITEM	POINTS ALLOTED
16. Furnace Temperature Control	
1500°F to maximum design	10
1300°F to maximum design	5
no records/not maintained	0 _____
17. Residue and Fly Ash Disposal	
sanitary landfilled or < 4% organics	8
> 4% organics not sanitary landfilled	0 _____
18. Emission Quality	
meets Federal standards	8
meets area standards	6
does not meet standards	0 _____
19. Hazardous Materials	
special provisions	2
exclusions	2
no special provisions	0 _____

ITEM	POINTS ALLOTTED
20. Salvage	
none	2
controlled	1
uncontrolled	0 _____
21. Open Burning	
none	4
any	0 _____
22. Vector Control	
rarely required	4
frequently required	2
not maintained	0 _____
23. Disposal of Quenching and Scrubbing Waters	
properly handled	8
improperly handled	0 _____
PAGE TOTAL	_____

MUST ITEMS AND RATINGS

ITEM	RATING			POINTS ALLOTED
	A	B	C	
7	10	10	10	
16	5	5	5	
17	8	8	8	
18	6	6	6	
21	4	4	4	
23	8	8	8	

TOTAL POINTS _____

RATING _____

SUITABILITY _____

_____

_____

TOTAL POINTS FOR RATING:

A = 80 or more

B = 60 - 80

C = 40 or more

TENTATIVE RATING METHOD FOR OPERATION OF COMPOSTING PLANTS [1]

ITEM 1: Access Roads. Access roads shall be designed, constructed, and maintained so that traffic will flow smoothly and will not be interrupted by ordinary inclement weather. Collection vehicles shall not interfere with normal traffic operation while waiting for access to the disposal facility.

Reason. It is of the utmost importance that collection not be delayed at the disposal facility and that unloading of vehicles at the facility not impede local traffic. A smoothly-operated disposal operation permits collection crews to accomplish collection routes on schedule, but delays in unloading result in deviations from normal collection schedules and refuse storage facilities become overtaxed.

This item shall be rated as follows:

If an all-weather access road, negotiable by loaded collection vehicles, with adequate on-site parking areas for collection vehicles, have been provided and unloading of vehicles is accomplished without delay.

2 points

If the access road provided is negotiable by loaded collection vehicles, but collection vehicles impede traffic flow or delay unloading because of lack of adequate parking.

1 point

If the access road is negotiable in good weather only.

0 points

ITEM 2: Employee Facilities. Suitable shelter and sanitary facilities shall be provided for personnel.

Reason. Sanitary facilities are desirable for good personal hygiene of both plant employees and collection personnel. If employees are required to operate the plant under inclement weather conditions without adequate shelter, a lack of attention to the operational requirements will result. Employee morale and efficiency are enhanced by provision of adequate sanitation facilities.

This item shall be rated as follows:

If all operational areas of the plant are provided with adequate shelter, including ventilation and screens (if required), and personnel are furnished with adequate drinking water, sanitary handwashing, toilets, locker, and shower facilities.

2 points

If adequate shelter is provided in all operational areas of the plant, but only minimal handwashing and toilet facilities are available.

1 point

If shelter or sanitary facilities are inadequate.

0 points

ITEM 3: Communications. Telephone or radio communications shall be provided at the composting plant.

Reason. Communications are necessary at composting plants in case of emergency. If the plant is part of a combined collection and disposal operation, better service and sanitary conditions can be rendered throughout the collection area by providing good communications.

This item shall be rated as follows:

If reliable telephone or radio communications are maintained at the plant.

2 points

[1] Not for General Distribution
Subject to Revision

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

If no communications are installed at the compost plant.

0 points

ITEM 4: Fire Protection. On-site fire protection shall be provided and arrangements shall be made with a responsible agency to provide adequate fire-fighting forces in an emergency.

Reason. Combustion in refuse storage or processing areas or malfunction of equipment may generate fires which will be of particular danger to men and equipment.

This item shall be rated as follows:

If the plant has an adequate water supply under sufficient pressure for fire-fighting purposes available at appropriate locations throughout the plant; approved extinguishers are so located to extinguish small fires or equipment fires; and arrangements have been made with the local fire-fighting agency to assist in an emergency.

2 points

If personnel must rely upon hand-operated extinguishers while waiting for assistance which has been arranged for from the local fire-fighting agency.

1 point

If suitable emergency procedures to isolate or confine a fire have not been established, a local fire-fighting agency is not available, or suitable water under pressure is not available.

0 points

ITEM 5: Accident Prevention and Safety. Employees shall be instructed in the principles of first-aid and safety and in the specific operational procedures necessary to prevent accidents or control dangerous situations. Accident precautionary measures shall be employed at the site. An adequate stock of first-aid supplies shall be maintained at the site.

Reason. The complex mechanical equipment required for composting and the processing of flammable (sometimes explosive) materials, creates a potential accident hazard for composting plant employees.

This item shall be rated as follows:

If all employees are given adequate and periodic operational and safety training; an adequate first-aid kit and at least one employee trained in first-aid are available on the site at all times.

2 points

If all employees are given periodic operational and safety training; an adequate first-aid kit is available at the site and trained first-aid assistance is available within three miles of the site and Item 3, Communications, is rated 2 points.

1 point

If periodic operational and safety training is not given; an on-site first aid kit is not maintained, trained first-aid assistance is not available within three miles, or communications to the trained first-aid assistant are not available at all times.

0 points

If all hazardous machinery is not equipped with appropriate safety devices and warning signs or unsafe practices are used at the site.

Deduct 5 points

ITEM 6: Operational Records. A daily log shall be maintained by the plant supervisor to record operational information, including the type and quantity of refuse received; hours of operation; maximum and minimum temperatures of the composted material and quantities of rejected refuse or salvageable items and disposal method used.

Reason. A composting plant is designed to reduce refuse to a sanitary, nuisance-free material through biochemical degradation

of compostable materials. It is essential that adequate operational records be kept in order to determine if satisfactory reduction of the refuse is routinely accomplished, if the plant's capacity is being exceeded and what disposition is made of rejected materials. Such records will indicate if changes in operating methods or if additional men, equipment or facilities should be sought to more adequately dispose of the incoming refuse.

This item shall be rated as follows:

If adequate records are routinely and accurately maintained.
6 points

If the operational records are inadequate.
2 points

If there are no records.
0 points

ITEM 7: Operational Maintenance. Adequate provisions shall be made for the routine operational maintenance of the composting plant. Repair or replacement of operational equipment shall be made efficiently and promptly. The plant shall be so designed and maintained that failure of one component of the composting plant will not result in complete plant shutdown. Provision shall be made for diversion of refuse to an approved alternate disposal facility in the event of a breakdown of more than 24 hours duration.

Reason. Routine maintenance of equipment reduces repair cost, prolongs equipment life and helps to prevent breakdowns that interrupt plant operations. If a failure of one component does not completely disable the composting plant, hours of operation may be extended to insure continuity of operations. Advance arrangements for making major repairs will materially reduce down-time. Complete breakdown of a day or more results in accumulation of refuse at the plant with development of health hazards and nuisances at the plant and throughout the collection system. Alternate disposal provisions will reduce health hazards and disruption of collection operations.

This item shall be rated as follows:

If routine maintenance is employed and if a decrease in plant capacity caused by malfunction of a component part can be overcome by extending the hours of operation or by alternate disposal in a properly operated sanitary landfill or other approved facility.
12 points

If no routine maintenance is employed and if a decrease in plant capacity caused by malfunction of a component part can be overcome by extending the hours of operation or by alternate disposal in a properly operated sanitary landfill or other approved facility.
9 points

If routine maintenance is employed but extension of the operating hours to adequately compost the refuse generated from the community is not possible or no alternate disposal method is provided.
3 points

If no routine maintenance is employed and if extension of the operating hours to adequately compost the refuse generated from the community is not possible or no alternate disposal method is provided.
0 points

ITEM 8: Limited Access. Access to the composting plant shall be limited to those times when operational employees are on duty. Only those authorized to visit or to use the disposal facility shall be allowed access to the compost plant. Particular caution shall be taken to insure that access to hazardous areas shall be restricted to authorized persons only.

Reason. When only authorized persons are permitted access to the composting plant during operating hours, traffic, fire, and accident hazards are minimized.

This item shall be rated as follows:

If neither vehicles nor pedestrians have access to plant outside of working hours.
2 points

If uncontrolled or partially controlled access is allowed.
0 points

ITEM 9: Area Sanitation. All refuse shall be confined to the unloading area, preferably within a building. No refuse, paper, etc., should be scattered adjacent to the plant site.

Reason. The purpose of the composting plant is to dispose of refuse in a sanitary, nuisance-free manner. If paper and other light refuse are allowed to be scattered, fire hazards and nuisances are created and the appearance of the composting plant will cause depreciation of land value in the surrounding area.

This item shall be rated as follows:

If the plant site and areas are kept neat and clean.
4 points

If paper or light refuse is scattered on or adjacent to the plant site.
0 points

ITEM 10: Plant Sanitation. All areas within the plant shall be maintained free of paper, refuse, dirt and debris.

Reason. A well-maintained plant will contribute to better working conditions and promote acceptability of the operation, thus attracting a better class of labor, improving the occupational environment, and maintaining better health and safety record for the employees.

This item shall be rated as follows:

If the interior of the plant is continually maintained free of paper, refuse, dirt, and debris.
4 points

If the interior of the plant is generally free of paper, refuse, dirt and debris, showing only occasional lapses in housekeeping practices.
2 points

If the interior of the plant shows general lack of good housekeeping practices.
0 points

ITEM 11: Weighing Facilities. Provisions shall be made for accurately weighing or suitably measuring all quantities of refuse delivered to the composting plant.

Reason. Weighing of incoming refuse is necessary to establish operating capacity in relationship to the design capacity of the plant and provide a basis for establishing fee schedules, and is an integral part of the plant operation. Weighing discourages collectors from making trips to the plant with half-full trucks.

