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TECHNICAL PAPER #6

UNDERSTANDING SEWAGE TREATMENT AND DISPOSAL

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Understanding Sewage Treatment and Disposal
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PREFACE

This paper is one of a series published by Volunteers in Technical Assistance to provide an introduction to specific state-of-the-art technologies of interest to people in developing countries. The papers are intended to be used as guidelines to help people choose technologies that are suitable to their situations. They are not intended to provide construction or implementation details. People are urged to contact VITA or a similar organization for further information and technical assistance if they find that a particular technology seems to meet their needs.

The papers in the series were written, reviewed, and illustrated almost entirely by VITA Volunteer technical experts on a purely voluntary basis. Some 500 volunteers were involved in the production of the first 100 titles issued, contributing approximately 5,000 hours of their time. VITA staff included Leslie Gottschalk as primary editor, Julie Berman handling typesetting and layout, and Margaret Crouch as project manager.

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VITA is a private, nonprofit organization that supports people working on technical problems in developing countries. VITA offers information and assistance aimed at helping individuals and groups to select and implement technologies appropriate to their situations. VITA maintains an international Inquiry Service, a specialized documentation center, and a computerized roster of volunteer technical consultants; manages long-term field projects; and publishes a variety of technical manuals and papers.

UNDERSTANDING SEWAGE TREATMENT AND DISPOSAL

by VITA Volunteer Henry Stonerook

I. INTRODUCTION

The treatment and disposal of domestic wastes--sewage--is becoming more and more important as ever-increasing rural populations and urbanization threaten existing potable water supplies in many areas of the world. Health problems and diseases are often related to inadequate sewage treatment. Pollution of rivers and lakes results in fish kills and destruction of other forms of aquatic life. Proper collection, treatment, and disposal of sewage is necessary to promote healthful conditions and maintain the quality of the world's water resources.

Domestic wastes can conveniently be separated into body wastes (feces and urine) and gray water, which is all the other liquid wastes of the household, including both laundry and kitchen waste water. Body wastes are the most hazardous due to the possibility of contact with intestinal disease organisms. Gray water ordinarily has few disease organisms unless the laundry has contained garments soiled by fecal discharges.

This paper is not meant to be an in-depth study of many kinds and types of sewage treatment systems in use throughout the world. Rather, it serves only as an introduction. Included is a discussion of sewage and its characteristics; the collection of sewage; and a brief discussion of physical, biological, and chemical treatment systems. Appropriate sewage treatment technology, including on-site, composting, land application, and aquaculture systems, are discussed as possible alternatives for developing nations. A glossary of terms used in this paper and common to discussions of sewage treatment systems is also included.

II. SEWAGE CHARACTERISTICS

The physical and chemical characteristics of wastewater vary according to both time of day and type of wastewater discharged (residential/industrial). Table 1 presents the major pollutants contained in wastewater, typical measurement parameters, and the potential environmental impact of the pollutants.

Most of these pollutants are present to one degree or another in any type of sewage discharge. Residential sewage is composed of several components, including discharges from toilets, sinks, bathing facilities, and laundry facilities. Table 2 provides a

Table 1. Principal Pollutants in Wastewater

Type of Measurement Environmental
Pollutant Parameter Impact

Biodegradable Biochemical oxygen demand Reduce oxygen
organics (BOD); chemical oxygen content of
demand (COD) receiving water

Suspended Total suspended solids Turbidity;
material (TSS) sediment

Pathogenic Fecal coliform bacteria Health hazard
bacteria

Ammonia Determine amount of Reduces oxygen
ammonia in content; toxic

wastewater to aquatic life;
([NH.sub.3] - N test) promotes algal
growth

Phosphate Determine amount of Promotes algal
phosphate in growth
wastewater
([PO.sub.4] - P test)

Toxic Depends on toxin Hazardous to
materials present aquatic life and
plants; may be
toxic to humans

range of flows and pollution loads in terms of the amount of biological oxygen demand (BOD), chemical oxygen demand (COD), ammonia nitrogen, and orthophosphate anticipated from an average household consisting of 3.2 persons using conventional "western-style" plumbing fixtures and detergents. Similar discharges from developing countries might be expected to be more concentrated as the amount of water used per household is lower, but the amount of waste is about the same.