This item shall be rated as follows:

If suitable fixed or portable scales have been installed for weighing refuse collection trucks or if they are continuously used to record plant quantities.
4 points

If suitable scales for weighing refuse collection vehicles are located on the way to the plant and are in use; or other suitable measuring facilities,* which accurately measure incoming refuse, are in continuous use.
2 points

If no weighing or measuring is accomplished or weighing or measuring procedures are inadequate.
0 points

ITEM 12: Unloading Facilities. Unloading facilities shall be of sufficient capacity and design to facilitate rapid and orderly unloading of collection trucks.

Reason. If collection vehicles are delayed at the unloading facilities, the efficiency and scheduling of collection services are disrupted. Confusion at the unloading area reduces the safety and efficiency of plant operations.

*Manufacturer's rated capacity for vehicles is not acceptable.

This item shall be rated as follows:

If the unloading facilities are adequate, trucks are unloaded without delay, and traffic is well organized and supervised.
4 points

If the unloading facility is not adequate for proper rapid unloading of collection trucks or the facility is poorly supervised so that prompt unloading and release of collection trucks is not accomplished.
0 points

ITEM 13: Dust Control. Dust generated by all components of the composting operation shall be controlled at all times.

Reason. Dust is a health hazard to plant employees and collection personnel.

This item shall be rated as follows:

If adequate dust control is in effect at all times during the unloading operation and personnel continually exposed to dust use proper protective equipment.
2 points

If control of dust during the unloading operation is inadequate but personnel use protective equipment.
1 point

If neither dust control nor protective equipment is adequate.
0 points

ITEM 14: Capacity and Operation of Storage Facilities. The capacity of the refuse storage pit shall be equivalent to at least the rated capacity of the composting plant for one day's operation. The unloading operation shall be organized such that reserve capacity is retained in the storage pit.

Reason. In the event of overload or plant malfunction, reserve capacity in the storage pit will permit storage of refuse until the composting plant can catch up or again become operational.

This item shall be rated as follows:

If the storage pit can hold at least one day's collection volume and the plant routinely processes one day's collection of refuse each working day.
2 points

If the refuse storage pit can hold one day's collection volume of refuse, but the plant does not process an equivalent volume on some working days.
1 point

If the refuse storage pit holds less than one day's refuse or the plant cannot process an equivalent volume each working day.
0 points

ITEM 15: Grinding and Separation. For effective composting, municipal refuse shall be ground at least once.

Refuse components that cannot be ground and/or composted, such as metals, tires and glass, plastics, and masonry shall be removed, and adequate provisions shall be made for these operations. Materials removed from the refuse shall not be stored on the premises.

Reason. Grinding of refuse accomplishes several things: 1) vastly increases the surface area available to the microorganisms to attack; 2) mixes the refuse into a more uniform mass; 3) breaks down the cell structure, releases fluids, and in general, makes the material more susceptible to decomposition; and 4) reduces the attractiveness of the putrescible material to insects and rodents. Separation of the material protects the grinding equipment and improves the finished compost.

This item shall be rated as follows:

If all noncompostable material is separated from the refuse and the grinding produces a particle size which is suitable for the composting method employed.
2 points

If some noncompostable items are apparent in the finished compost but the grinding produces a particle size which is suitable.
1 point

If the grinding does not produce a particle size suitable for the composting method employed.

0 points

ITEM 16: Time and Temperature for Compost Curing. The ground refuse shall be composted by methods in which each and every portion of the compost material is subject to a minimum temperature of 140°F for no less than forty hours.

Reason. In normal composting, temperatures of 140°F or higher are achieved for several hours or even days. This time/temperature exposure is believed to be adequate to destroy most, if not all, pathogens in the compost. Pasteurization of all of the compost must be relied upon for maximum protection, and it is essential that all portions of the compost be exposed to the minimum of 140°F temperature for at least forty hours to destroy pathogens throughout the compost.

This item shall be rated as follows:

If plant design and operation assure that all compost materials will be consistently heated to at least 140°F for forty hours or more, or laboratory examinations of appropriately selected compost samples are used as a routine control measure to certify that occurrence of pathogens is maintained at a level satisfactory to the responsible health officer.

10 points

If the above described design and operation requirements are not fulfilled and routinely-made laboratory examinations are not available to assure the adequacy of the composting operations for pathogen destruction.

0 points

ITEM 17: Compost Quality. Compost shall be of uniform quality, acceptable from pathogenic and hygienic viewpoints. Inert materials, such as glass and metals, shall be finely ground, intimately mixed and uniformly dispersed. Sharp slivers of glass and metal shall not be contained in the finished product.

Reason. The production of safe high-quality compost is essential for the successful marketing and utilization of this material. If successful marketing of compost is vital to the continued operation of the composting plant, production of safe high-quality compost has to be assured.

This item shall be rated as follows:

If the finished compost contains less than 10% inorganic or inert material by weight, as determined by the standard procedure listed in the APWA publication Municipal Refuse Disposal, Appendix A for the determination of volatile solids in residue; those inert materials are finely divided and intimately mixed; the pathogens in the finished compost have been maintained at or below a level approved by the local health officer; and the compost is acceptable for favorable marketing.

10 points

If the compost fails to qualify as listed above.

0 points

ITEM 18: Emission Quality. Gaseous and particulate emissions or objectionable odor from compost plant operations, including those from combustion of refuse shall be of a quality acceptable to the community where the plant is established.

Reason. Proper management, facilities, and control devices can prevent emission of gases, particulates or objectionable odor from composting plants. In order for such plants to maintain acceptability in locations best suited for the needs of the refuse disposal system, they have to continually comply with local emission limitations. (Recommendations for standards can be obtained from the National Center for Air Pollution Control.)

This item shall be rated as follows:

If the emissions from the composting plant continually comply with the air pollution standards established for the area.

8 points

If the emissions from the composting plant do not continually comply with local air pollution standards.

0 points

ITEM 19: Sewage Solids, Liquids, and Other Hazardous Materials. If sewage solids and liquids (septic tank or cesspool pumpings and sewage sludge and grit), and other hazardous materials, are accepted or disposed of in a composting plant, special provisions shall be made to insure proper handling.

Reason. Sewage solids or liquids are infectious and create health hazards if not properly handled. Other materials including oil sludges, chemicals, magnesium shavings, and empty insecticide containers, may also present special hazards. These materials can endanger plant employees and harmful elements may persist in the compost unless proper handling and processing is routinely employed. When the design and operation of a composting plant includes special provisions for the disposal of these hazardous materials, they can be disposed of safely and need not be excluded.

This item shall be rated as follows:

If suitable procedures are established and routinely followed for the disposal of hazardous materials, all hazardous materials are excluded from the composting plant and pathogens do not survive in the compost.

2 points

If hazardous materials are accepted with no provision for proper handling or disposal or pathogens survive in the compost.

0 points

ITEM 20: Salvage. Salvaging conducted at a composting plant shall be so organized that it will not interfere with the prompt and sanitary disposal of the refuse through the composting operation. Personnel shall be protected from potential health and accident hazards. Salvaged material shall be stored in a neat and orderly manner in vermin-proof containers, if necessary, but excessive amounts of salvaged materials shall not be stored upon the premises.

Reason. Nothing can be tolerated that interferes with prompt sanitary composting of refuse. Improperly conducted salvaging delays the composting operation and creates insanitary conditions. Accumulation of salvaged items at the plant often results in vector problems and unsightliness, both detrimental to public acceptance of the operation. Proper collection, storage, and disposal of salvaged materials will aid in maintaining high public health standards and will increase the efficiency of plant operation.

This item shall be rated as follows:

If the salvaging is well organized, salvaged material is properly stored and no excessive quantities of salvaged material are kept on the premises.

8 points

If the salvaging is well organized and salvaged materials are stored in a proper manner, but excessive amounts of salvaged materials have accumulated.

4 points

If salvaging is disorganized, proper storage is not provided or salvaging contributes to odor production or the attraction or production of insects and rodents.

0 points

ITEM 21: Disposal of Nonsalvageable Materials. Materials separated from the refuse which have no marketable value shall be disposed of in a sanitary landfill. If market or other conditions make the salvage of any particular material impractical, salvaging of the material shall be discontinued or the material shall be stored elsewhere or disposed of by sanitary landfill.

Reason. Most noncompostable items which have no salvage value cannot be incinerated because of bulk or noncombustible content. On-site storage or unsatisfactory disposal of these materials will be unsightly or contribute to vector problems.

This item shall be rated as follows:

If noncompostable items separated from the refuse are disposed of immediately in a sanitary landfill or are removed to proper storage elsewhere. 8 points

If noncompostable items are allowed to accumulate at the plant or the disposal of the items is improper. 0 points

ITEM 22: Vector Control. Attraction or production of insects and rodents shall be prevented by conducting all plant operations in a systematic well-organized manner. Supplemental vector control measures shall be instituted if necessary.

Reason. Routine operation of a composting plant according to these standards will prevent or minimize insect and rodent problems. Any lapse in proper operating procedures may result in attraction and production of insects and rodents, requiring supplemental vector control measures.

This item shall be rated as follows:

If vector control is not needed. 2 points

If vector control is properly supplied when conditions warrant such control. 1 point

If vector control is needed or is not promptly furnished. 0 points

Suggested Method for Evaluating Numerical Rating

A-Rated Composting Plant - For industrial areas. The following items must score points as follows:

Item 16	(Time and Temperature for Compost Curing)	- 10 points
17	(Compost Quality)	- 10 points
18	(Emission Quality)	- 8 points
20	(Salvage)	- 8 points

Total rating must equal 80 or more points.

B-Rated Composting Plant - For heavy industrial or rural areas. The following items must score as follows:

Item 16	(Time and Temperature for Compost Curing)	-10 points
17	(Compost Quality)	-10 points
18	(Emission Quality)	- 8 points

Total rating must equal 60 or more points.

C-Rated Composting Plant - For very rural areas. The following items must score as follows:

Item 16	(Time and Temperature for Compost Curing)	-10 points
17	(Compost Quality)	-10 points

The total rating must equal 40 or more points.

Any rating less than 40 points regardless of the ratings of Items 16, 17, 18 or 20 is unsatisfactory.

CHECK LIST FOR COMPOST PLANT EVALUATION

COMPOST PLANT _____ POINTS _____

LOCATION _____ RATING _____

RATER _____ DATE _____

CONTACTS _____

_____

ITEM	POINTS ALLOTTED
1. Access Road	
all-weather with parking	2
all-weather, no parking	1
undesirable	0 _____
2. Employee Facilities	
satisfactory	2
limited	1
none	0 _____
3. Communications	
reliable on-site	2
none on-site	0 _____
4. Fire Protection	
satisfactory	2
limited	1
none	0 _____
5. Accident Prevention and Safety	
training, on-site aid	2
training, nearby aid	1
no training, remote aid	0
unsafe practices	DEDUCT 5 _____
6. Operational Records	
satisfactory	6
limited	2
none	0 _____
7. Operational Maintenance	
routine maintenance and alternate plan	12
alternate plan only	9
routine maintenance only	3
neither	0 _____
8. Limited Access	
controlled	2
uncontrolled	0 _____

ITEM	POINTS ALLOTED
9. Area Sanitation	
neat and clean	4
littered	0 _____
10. Plant Sanitation	
neat and clean	4
occasional lapses	2
littered	0 _____
11. Weighing Facilities	
on-site scales continually used	4
off-site scales continually used	2
none	0 _____
12. Unloading Facilities	
spacious and supervised	4
limited and/or uncontrolled	0 _____
13. Dust Control	
controlled, personnel protected	2
uncontrolled, personnel protected	1
no control or protection	0 _____
14. Capacity and Operation of Storage Facility	
remaining capacity > 1 day	2
remaining capacity < 1 day	1
available capacity < 1 day	0 _____
15. Grinding and Separation	
suitable	2
limited	1
not suitable	0 _____

PAGE TOTAL _____

ITEM	POINTS ALLOTTED
16. Time and Temperature for Compost Curing	
suitable	10
not suitable	0 _____
17. Compost Quality	
suitable	10
not suitable	0 _____
18. Emission Quality	
meets area standards	8
does not meet area standards	0 _____
19. Hazardous Materials	
special provisions	2
exclusion	2
no special provisions	0 _____

ITEM	POINTS ALLOTTED
20. Salvage	
organized	8
partially organized	4
disorganized	0 _____
21. Disposal of Nonsalvageable Materials	
properly handled	8
improperly handled	0 _____
22. Vector Control	
not needed	2
supplied when needed	1
needed	0 _____
PAGE TOTAL	_____

MUST ITEMS AND RATINGS

ITEM	RATING			POINTS ALLOTED
	A	B	C	
16	10	10	10	
17	10	10	10	
18	8	8	-	
20	8	-	-	

TOTAL POINTS _____

RATING _____

SUITABILITY _____

_____

_____

TOTAL POINTS FOR RATING:

A = 80 or more

B = 60 or more

C = 40 or more

A SIMPLE KEY TO SOME FLIES FOUND ASSOCIATED WITH REFUSE

Training Staff*

I FLIES WITH DULL BODIES COLORED BROWN, GRAY OR BLACK

A Thorax (the part of the body to which legs and wings are attached) gray, with three distinct black stripes; abdomen checkered, usually with tip (tail light) of red or orange - Flesh Fly (Sarcophaga).

B Thorax with four dark stripes, underside of abdomen - House Fly (Musca domestica).

C Thorax with four dark stripes, abdomen usually spotted. About the same size and general color as a house fly. Long, slender piercing mouthparts stick out from head - Stable Fly (Stomoxys calcitrans).

II FLIES WITH THORAX DULL, AND ABDOMEN METALLIC OR SHINY BLUE OR GREEN

A Blue Bottle Fly (Calliphora)

III FLIES WITH SHINING, METALLIC BODIES COLORED GREEN, BLUE OR BLACK

A Body metallic, with no stripes, colored bronze, coppery green, light or bright green. Garbage or Green Bottle Fly (Phaenicia).

B Body metallic with no stripes, colored very dark blue or very dark green. Black Blow Fly (Phormia regina).

C Body shining black, slender, and rather small size. Dump Fly (Ophyra).

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

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VECTOR CONTROL

Training Staff*

I INTRODUCTION

In the almost endless variety of discarded materials many organisms find food, shelter from enemies or extremes of weather, and other comforts which lead to their development, or at any rate, concentration, at disposal sites. Most of these organisms are at least nuisances; many are carriers (vectors of human or animal disease); and a few, seagulls for example, present the risk of accidents. Ordinarily the problems presented from these insects or animals are inversely proportional to the care given to proper refuse disposal. However, supplemental control measures are occasionally necessary even at well operated sanitary landfill sites.

II PESTS OR DISEASE VECTORS PRESENT

A Flies

1 Housefly, Musca domestica

2 Stablefly or "Biting Housefly", Stomoxys calcitrans

3 Flesh Fly, Sarcophaga sp.

4 Greenbottle or Garbage Fly, Phaenicia sp.

5 Black Blowfly, Phormia regina

B Mosquitoes

1 Yellow Fever Mosquito, Aedes aegypti

2 Brown House Mosquito, Culex pipiens

C Rodents

1 Norway Rat, Rattus norvegicus, and climbing rat, Rattus rattus

2 House Mouse, Mus musculus

3 Various native rodents - wood rats, cotton rats, white-footed mice, etc.

D Miscellaneous Pests, Disease Vectors

1 Seagulls, other flocking birds

2 Cockroaches

3 Dogs, cats

4 Mongooses, nutria, raccoons, bears

III DISEASE TRANSMISSION POTENTIALS

A The fact that domestic flies can carry many agents of human disease is firmly established in the laboratory and in one study houseflies were proven to be important in the spread of bacillary dysentery.

B Rodents, similarly, are carriers of enteric and other infections.

C Mosquito species associated with open dumping, including container breeders and those liking dirty water, may carry important viral diseases of man, particularly.

IV ENVIRONMENTAL CONTROL

A Insects, in addition to needs for food and protection from enemies, are vulnerable to extremes of temperature and humidity. Basic needs may be summarized as:

1 Food

2 Warmth

3 Moisture

4 Time to develop

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B Rodents may or may not require drinking water (rats do, mice do not). Basic needs may be summarized as:

1 Food

2 Water (sometimes)

3 Shelter

C Environmental control consists largely of denying these needs or making them unsuitable.

V CHEMICAL AND PHYSICAL CONTROL

A Flies and Other Insects

1 Trapping, screening

2 Attractants, repellents

3 Insecticides

a Pyrethrum

b Chlorinated hydrocarbons

c Organic phosphorus compounds

4 Formulations

a Solid and wet baits

b Fogs, mists, residual sprays

B Rodents

1 Trapping, rodent proofing

2 Rodenticides

a Gassing of burrows

b Red squill, zinc phosphide, ANTU, norbromide

c Sodium fluoroacetate (1080), fluoroacetamide

d Anticoagulants - water baits, dry baits, paraffin blocks

C Birds

1 Trapping, scare devices

2 Poisons, narcotics

VI SUMMARY

Your vector control program should be a supplement to, not a substitute for, proper refuse handling procedures. It is always easier to breed pests than it is to kill them.

REFERENCES

1 Shepard, Harold H. The Chemistry and Action of Insecticides. McGraw-Hill/ New York, 1951. 504 pp.

2 Mallis, Arnold. Handbook of Pest Control. MacNair-Dorland, New York, 1960. 1132 pp.

3 PHS Communicable Disease Center. Report on Public Health Pesticides, 1600 Clifton Rd., N.E., Atlanta, Georgia, 1966.

SOME GUIDELINES FOR CONTROL OF RATS IN DISPOSAL SITES

Training Staff*

Properly operated Sanitary Landfills should not require supplemental use of rodent poisons ordinarily, since the operation itself should deny all food and shelter to vermin. Routine pesticiding of open dumps is administrative insanity, and calls to mind Voltaire's comments about the Russian foot soldiers, who poured perfume in their boots instead of washing their feet.

Still, there are times when dump poisoning is clearly indicated: for example, prior to closing a dump or converting it to a Sanitary Landfill. Unless the rat population is destroyed, the rats may, with the loss of food and shelter, move into surrounding areas.

There is really no such thing as an absolutely safe rat poison. Freak accidents have occurred even with squill and the anticoagulants. It behooves us therefore, to use the safest possible pesticides, apply them safely, and guard the disposal site during the poisoning period. There are more effective, but more dangerous, rodent poisons on the market. Only trained pest control operators should use them.

FORMULATIONS

Red Squill

This product has probably been used for more than a thousand years, and still has merit. Its greatest advantage is its safety, because it contains a natural emetic. Rats do not vomit, and are poisoned by it. The greatest disadvantage is its bitter taste, which must be overcome with tasty baits. Here is a suggested bait formula:

Fortified red squill	1 lb.
Corn oil or salad oil	2 lbs.
Chicken mash or corn meal	2 lbs.
Ground beef, horse meat, or fish	5 lbs.
	10 lbs.

Depending upon availability, you may wish to substitute ground up returned bakery goods for some of the grain. Rats also love bacon grease and you can substitute it for the corn oil. Cheap canned mackerel and tuna fish also go well and increase bait acceptance.

The finished baits may be rolled up in 6 inch squares of wax paper, about a tablespoon to the bait, or distributed with a tablespoon at the site on paper squares where there is rat infestation. Larger "bait stations" of 4 to 8 ounces may be placed, cover with a board so they will be accessible to rats but screened from the weather. You would not know how much to use except by rebaiting on successive days as the baits are taken until no more "takes" are seen. Then remove all baits when the public or pets again have access to the site. For initial baiting figure for about one bait for each rat hole or a half pound every hundred square feet (10 feet by 10 feet).

Zinc Phosphide

Here is another old favorite, still very good for this kind of work. This rodenticide is a black powder with a distinct phosphine odor which makes it unattractive to children and pets, though the rats accept it. It may be advisable to add tartar emetic (antimony potassium tartrate) to your bait formula to induce vomiting in case the rodenticide is accidentally eaten by pets or humans. It will, however, make it a little harder to get the rats to eat it.

Zinc phosphide	4 oz.
Ground meat, canned fish, bacon or fresh tomatoes	25 lbs.
Tartar emetic	$1\frac{1}{2}$ oz.