A major environmental problem caused by too much sewage discharged into a lake or other confined body of water is eutrophication. Eutrophication is a natural aging process that is greatly accelerated by the discharge of ammonia and phosphates. These nutrients promote the excessive growth of algae, which further depletes the dissolved oxygen content of the water body. This

Table 2. Residential Wastewater Discharge Composition

Type of Facility	Flow of Wastewater (gpcd)(*)	Pollutants (Milligrams per Liter) BOD	COD	Ammonia Nitrogen	Ortho-phosphate
Kitchen sink	3.6	676	1,380	5.4	12.7
Bathtub	8.5	192	282	1.3	1.0
Bathroom sink	2.1	236	383	1.2	48.8
Laundry machine	7.4	282	725	11.3	171.0
Toilet	19.8	313	896	37.1	77.4
Average (**)		310	755	20.5	71.4

(*) Gallons per capita per day.

(**) The total flow of wastewater is 41.4 gallons per capita per day.

Source: John B. Winneberger, Manual of Grey Water Treatment Practice (Ann Arbor, Michigan: Ann Arbor Science, 1974).

reduces the variety of aquatic life and the quality of the water itself and imparts unpleasant tastes and odors. Limiting the discharge of untreated or partially treated sewage will prevent such pollution of the water.

III. SEWAGE COLLECTION SYSTEMS

In areas with a significant housing density, sanitary sewers are built to remove the wastewater to a treatment facility or disposal area. Although combined sewers (sewers that collect both wastewater and storm water) cost much less to build than do sewers that separate wastewater from storm water, they can become a health hazard. For example, with combined sewers comes the danger that, during a rainstorm, raw sewage could enter a bypass conduit and pollute water used for drinking or bathing. In addition, the cost of treating the combined storm and sanitary wastes is high. Most new sewer construction makes use of separate sanitary sewers for these reasons.

Clay tile, concrete, asbestos-cement, and PVC plastic are the four most common materials used in the construction of sewers. These materials are chosen because of their resistance to corrosion and their strength and flow properties. However, sulfide corrosion, which occurs when wastewater is confined or slow moving, can affect concrete and asbestos-cement sewers as can some industrial (toxic) materials. Sulfide corrosion is accelerated by high temperatures. Clay pipe or PVC plastic may be a more advisable choice of material under those conditions. However, replacement costs must be considered as well as construction

costs.

Sewage collection systems are designed according to a basic flow plus an allowance in infiltration through sewer joints. Actual wastewater discharge ranges from 40 to 50 gallons per capita per day in homes having flush toilets, sinks, showers, and laundry facilities. Allowing for infiltration through sewer joints and inflow from miscellaneous clear water direct connections (e.g., catch basins, drains), per capita flow can be expected to range from 70 to 100 gallons per day. Where flows of this magnitude occur, minimum sewer size is generally eight inches in diameter. Sewer sizes vary according to the flow being conveyed and are a function of slope, velocity, and internal roughness of the conduit. Manholes (holes equipped with covers) are built to gain access to the sewers from ground level for cleaning and inspection. The manholes are placed at 300- to 500-foot intervals and at those points where changes in direction and slope occur.

Smaller sewers (i.e., those with diameters less than eight inches) have been used in conjunction with septic or interceptor tanks, where many solids can settle out and not cause obstruction in the pipe. These tanks constitute pretreatment facilities. Solids collected in the tanks must be removed periodically, i.e., usually at 1- to 2-year intervals, by pumping them into tank trucks and treating the material in special treatment facilities. Pressure sewers, combined with grinder pumps following storage in a wet well or effluent pumps following settling in septic tanks, have also been used to transport sewage to the treatment plant.

These systems are relatively inexpensive to construct, but the maintenance and power costs associated with their operation can be high. Furthermore, skilled maintenance is required.

Various combinations of short collector systems and dispersed pretreatment or treatment facilities serve as alternative designs in cases where housing densities cannot justify expensive gravity collection systems.