Canned mackerel is a good material for at least some of the bait. Many operators substitute oats or corn meal for half or more of the bait to get a drier and more economical mixture. Distrubute as was suggested for

*Training Branch, Division of Technical Operations, Solid Waste Management Office, Cincinnati, Ohio

the squill bait. If your dump has a face, figure about a pound of bait for each ten running feet of face on the first application. If your dumping area is unrestricted you will have to bait accordingly, and may come to feel that you are trying to bait the world. At this point the merits of Sanitary Landfill become more evident.

Anticoagulants

These rodenticides are comparatively safe to use where the public may have access to them. They reduce the clotting properties of the blood and cause internal bleeding, which results in death of rats after they have fed on the bait for 4-10 days. Besides the safety factor, they are advantageous to use because the rats accept the bait well, and cheap dry baits consisting mostly of grain can be used. The main disadvantage lies in the amount needed. You must put out about 4 ounces of bait per rat. During the period of poisoning, birds may eat up a lot of your grain bait. It would not hurt them but may cause you to have to use more bait.

In the anticoagulant group are warfarin, pival, fumarin, and diphacinone. It really does not matter which one you use. Another one, PMP, has similar properties but if you use it you should put in twice as much as the formula indicates.

Anticoagulant (0.5% concentrate)	25 lbs.
Corn oil or mineral oil	25 lbs.
Powdered sugar	25 lbs.
Rolled or ground oats	100 lbs.
Corn meal or corn chop	325 lbs.
	500 lbs.

The complete bait may be placed in small pans not over one-half inch high and inserted under boards or other protected locations at the dump site. The bait should be checked at two-day intervals and replenished until there is evidence that no more feeding has taken place.

Most of the anticoagulants mentioned above may also be purchased as wax treated bait blocks or rodent cakes with meat or fish flavor to attract rats.

If you want to try some water baits, try the water-soluble anticoagulants: warfasol, fumasol, or pivalyn. Use as instructed on the package.

For dump poisoning, I personally prefer to use red squill or zinc phosphide to reduce the rat population, and follow up with bait stations of anticoagulant for final cleanup.

Calcium Cyanide

This is a material commonly used for gassing rats. In the presence of moisture in the air or soil, this chemical forms hydrocyanic acid gas (HCN). Both calcium cyanide and the gas are deadly poisons for animals and man, and must be handled with extreme care.

Calcium cyanide is commercially available as a dust and should be applied with a pump made and sold for this specific purpose. The pump is so constructed that it may be held in place with the foot, and both hands are free for the operation of the pump. A glass jar holds about three-quarters of a pound of dust, which is sufficient to treat approximately thirty-six burrows at one time without reloading. Air is forced through the glass jar containing the powder, and the dust-laden air passes through a hose into the rat burrow. The end of the hose is placed 10 to 12 inches inside the burrow, the entrance closed with earth, and several strokes are made with the pump. If the dust comes out of other holes, they should be covered with soil. The valve on the bottom of the pump is then switched over to "air" position and the gas is forced through the entire burrow system.

Control should not be attempted during a strong wind. In opening cyanide cans or loading the pump the operator should stand to windward to avoid exposure to dust or fumes. He should also be careful to apply the dust so that it will not drift toward other individuals in the area.

SOME SUGGESTED SOURCES FOR SUPPLIES

These are merely put forth to give you a start in looking for materials. The list is by no means exhaustive, and mention of these

suppliers in no way should be construed as an endorsement of their products over those of any not mentioned.

Rat Control Products

American Cyanamid Co., Agricultural Chemicals Div., 30 Rockefeller Plaza, New York 20, New York.

California Spray-Chemical Corp., Richmond, California.

Continental Chemiste Corp., 2256 West Ogden Avenue, Chicago 12, Illinois.

J. T. Eaton & Co., Inc., 3110 W. 65th Street, Cleveland, Ohio 44102 (squill, and warfarin bait blocks).

Elco Manufacturing Co., 2039 Fifth Avenue, Pittsburgh 19, Pennsylvania.

Hopkins Agricultural Chemical Co., P.O. Box 584, Madison, Wisconsin.

Hub States Chemical & Equipment Co., 2002 N. Illinois Street, Indianapolis, Indiana 46202.

Miller Chemical & Fertilizer Corp., 2226 N. Howard Street, Baltimore 18, Maryland.

Niagara Chemical Div., Food Machinery & Chemical Corp., Middleport, New York.

S. B. Penick & Company, 50 Church Street, New York 8, New York.

John Powell & Company, 10 Light Street, Baltimore 3, Maryland.

Prentiss Drug & Chemical Co., 101 W. 31st Street, New York 1, New York.

Pyrrole Chemical Corp., 817 Spring Lane, Portsmouth, Ohio.

Gallard Schlesinger Chemical Corp., 37-11 29th Street, Long Island City 1, New York. (zinc phosphide)

Seacoast Laboratories, Inc., 156 Perry Street, New York 14, New York.

Selco Supply Co., 109 Elm Street, Eaton, Colorado.

Stephenson Chemical Co., P.O. Box 188, College Park, Georgia.

Wil-Kil Pest Control Co., 522 West North Avenue, Milwaukee 12, Wisconsin.

Andrew Wilson, Inc., Springfield, New Jersey.

Wisconsin Alumni Research Foundation, 506 North Walnut Street, Madison, Wisconsin.

CONNECTICUT STATE DEPARTMENT OF HEALTH
SOLID WASTES SECTION

RODENT CONTROL PROGRAMS AT REFUSE DISPOSAL AREAS

When closing a site or converting an open-face dump to a sanitary landfill type of operation, it will be necessary to carry out a rodent-baiting program. The rodents must be exterminated so that they will not migrate to surrounding areas when their food supply is cut off at the refuse disposal site.

A Time Schedule

1 It will be necessary to close the site for a minimum of three days.

   a On the first day, the site must remain free of activity to allow the rodents to feed on refuse deposited on the previous day.

   b On the second day, the bait is distributed in burrows and in sheltered areas.

   c On the third day, the rodents are allowed to feed on the bait.

2 Dumping may be resumed and heavy equipment should be brought in on the fourth day to initiate conversion to sanitary landfill and/or to spread, compact, cover and seal the area if the site is being closed. There should be no delay in completing this work.

B The Bait

1 Upon agreement with local officials to bait an area, the Connecticut State Department of Health will order the poison and have it sent to the town. The town should notify this department when the poison has been delivered in order that a date for baiting may be scheduled.

2 The town will be responsible for storing the poison safely, preferably under lock and key.

3 The ingredients are to be purchased by the town and mixed under the supervision of the staff of the Connecticut State Department of Health.

4 Ingredients for a 100 pound mix:

   a 90 pounds of fish meal cat food.

   b 10 pounds of corn meal.

   c 25 ounces of zinc phosphide poison (contains an emetic).

C Distributing the Bait

1 The town will be responsible for the following:

   a Have men with heavy shoes available for work.

   b Provide, for each worker, gloves which are to be disposed of afterwards.

   c Provide a mixing container, hoes for mixing, and a spade.

   d Provide long-handled spoons and buckets or pails for each worker.

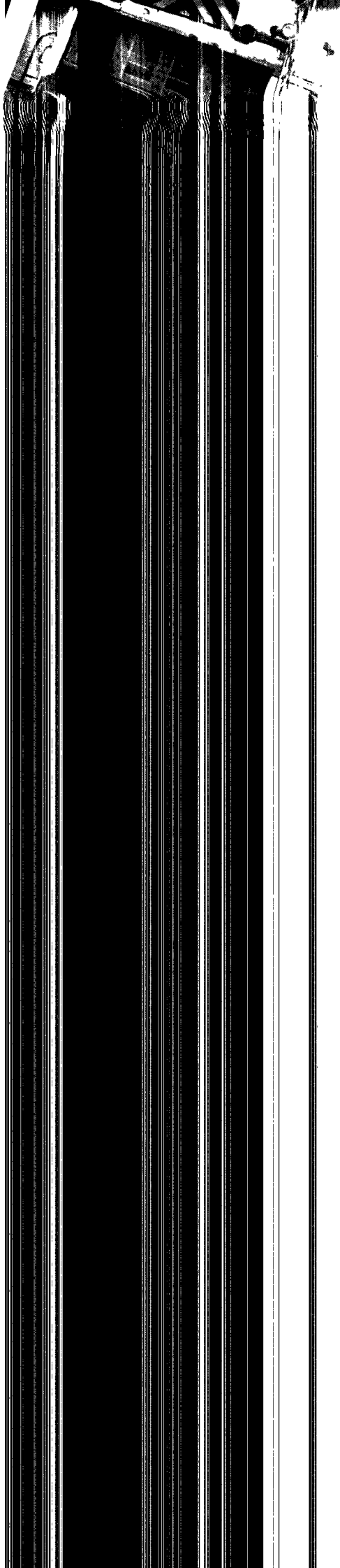
   e Provide soap and water for immediate hand washing after distributing the poison.

2 There will be no smoking while distributing the bait.

3 The Connecticut State Department of Health will supervise the distribution program.

Baiting should not be done on days when rain or snow is predicted during the next 24 hours. On the morning of the day scheduled for the baiting program, there should be close communications between the state and town officials to be certain that the weather conditions are favorable for the baiting program.

Rats may contain disease-bearing fleas and ticks, therefore care should be taken to assure they are promptly buried in with the refuse during conversion operations with minimum of handling.



million hours worked com-
ated according to the follo
formula:

Frequency ra
N(((

REFUSE COLLECTION IN MUNICIPALITIES

This data sheet was prepared by the Special Projects Section, National Safety Council, 425 North Michigan Avenue, Chicago, Ill. 60611, and is published by the Council.

REFUSE COLLECTION is directly related to the preservation, protection, and the health and welfare of citizens. Problems associated with collection and disposal of refuse must be faced by all communities regardless of size. It should be recognized that certain hazards are inherent in the nature of refuse handling activities and will vary with the types of equipment used and the various conditions surrounding the operations. Experience of various cities and communities indicates that these activities are in an area to which management should develop a proper amount of attention in order to motivate employees to maintain the highest level of safety. The circumstances contributing to potential hazards for employees' injuries will vary greatly among organizations.