IV. HIGH-COST TECHNOLOGIES FOR WASTEWATER TREATMENT

PHYSICAL, BIOLOGICAL, AND CHEMICAL TREATMENT TECHNOLOGIES

Wastewater is treated using one or a combination of processes including physical, biological, and chemical systems. Process units typical of each of these systems are given in Table 3.

Table 3. Process Units Typical of Various Wastewater Technologies

Physical System	Biological System	Chemical System
Pumping	Aerobic systems	Precipitation
Screening	- lagoons	Coagulation
Flow equalization	- trickling filter	pH adjustment
Settling	- rotating contactors	Disinfection

Grit removal - sludge digestion

Filtration Anaerobic systems

- sludge digestion

- lagoons

Land treatment

Subsurface disposal

Physical Technologies

Physical systems include processes that pump, that remove solids by screening or settling, or that equalize flow fluctuations. Bar screens, both mechanical and hand cleaned, are used to remove large objects and serve to protect downstream mechanical equipment. Grit (inorganic, fine solids such as sand, coffee grounds, egg shells, etc., which are relatively heavy) is removed by controlled settling. Removing grit also helps to protect pumps and equipment from abrasion and prevent the settling of these materials in other treatment units. A simple grit tank consists of a channel through which wastewater flows at a constant velocity independent of the volume of discharge. Settling tanks, which are rectangular or circular in shape, are designed to remove solids and are sized according to the velocity of the flow through the tank. Solids settle out and fall to the bottom of the tank. These tanks employ a subsurface scraping mechanism to

direct the settled solids or sludge to a pump well for discharge to the sludge treatment facility. Overflow from the tanks exists through a system of weirs for further treatment or discharge. A surface skimmer is often employed to remove floating solids and scum. Flow equalization facilities are tanks that serve to regulate and dampen the variable peaks of flow that occur over a normal day's time or as a result of severe inflow caused by rain.

Biological Technologies

Biological systems employ both aerobic and anaerobic systems to stabilize wastewater and sludge. The most common of these, the activated sludge system, involves adding air to the wastewater to promote the growth of aerobic microorganisms that feed on and digest the organic material. Detention times of two to six hours are necessary to stabilize the waste, which requires large tanks capable of holding two to six hours of the average daily flow. Air is blown into these tanks to promote the growth of aerobic organisms. Large amounts of power are required to mix and aerate the tanks. Settling tanks follow the activated sludge system, and some of the settled sludge, containing a high concentration of microorganisms, is returned to the aeration tanks to promote microorganism growth. This is a highly skilled operation and is very expensive to build and operate.

Another type of aerobic treatment system is the trickling filter. Incoming wastewater, which is first settled, is distributed at a uniform rate over a medium of rock or plastic upon which aerobic

organisms attached themselves and grow. These organisms attack the sewage, reducing it in strength. The dead organisms and other solids are removed in settling tanks. Flow is also recycled with this system. Although not as complex as activated sludge, this is a delicate, complex treatment method that also requires a high level of operator skill.

Anaerobic systems are commonly used to digest the settled solids; they are less commonly used as wastewater treatment systems. Anaerobic digesters are enclosed tanks of 20 feet or more in depth, sometimes insulated and equipped with external heating capabilities for cold climates. In many cases, a floating cover allows for the production of methane gas and the mixing of the sludge. Anaerobic digesters, if well insulated or operated in warm climates, need little or no input of energy to function. They usually decompose wastes at temperatures of 35 to 40 [degrees] C. Gas produced from the decomposition can be captured and used to provide fuel to operate natural gas pumps. Digester performance is a function of sludge feed rate, moisture content, the amount of volatile contents of the sludge, and the amount of toxic materials present. Large quantities of moisture and toxics will retard sludge digestion and minimize methane gas production.

Chemical Technologies

Chemical treatment systems are designed to remove pollutants through the addition of certain chemicals. Capital costs for these systems are usually low, but operating costs can be significant.