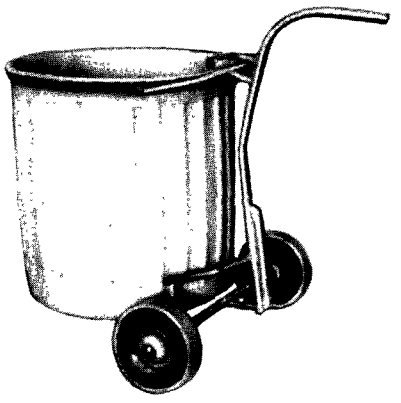


Figure 1 illustrates a two-wheel hand truck —the type used to haul refuse containers.

2. This data sheet will discuss the hazards pertaining to refuse collection in municipalities and the measures which should be followed to avoid them.

3. Some organizations operate on an incentive program in refuse collection, thereby conceivably putting an added strain on a safety program. The incentive system is so ingrained in some organizations that it would

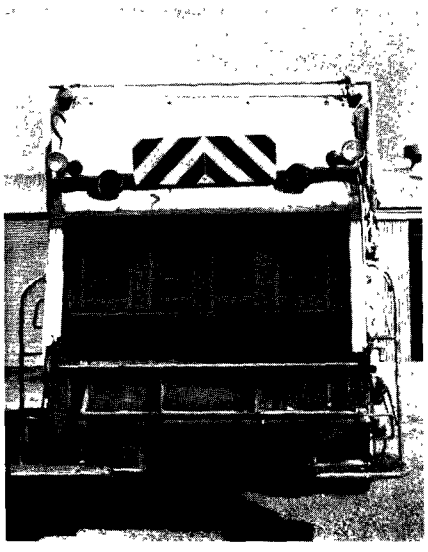


Figure 2 is a typical refuse truck with a serrated metal step and hand-hold safety rail.

be extremely difficult to change. (Certain "bonuses" grant each worker permission to leave for home when his route has been completed. This leads to excessive speed and "chance-taking.") Some crews may pick up more refuse per day than other crews. This added workload and the speed of operation may add additional hazards to an already potentially hazardous job.

Hazards

4. Refuse collection requires the use of large amounts of costly equipment, and sufficient operating, supervisory, and administrative personnel. Table I analyzes accidents that have occurred in refuse collection within a given city operation, indicative of the type of hazards encountered. The analysis of these accidents, suggests countermeasures that may be taken.

5. Employees have had frequent accidents involving packing blades, which have caused partial loss of fingers, hands, arms, and feet. Meaningful statistics on accidents in refuse collections are not numerous, but the few that are available will illustrate the magnitude of the problem.

6. Cities, with a population of over 100,000 have submitted data which totaled 16.5 million manhours of exposure. The frequency rate was 60.77 and the severity 2,012 (Table II). This frequency rate is nine times that of the average industrial worker! The frequency rate is the number of disabling injuries per million hours worked computed according to the following formula:

$$\text{Frequency rate} = \frac{\textit{Number of disabling injuries} \times 1{,}000{,}000}{\text{Employee-hours of exposure}}$$

The severity rate is the total days charged per million hours worked, as follows:

$$\text{Severity rate} = \frac{\textit{Total days charged} \times 1{,}000{,}000}{\text{Employee-hours of exposure}}$$

All fatalities, permanent total disabilities, permanent partial disabilities, total and temporary disabilities arising out of and during the course of employment are reportable whether due to accidental injury or occupational disease. The number of lost-time injuries, and not the number of accidents, is included.

Hazards encountered

7. The hazards encountered in carrying heavy containers and in stepping on or off refuse trucks were reflected in one out of every two lost-time injuries during a period under study. This involved a strain, sprain, or dislocation. (About one-third of all disabling injuries in California industries,[4] which were taken as a group, are strains, sprains, or dislocations.) Back strains represented the leading single type of injury sustained by refuse collectors, accounting for about one-fourth of the injuries recorded. Back strains in the state of California are just under one-fifth of the lost-time work injuries. Sprained ankles were recorded more frequently for workers injured in refuse collection than for all injured workers taken as a group. Ankle sprains accounted for seven per cent of the disabling injuries in refuse collection compared with only three and one-half per cent of the lost-time injuries reported.

8. The wide variety of hazards to employees engaged in refuse collection is reflected in the industry's manual of Workmen's Compensation premium rate, i.e., $8.05 per $100 payroll. This is four times the rate for all manual classifications taken together. (In other industries, the manual rate may be modified to individual employers who are eligible for experience rating. Modifications may be either upward or downward depending upon the individual employer's own experience.) The increasing cost of work injuries to the employees within industry is clearly indicated by the fact that the manual rate per $100 payroll for Workmen's Compensation insurance was $8.05 in 1967 compared with $4.12 ten years earlier. The rise of 95.4 per cent in the manual rate level for this industry is greater than the overall raise for all manual classifications, which was 81.4 per cent for the same period.[4]

9. Nationally, some of the contributing factors to hazards encountered are: narrow streets and alleys, inadequate, old or poorly maintained equipment, faulty design, variation in requirements for size, weight, type, and contents of refuse containers and bundles. All of these contribute to the diversity of accidents within various organizations. Some of the hazards faced by refuse collectors arise from the "booby traps" unwittingly laid by the householders whom they serve. The householder increases the likelihood of injury for refuse collectors when broken glass is placed loose in the refuse container; when lightweight trash cans are filled with chunks of concrete or other heavy objects; when the outside of a heavy object is covered with paper or other trash; or when a garden hose or other object is left strewn along the pathway to a rubbish can. A householder who continues to use a container which is rusted through or one with unserviceable handles also increases the risk of a job injury for the refuse collector.

10. Cuts, lacerations, and punctures accounted for 14 per cent of the lost-time injuries to refuse collectors; whereas, within industry generally, 17 per cent of the workers suffered such injuries. As refuse collectors handle sharp or jagged objects frequently in the course of their work, it appears that the likelihood of sustaining cuts, lacerations, and puncture wounds would have been minimized through the use of heavy work gloves.

11. Refuse collectors carry loads which may exceed safe maximum loads, and handle heavy and bulky

containers. Sharp edges on garbage cans, metal splinters, and perforations add to the injury potential. Containers often are of makeshift construction and are frequently not designed for easy lifting.

12. Street loading should take place during non-peak traffic hours, thereby affording the collector freedom of movement on the streets where refuse is collected. The emphasis in refuse collection is on speed; this, however, may lead to a complete disregard of safety. Listed below are types of accidents and injuries which occur most often during refuse collection:

a. *Accident type:* Slips and falls, over-exertion, struck-by (blades or motor vehicle), falling objects, flying objects, animal and insect attacks, and exposure to extreme temperatures.

b. *Injuries:* Strains, sprains, back injuries, cuts, amputations, bruises, lacerations, fractures, and eye injuries.

Factors in refuse collection

13. Most ordinances regulate the size, type and material, metal or plastic, of containers and specify suitable handles and configurations.[1] The guiding principle should be the weight and bulk that an average man can lift safely. Many municipalities specify the use of tapered containers, made of galvanized steel. Others have set up their own ordinances so that they virtually rule out any other material for containers except that specified. Disposable paper and plastic bags are used as well as plastic containers in some areas.

14. A large "carry-barrel," made of plastic or aluminum, is used by some organizations to transport the refuse from the rear of the home to the trucks, thereby eliminating the need for carrying the containers to the collection vehicle. Some procedures include the use of two-wheel rubber-tire hand trucks (Figure 1), while in others the collector carries the load to the truck.

Training

15. Collectors should be trained in proper lifting techniques and in the handling of all containers, plastic, aluminum, or steel, etc., used for backyard carry-out service. In order to avoid injuries, collectors should not carry containers to the truck in undue haste. This is particularly true where stairs, or uneven walkways are involved.

16. The presence of moving mechanical parts on automatic, packer-type compaction units is potentially hazardous and could cause severe injury or amputation. An analysis of accidents show that "human nature" is responsible for more accidents and injuries than those of purely mechanical causes. This theory stems from the fact that collectors are often drawn from the most unskilled segment of the working force, have little or no experience with heavy equipment, and receive little or no initial or subsequent training and supervision. Therefore, a training program should be instituted for new employees and refresher courses for employees required to operate new equipment. Some cities use audio-visual aids, such as a slide presentation during their training program for collectors. This could be of great value in explaining what or indicating how certain hazards inherent to a job, occur.[3]

17. Some of the causes of human failure include insufficient rest, poor physical condition, personal problems resulting in lack of proper attention to the job, daydreaming, faulty observation, negligent attitude, and "chance-taking." Many accidents result from workers' attempts to salvage articles from a hopper after the packing motion has begun. Salvaging refuse from collection trucks should be forbidden. "Chance-taking" such as an attempt to push materials into the hopper by hand or foot while the blade is descending, should also be prohibited.

18. Containers should be tilted to check the weight before trying to lift them, and assistance obtained whenever necessary.

19. Only approved walks or routes should be used when collecting on private property. If containers are not placed in proper location for pick-up, the supervisor should be notified. Backyard carry-outs inevitably invite dog-bites. A good dog repellent should be used when this possibility exists. (Training classes on how to understand and control dogs have been successful in some areas.)

20. Riding trucks between stops should be done only on the steps provided. Sturdy riding steps and hand-holds are necessary requirements. Members of each crew should keep their arms, limbs, and shovels and "carry-barrels" within the body lines of the vehicle and away from packing mechanisms.

21. Collectors should not jump on or off moving vehicles during collection. Although the practice of

Figure 3 shows a refuse collector unloading refuse into an escalator conveyor-type truck. Note bar across hopper. It prevents the possible exposure of the workman to the blades.

TABLE I
ACCIDENT RECORD OF A GIVEN CITY
(One Year Experience)

PUBLIC WORKS DEPARTMENT **REFUSE SECTION**

Class	*Location (Part of Body)*	*Injury*	*Accident Type*	*Employee Action*	*Paid Time Lost (workdays)*
Refuse Collector	Back	Strain	Struck against	Stepped off truck	1
Refuse Collector	Left leg	Puncture	Struck by	Emptying can, bit by dog	0
Laborer	Right foot	Laceration	Struck against	Dumping bucket	0
Hvy. Equipment Operator	Right eye	Scratch	Struck by	Struck in eye by tree limb	0
Equipment Operator	Left ankle	Strain	Struck against	Stepped on rock, twisted ankle	10
Refuse Collector	Lower back	Strain	Overexertion	Lifting boxes	5
Equipment Operator	Back	Strain	Overexertion	Lifting 50 gal. drum into truck	7
Refuse Collector	Back	Strain	Overexertion	Lifting garbage can	5
Refuse Collector	Left shoulder	Strain	Overexertion	Lifting garbage can	5
Refuse Collector	Left ribs	Contusion	Struck against	Moving box inside hopper	2
Refuse Collector	Groin	Hernia	Overexertion	Reportedly lifted can	0
Refuse Collector	Left eye	Conjunctivitis	Contact	Working at rear of truck	1
Laborer	Left thumb	Laceration	Caught in	Caught thumb in door of truck	0
Refuse Collector	Right elbow	Bruise	Struck against	Lifting garbage can	0
Refuse Collector	Right wrist	Soreness	Struck against	Pulling can from box	6
Refuse Collector	Back	Strain	Overexertion	Strained back lifting garbage can	9
Refuse Collector	Left knee	Sprain	Overexertion	Stepped off truck — slipped	6
Refuse Collector	Right ankle	Sprain	Struck against	Stepped off truck into hole	4
Refuse Collector	Right hand	Sprain	Overexertion	Stepped off truck	0
Refuse Collector	Left shoulder	Strain	Overexertion	Lifting overloaded can	2
Equipment Operator	Right wrist	Abrasion	Struck against	Emptying can	5
Refuse Collector	Right arm	Strain	Overexertion	Handing garbage can to helper	3
Refuse Collector	Left knee	Strain	Struck against	Standing on back of truck, truck struck hole	1
Refuse Collector	Fingers	Avulsions	Caught in	Jumped on truck, caught fingers in hopper	40
Equipment Operator	Finger right hand	Fracture	Caught in	Closing tail gate of truck	0
Refuse Collector	Left eye	Conjunctivitis	Contact	Unloading refuse truck	0
Refuse Collector	Groin	Strain	Overexertion	Lifting heavy garbage can	1
Equipment Operator	Back and shoulder	Muscle spasm	Overexertion	Turned around — reached for book while seated	0
Equipment Operator	Sacrum and Coccyx	Bruise	Fall to different level	Slipped, fell from truck to garage floor	0
Laborer	Right ring finger	Laceration	Caught in	Ring caught in door — bent into finger	2
Refuse Collector	Right elbow	Contusion	Struck against	Struck elbow against truck	33
Refuse Collector	Right wrist	Sprain	Overexertion	Lifting heavy garbage can	8

Refuse Collector	Left arm and chest	Strain	Overexertion	Holding on rear step of truck	3
Refuse Collector	Left eye	Conjunctivitis	Struck by	Struck by tree branch	0
Refuse Collector	Back	Strain	Overexertion	Lifting and emptying garbage can	5
Refuse Collector	Back	Strain	Overexertion	Lifting heavy garbage can	0
Refuse Collector	Left elbow	Contusion	Struck against	Slipped on ice — fell on curb	14
Refuse Collector	Left elbow	Contusion	Struck against	Struck elbow against truck	0

ANALYSIS OF ACCIDENTS
(above)

Nature of Injury		*Part of Body*		*Agency or Source of Injury*		*Accident Type*		*Hazardous Condition*		*Unsafe Act*	
Strain	14	Back	8	Garbage can	13	Overexertion	14	None	20	Improper lifting	13
Sprain	4	Arm	8	Truck	13	Struck against	14	Heavy garbage can	4	Jumping off of moving truck	3
Contusion	4	Trunk	5	Tree	2	Caught in	4	Truck door (open)	2	Standing in moving truck	2
Laceration	3	Leg	5	Packer-loader	2	Contact	2	Dangerous environment	2	Unsanitary act	2
Other	13	Other	12	Other	8	Other	4	Other	10	Other	18
Total	38	Total	38	Total	38	Total	38	Total	38	Total	38

CONCLUSIONS:

1. Improper lifting during the performance of repetitive tasks or overexertion, produces strain on the back.
2. Improper acts of collectors during truck movements and frequent in-and-out of vehicles produce many accidents.
3. Analysis suggests a need for training in lifting techniques, and in truck discipline.

TABLE II
FREQUENCY-SEVERITY
for
REFUSE COLLECTION IN MAJOR U.S. CITIES
(CITIES OVER 100,000 POPULATION ARE IDENTIFIED ONLY BY A LETTER)

City	*Name of Department*	*Employee Hour-Exposure*	*No. of Work Injuries TOTAL for year*	*Days Charged*	*Frequency*	*Severity*
A	Streets	4,418,470	120	5,519	27.16	1,249
B	Sanitation	379,000	24	427	63.32	1,127
C	Sanitation	415,060	7	289	16.87	696
D	Sanitation	1,787,338	22	777	12.31	435
E	Garbage	106,880	9	35	84.21	327
F	Waste Division	1,411,791	219	3,059	155.12	2,167
G	Garbage	1,506,398	100	1,434	66.38	952
H	Sanitation	358,176	23	235	64.21	656
I	Sanitation	2,778,008	212	12,424	76.31	4,472
J	Sanitation	159,231	17	194	106.76	1,218
K	Waste Removal	160,288	8	71	49.91	443
L	Street Cleaning	694,332	36	690	51.85	994
M	Refuse Collection	452,326	81	704	179.07	1,556
M	Sanitation	653,800	20	6,558	30.50	10,031
N(1961)	Refuse Collection and Disposal	78,437	15	87	191.24	1,109
N(1962)	Refuse Collection and Disposal	77,962	14	112	179.57	1,437
N(1963)	Refuse Collection and Disposal	82,455	18	89	218.30	1,079
N(1964)	Refuse Collection and Disposal	82,725	12	85	145.06	1,028
N(1965)	Refuse Collection and Disposal	83,286	19	81	228.13	973
O	Street Cleaning	736,952	12	167	16.28	227
TOTAL		16,422,915	998	33,037	60.77	2,012

NOTE: *Only cities having a population over 100,000 submitted data of work-injuries, broken down by departments.*

Figure 4 shows a rotary blade pushing refuse into a truck. The control lever, located on the side above the step, must be depressed a second time to lower the blade completely.

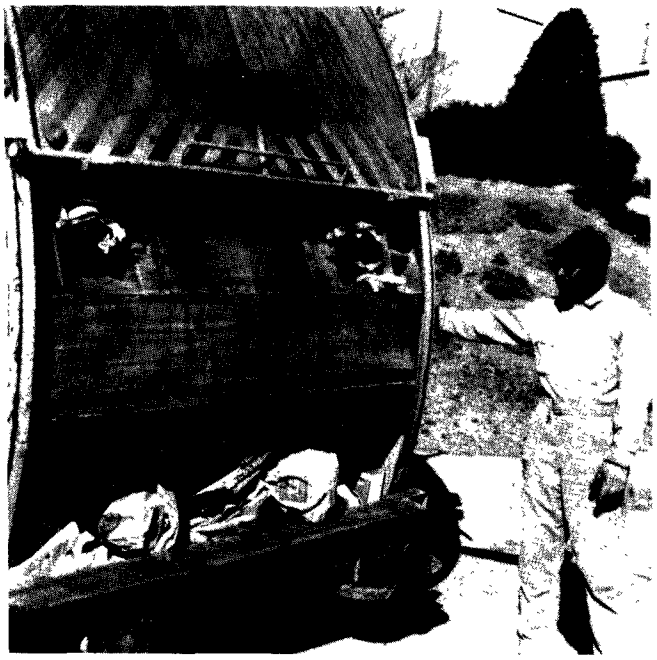


Figure 5 shows a workman watching closely while the edge of the blade, which rides against the body of the frame, pushes the refuse into the storage area of the truck.

boarding or dismounting from moving trucks is widespread, it is exceedingly dangerous and is condemned by safety personnel. Trucks should be halted when employees are boarding or getting off. Collectors should exercise extreme care when dismounting from a vehicle onto loose or slippery surfaces.

22. Signals to the driver should be visible and clearly understood and all back-up operations standardized. The driver should always keep the loader in view while backing up his vehicle. Certain municipal regulations concerning back-up operations state: NO BACKING WITHOUT SOMEONE WATCHING AND SIGNALING TO THE DRIVER. This statement should be appropriately posted on all vehicles.

23. When dumping loads, loaders should stand clear while emptying truck beds. Rakes should be used for this purpose. Shovel-out trucks for refuse service are a makeshift operation and should be discouraged. In hydraulically operated self-dumping trucks, the operator should avoid using erratic or "jerky" movements of the truck while the body is in the dumping position and the hopper is raised. Such movements cause severe strains and possible breakage at the pivot joints. They may also cause the vehicle to overturn. Floor chains should be required whenever and wherever hydraulic operated self-dumping trucks are used. There should be no loosening of turnbuckles en route to dump areas or while en route. This causes undue strain on the turnbuckle and pivot point and may cause the tailgate to open prematurely and injure a workman standing nearby.

Health provisions

24. Arrangements should be made for crews to use rest rooms and washing facilities at service stations along the route at the collection site, and particularly before the lunch period. Locker facilities should be provided for a collector's lunch box and for raincoats and protective equipment. Potable water should be available at the disposal site, along with sealed containers, and paper cups unless, of course, running water is available. Employees should be encouraged to shower and change into clean clothing before leaving for home.[2]

NOTE: Flu shots, other immunizations and innoculations, if desired, are economically feasible and should be considered for a complete health program.

Personal protective equipment

25. Workers should wear safety shoes or high top boots with safety toes. No tennis or dress shoes should be permitted. Sturdy work gloves should also be worn for handling all refuse containers. A cotton, latex-covered (full dip) glove with a rough gripping area is most acceptable for use. Rubber shoulder pads and hip pads will prevent bruises or cuts from edges of metal containers. Approved respirators should be worn when handling loose or dusty materials and liquids. Employees wearing prescription eye glasses should be required to have safety-type prescription lenses fitted to safety frames.