Chemicals are used extensively in wastewater treatment for disinfection (chlorine) and sludge thickening (dewatering). They are also used extensively in industrial wastewater treatment to adjust the pH and to remove heavy metals. Chemical costs and handling properties, however, make them rather poor choices for sewage treatment systems for developing countries. A typical sewage treatment plant employing screening, grit removal, primary settling, trickling filter, final setting, disinfection, and anaerobic sludge digestion is presented in Figure 1.

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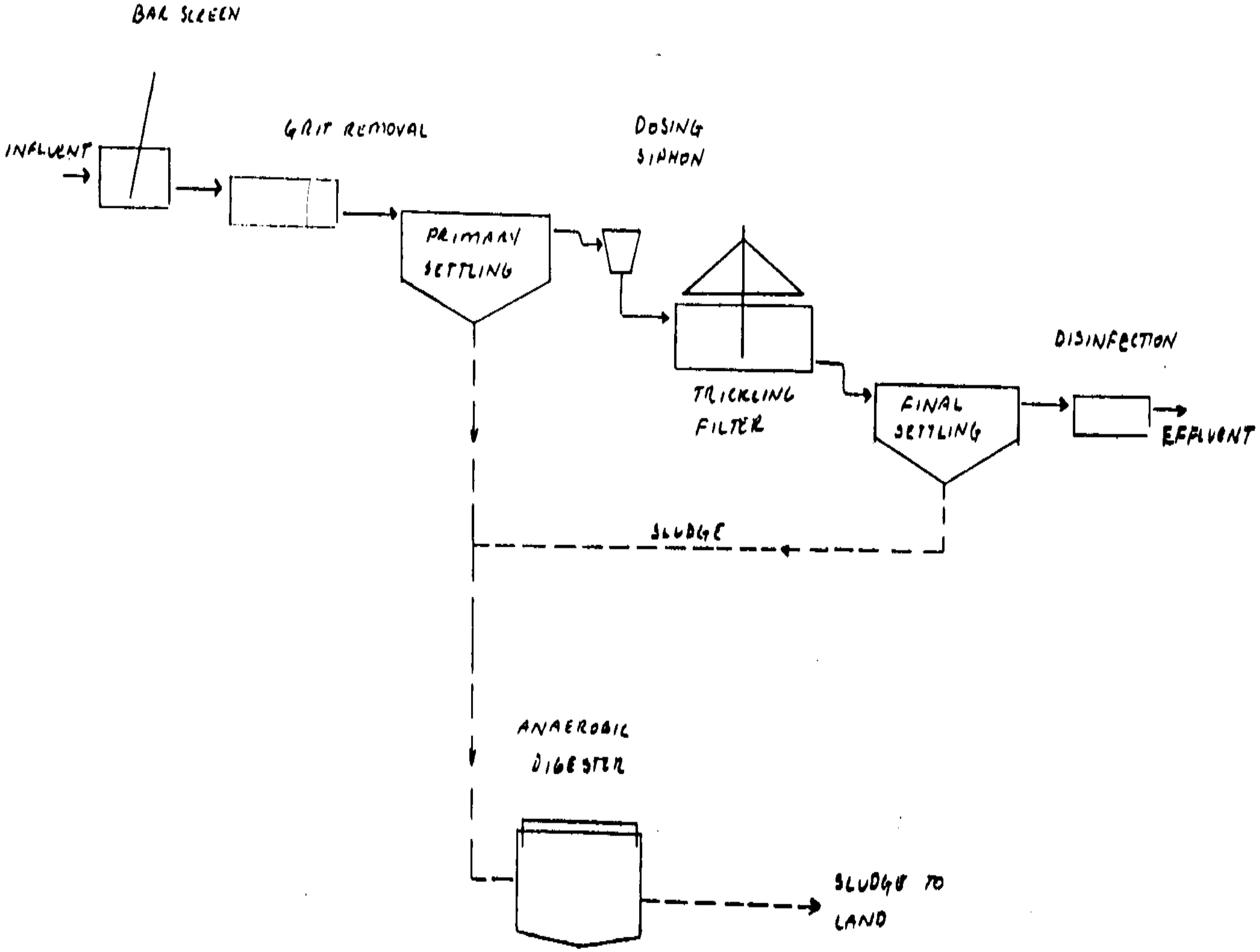

Figure 1. Typical Sewage Treatment Plant

V. ALTERNATIVE TECHNOLOGIES

The technologies described in Section IV are designed to treat wastewater and sludge effectively. They are generally very expensive, however, and require extensive operation and maintenance. As such, they may be applicable for larger population areas, which can afford their construction and maintenance, but other, simpler methods are likely to be more suitable for smallscale applications.