26. Workers should wear long-sleeved shirts, sturdy work clothes, jackets or sweaters, except during the summer months. These garments will retain body heat and prevent possible muscle strains. Raincoats and non-slip safety boots should be worn during inclement weather.

Vehicle design

27. Refuse collection trucks usually include a cab where one, two, or three crewmen may ride; in some, there may be room for a crew up to five. A well-rounded step of serrated metal, or one coated with adhesive material with a handhold and safety

Figure 6 shows a safety gate in the UP position. The gate rides up and down in a 1½-inch pipe-sleeve guide. A "dog" holds the gate in position.

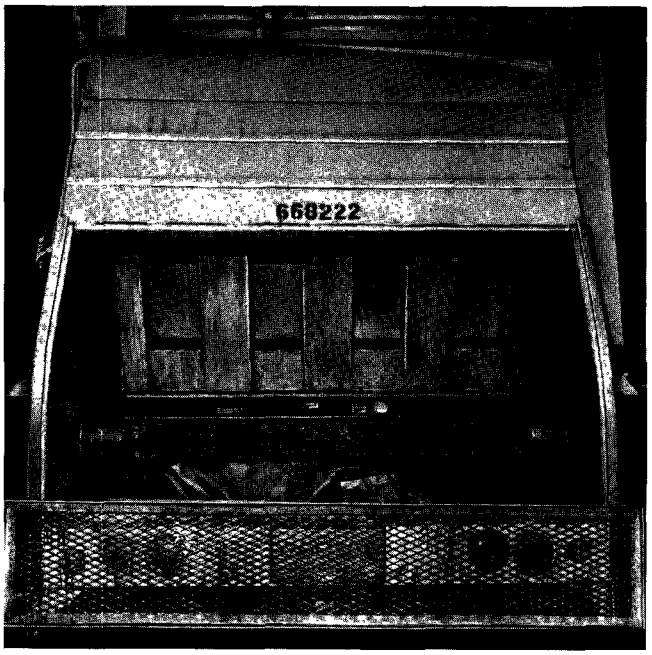


Figure 7 shows a safety gate in the DOWN position. The loading table is two feet, nine inches from the street level. Total vertical travel is 12 inches.

rail, should be provided on each side of the body and at the rear for collectors to ride between loading points. The hand-hold should be located in a position where the workman can stand on the step and balance himself against inconsistent truck movements. This will eliminate a potential hazard where trucks are required to operate in tight places (Figure 2). Wherever steps are used, safety belts similar to those used on fire trucks, should be provided for use on long trips. Safety belts are not practical for riding between pick-up points. To prevent injuries while riding on or driving refuse trucks, it is recommended that workers be taught the proper way to grip hand-holds on the truck; that they be cautioned to watch out for low-hanging wires and tree limbs while sitting on top of the truck; and that all employees be encouraged to ride in the truck whenever possible (See paragraph 33-h).

Equipment

28. Equipment used in refuse collection is often designed for a maximum pay load with insufficient regard to safety. Consequently, many cities are using specifications under which manufacturers are required to provide safety features. Often these features become standard equipment. Care should be exercised to ensure that the type of equipment selected is the best suited for local conditions. The following equipment features should be considered: Capacity, size, loading height, loading speed, compaction, loading devices, and water tightness. Other criteria should include maneuverability, crew size, number of pick-ups per mile, nature of refuse accepted, and the terrain over which the vehicle is to operate. Important mechanical features that should be considered are (a) air brakes, and power steering, (b) engine sufficiently powerful to pull steep grades, (c) anti-carburetor overloading device, (d) hopper designed to prevent refuse from falling onto the roadway, (e) pinch points and shear points protection.

29. There are several types of refuse collection vehicles:

a. Open trucks.
b. Enclosed non-compactors.
c. Enclosed compactor.
d. Other (new).

30. *The open truck* is being rapidly displaced by other vehicles which are more sanitary for refuse collection. The appearance of the open type vehicles and the losses due to scattered refuse, overturned loads, and the extra effort in loading and stowing make the use of open trucks uneconomical, compared with other types of equipment.

31. *The enclosed non-compactor* truck completely encloses the refuse material, except when doors are open for loading. Refuse may be loaded by means of an hydraulic hoist from the front or rear, or manually from the side.

32. *The enclosed compactor truck* is the most widely used. Mechanical devices load the refuse into main compartments, and compress the refuse, then eject it to the rear. In some batch-type vehicles the packing mechanism may "double cycle." When the packer-blade (double cycle mechanism) is actuated, by the same truck motor, the gear shift of the truck's automatic transmission should be placed in "neutral." There have been instances where the packing operations accelerated the motor and the truck moved off. Care should be taken to keep this possibility from happening.

33. A brief description of the types of compactor trucks now used is listed below:

a. *Escalator-conveyor loader.* Refuse is elevated into the enclosed body by means of a continuous conveyor. Sprockets and caps are exposed during the continuous travel of the chain-like con-

veyor. This critical moving machinery is extremely close to the point-of-operation and creates a hazard (Figure 3). Some vehicles have a safety bar across the hopper to prevent the container or workmen's hands from being caught in the exposed mechanism. Refuse is dumped into a lower hopper at the rear of the truck. A moving conveyor carries the refuse to the roof and towards the front of the truck and then deposits it into the main compartment. Collectors actuate levers and controls near the load-loading hopper with power obtained from a take-off unit located under the vehicle.

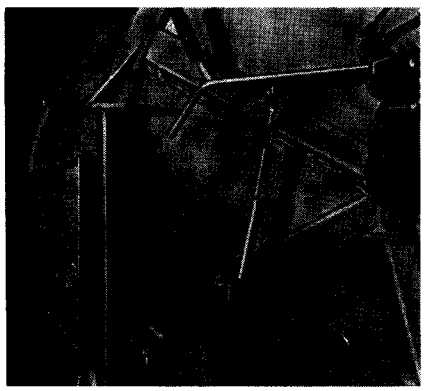


Figure 8 shows the safety gate in the uppermost position. The packer control lever is activated by a downward movement of the lever. Upon cycling, the control lever is returned to its normal position.

b. *Trough or bucket loader.* Refuse is dumped into a low-loading height, 1½ cubic yard trough, suspended at the rear or side of the body. When filled, the trough is raised and dumped into an opening at the top of the truck. Side doors for bulky items are installed on some trucks, while others have internal compacting devices. The platform buckets are about 36 in. from the ground, making it easier for the collector to load.

c. *Rotary blade type.* This equipment is extremely dangerous since there is direct power and no release. The close proximity of the rotating blade to the worker is a critical hazard (Figure 4). This unit can be modified to such a degree that unless the operator deliberately depresses the control lever, the blade will stop about 4 in. from the hopper, thus allowing the employee to remove his hand before resetting the blade into action by depressing the control lever a second time. Gravity causes the blade to fall, thereby, creating a source of injury. Another serious problem in this type of vehicle is double-cycling. (Refer to paragraph 31.) This occurs when the packing mechanism is actuated and the blades complete one cycle. The packing mechanism continues operating through a second cycle without the operator touching the controls. This is quite common when the vehicle is nearly loaded.

d. *The batch-loader.* This equipment consists of a rear-end loader in which the slope of the blade is so designed as to provide an *upward* packing action. This type loads and consolidates in one operation. Refuse is dumped into a hopper approximately 30-in. above the pavement. An auxiliary engine is now used on many of the vehicles to improve safety operations. The blade, which follows guide rails in a sweeping motion within the hopper, pushes the refuse from the hopper into a 13-25- cubic yard truck body. Prior to the forward packing motion, the edge of the blade, sinks flush against the body frame (Figure 5). Sometimes this will catch the operator's fingers or hand. The blade will sever objects protruding over the hopper's edge during its downward travel. The blade may also be equipped with two-stop operating controls, i.e., the blade stops half-way through its motion and the controls must be actuated again to complete the cycle. Equipment of this type must have manual or automatic controls to prevent the hazardous "double-cycling," which can occur when the unit is nearly loaded. When dumping, the hopper is raised hydraulically from the truck body, and the vehicle is driven forward permitting the refuse to fall to the ground by its own weight, as the refuse is ejected hydraulically from the rear of the load tank. The following steps should serve as a guide toward understanding batch-loader equipment and thereby avoid possible hazards.

NOTE: In the interest of safety, all new batch-loaders equipped with the 12-second cycle will be revised to include a two-stop operating control. Each refuse collection vehicle shall come equipped, when purchased, with a 4-way emergency flasher system.

(1) Personnel should understand the operation of power equipment on the trucks and be made aware of the injury potential before operating. Workers should learn the location of all stop buttons and emergency levers. Hands should be kept clear of blades and other hazardous areas.

(2) Collectors should be instructed to stand clear of truck body and the hopper when the motor, which operates the packing mechanism, is operating regardless of whether

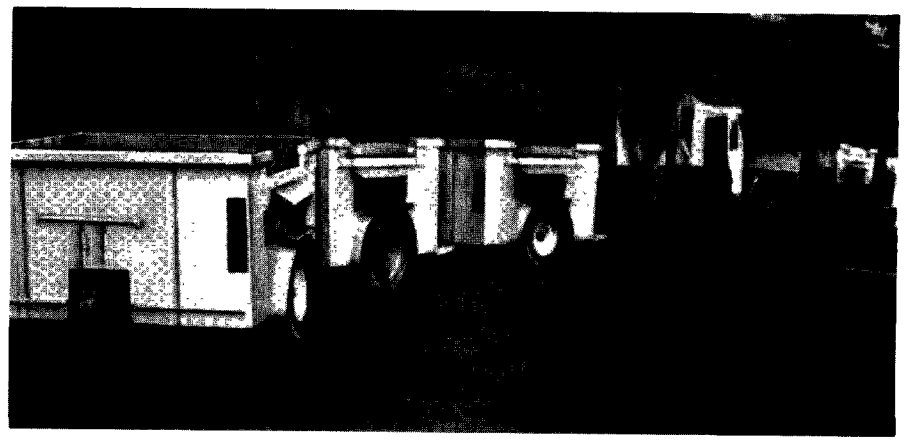


Figure 9 shows small 4-by-4-drive trucks in use hauling refuse.

the mechanism is driven by the truck motor or auxiliary motor.

(3) One crew member should be *solely* responsible for operating the packing mechanism. The controls should be located at the rear corner of the truck where the operator has a full view of the blade.

(4) A shield may be provided during the unloading operations, at the disposal site, to prevent material under compaction, from ejecting to the sides where a worker or a driver may be standing.

e. *Safety gate.* Since many accidents involve "packer-loader" refuse trucks it is obvious that a safety gate can provide the mechanical safeguards which will protect employees from direct contact with moving parts. A specially designed safety gate has been developed for the packer-loader type mechanism. With a simple control, the safety gate is released to an "up" position which keeps the worker away from the blade (Figures 6 and 7). This part of the operation is "spring-loaded" and calls for a minimum effort on the part of the operator. The blade descends only when the gate is up and the hopper is loaded, by a downward movement of a control lever. Safety gates have been successfully installed on some packer type units and it is a relatively simple device to operate. It consists of a gate, 1-ft, 4-in. by 6-ft, 11-in., and is installed over the loading area or platform. The gate is made of an angle-iron frame covered with expanded metal. The gate is lightweight and affords a view of the packing blade while it is in motion (Figure 8).

f. *Hydraulic hopper.* Another type of packer-loader is the hydraulic hopper which places refuse in a 1 to 2-cubic yard hopper. The hopper is raised hydraulically by an auxiliary engine. The refuse is then swept into a 25-cubic yard body against an ejector panel by a packer blade which operates with a sweeping motion. Dumping is achieved by raising the hopper hydraulically and actuating the ejector panel which forces the refuse out of the truck. The body need not be raised.

g. *Movable bulkhead loader.* The body of this loader may be square or round in transverse section, with loading through openings in each side, near the front. Refuse is moved from front to rear by an hydraulically operated plate, which fills and compacts at the same time. Ejection is accomplished by opening the rear of the body and moving the plate to the rear.

h. *Other equipment (new)*

(1) Trucks are available with right-hand-drive chassis and steps which permit the driver to aid collectors. One type contains an hydraulically actuated compactor plate, which compresses the refuse from a one-cubic yard hopper into a detachable body of 4 to 6 cubic yards, with a force of 30,000 lb. The filled container is brought to a centralized collection point, and replaced with an empty container. The contents of these containers are then loaded into a 21- to 30-cubic yard "mother truck" by means of a front-end loader.

(2) A relatively new (about 10 years) type of equipment for bulk containers consisting of a 20-to 24-cubic yard capacity truck with front-end loaders is gaining acceptance. Some of these, however, do have certain hazardous features, e.g., loader arms that come past the cab and can sever an arm. A safer design has U-shaped arms that do not pass the driver's window. Another design is one in which windows are prevented from opening fully,[4] and interlocks installed to prevent the arms from operating when the doors are open.

(3) Another method for refuse pickup is the use of a small 4 x 4-drive trucks. These pull three large boxes on wheels, thus forming a "train" (Figure 9). A 20- to 24- cubic yard capacity "mother truck" removes the contents of these trains to the disposal site while the crews and the trains are engaged in collection. When moving on thoroughfares these trains should not exceed 25 to 30 mph, because they may "whip"—at higher speeds. Also, these trains should be driven with extreme care on hills and under icy conditions.

(4) Fifty-cubic yard front-end loading collection (front end loaders) trucks, serviced by diminutive scooters, are also used. Collection crews consist of a truck driver, two motorized scooter operators, and generally a third crewman, who collects refuse from locations inaccessible to the scooters, using a hand-wheeled metallic container of ½ cu. yd. capacity. The procedure is as follows:

a. A giant packer pulls into a city block and parks. The collectors drive their scooters up driveways, and can service up to three homes before returning to the truck. They dump their refuse from their 1⅓ cu. yd. hydraulically operated containers, into the three cu. yd. collection truck hopper, which has been lowered to the ground in front of the truck. The driver then raises this hopper over the cab to drop the load into the truck box. Shields on either side enclose the debris and prevent it from scattering. After scooters have dumped their load, packer-rams compact each load and the truck is moved to the next block.

b. The introduction of scooters, instead of the use of large 50 cu. yd. capacity trucks, has reduced the incidence of back injuries and worker fatigue complaints.

Special lights and reflectorized signs

34. The lights and signs illustrated in Figure 10 may be installed parallel to the ground on the tailgate of the refuse collection truck with the center line of the light six-feet six-inches above the stand platform. The lights and signs may be attached to a separate piece of 2 in. angle iron extending the full width of the body. The lights are to work in unison with all other lights. The turn signals should be located with the center line of the light 5½ in. from the outside of the body and the lens not less than 4 in. from the chassis. The stop lights should be located with the center line of the light 15 in. from the outside of the bed and the lens not less than 7 in. from the chassis. The signs, 1 by 3 ft, should be centered between the stop lights and should be placed on a sheet of aluminum and reflectorized with an alternate 2 in. red and

2 in. white diagonal line. The word "CAUTION" should be in 4 in. letters and centered on the sign. Local and state vehicle codes for lighting should be followed.

Driver responsibility

35. The actions of the driver greatly affect the safety of the crew. In most cases the driver is the crew leader. Therefore, the manner in which the individual drivers perform their duties determines the safety of the crew and mobility of the vehicle. The driver should be dependable, alert, sober, steady, ambitious, have good judgment, and a good mechanical aptitude. The driver should be taught safety rules and given the authority to enforce them.

36. The driver should be directed by a crew member when backing his truck. The safety of individuals depends upon the condition and proper use of controls, consequently, correct usage is mandatory.

37. An unsafe practice among some packer-loader drivers is to drive over cardboard or wooden boxes thereby, flattening them to facilitate loading into a hopper. A popular activity of children is to play with and hide inside cardboard or wooden boxes. The practice of packer-loader trucks crushing these empty boxes should be prohibited. Corollary to the training of drivers, articles in local newspapers should instruct citizens to breakdown cardboard and wooden boxes prior to being placed in trash areas for disposal. Several children have suffered injury and death because this procedure had been neglected.

Vehicle inspection

38. Daily and weekly routine inspections should be conducted by qualified personnel to locate:

a. Cracks and operating parts to the packing mechanism.
b. Hydraulic oil leaks.
c. Indications of metal fatigue.
d. Signs of improper truck operations.
e. Potential electrical failure.
f. Any deficiencies that would be in violation of motor vehicle laws should be observed by a cursory inspection of the normal operating vehicle.

Preventive maintenance

39. Preventive maintenance, as the name implies, is the means of detecting and correcting those incipient causes of equipment casualties before they occur, and the precautions and actions constantly taken to maintain satisfactory day-to-day operating conditions of the equipment. Truck maintenance should include the bleeding off of moistutre collected in the air tank to prevent brake failure, and keeping windshields clean and signal lights in operating condition at all times. A preventive maintenance program should be established and maintained by qualified personnel. Such a program should include:

a. Comprehensive testing and cleaning of the hydraulic system.
b. Replacement of critical parts at regular intervals.
c. Cleaning, checking, and adjusting the electrical controls at defined intervals.
d. Checking the wiring system for wear, loose connections, bare wires, etc.
e. Checking the condition of the loading parts, body, and hopper.
f. Regular lubrication at definite intervals.
g. Checking and repairing the vehicle where it affects the proper functioning of the vehicle.

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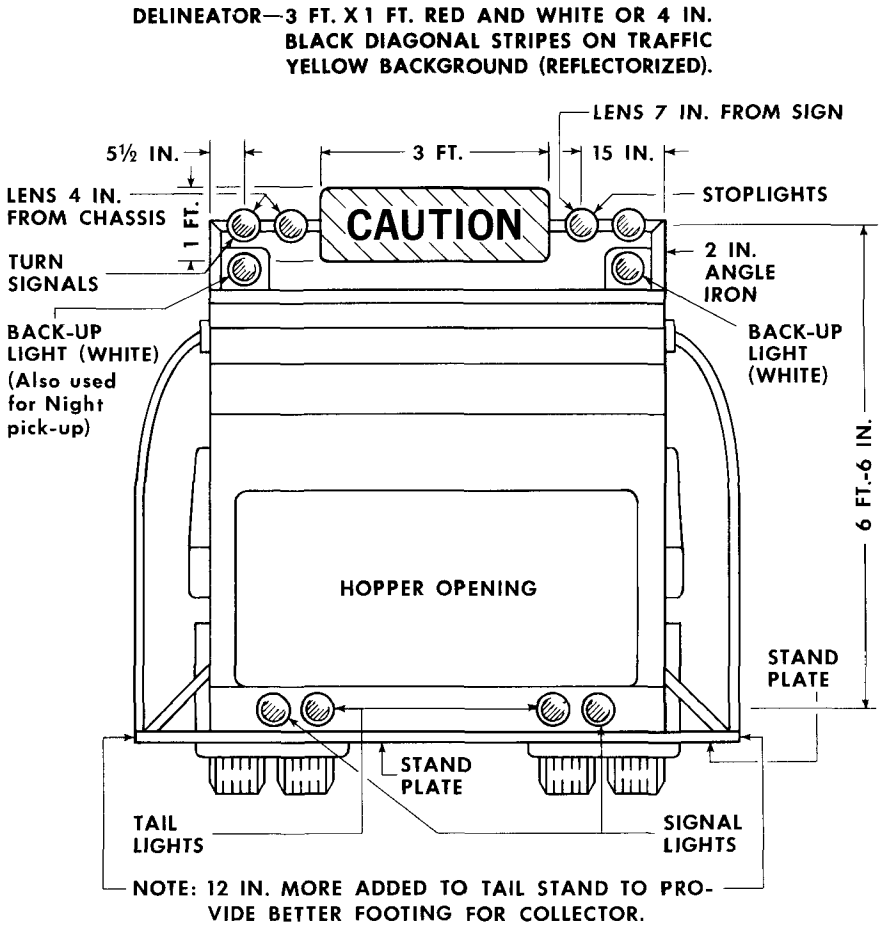

Figure 10 is a schematic drawing showing the use and location of lights, reflectors, and CAUTION signs.

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