LATRINES

For ordinary households or family groups, body wastes are best disposed of in a sanitary latrine. Health authorities in most countries have developed plans for such installations. The most important considerations are that the pit should be designed so it will not pollute ground water or permit access by insects or rodents. The pit will become full over several years depending on its size and the number of users. When full it can be cleaned out; this is a disagreeable job and may result in exposure to fresh fecal material. A good arrangement is to have two pits. When the first is full, the slab and building are moved to the second pit and the first is covered with earth and allowed to compost. When the second pit is full, the first pit is cleaned out and the slab and building moved back over it and the second pit is covered and allowed to compost. If a water-seal latrine is used, the slab and building can be permanent. The sewage is carried behind the latrine where it can be distributed to one of two pits for alternate use and composting.

Gray water is usually used for irrigation of garden plots,

shrubs, or trees and scattered to help settle the dust around the premises. It should not stand to form puddles, which may result in mosquito propagation.

Sewer systems are expensive--usually two or three times the cost of a water supply system. Sewers also require a good flow of water or material will settle in the sewers, resulting in blockages. In the United States between 40 and 50 percent of domestic water goes to flush toilets. This is a great waste of water and can create a problem when discharged into streams and lakes, so expensive treatment is necessary.

STABILIZATION PONDS

If water is in ample supply water-flush toilets can be used in institutions such as hospitals, schools, and government buildings. In such installations, a plumbing system in the building can collect the toilet wastes and gray water together and deliver them to a sewer that takes them a short distance from the building to a small stabilization pond. Such a pond is less expensive to build than a septic tank and tile field. It will also have fewer operating problems, because it will lose water from seepage and evaporation and the overflow can be used for irrigation.

In tropical climates the pond can be loaded at a rate of 2,500 people per acre (or 6,000 per hectare). For a population of 500 people the pond would only be one-fifth of an acre in area, or about 60 feet wide and 140 feet long (approximately 20 meters wide by 50 meters long). The length should be about two to three times the width. The pond should be at least three feet deep (1 m) and should be deeper at the inlet end to allow for sludge accumulation. The inlet pipe should extend about one-quarter of the way into the pond. Over time, the pond will develop a rich green algal culture that, with the bacteria, will break down the organic materials in the sewage. Many ponds have fish, frogs, and ducks as residents. A properly designed pond will have little or no odor and what odors that might occasionally occur usually cannot be detected beyond 300 feet (100 m). A newly constructed pond may take some months before the bottom will be sealed and water will get to the design depth. Once the pond is operating, maintenance is simple and requires only part-time ordinary labor to check on the inlet flow and the retaining dikes, to cut the grass and weeds on the dikes, and to remove any aquatic vegetation in the shallow areas along the dike so as to discourage mosquito propagation.

Various other alternative technologies for wastewater treatment have developed over the years. Table 4 lists the technologies, their intended use (wastewater or sludge), and their design parameters, and provides comments to each technology.

Table 4. Some Popular Low-Cost Technologies
for Wastewater Treatment

Technology Use(*) Technology Design Comments
Parameters

Land treat- W Land area; soil type; Reuse potential

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ment crops grown; climate wastewater; pre-
treatment required;
potential to pollute
water and crops;
may attract flies
and parasitic worms;
may cause odors

Composting S Detention time; air Soil conditioner;
requirement; moisture turning required;
content need additive to mix
sludge with compost

Leaching W Soil type; topography; Large areas required
field groundwater; depth to
bedrock; area

Anaerobic S Detention time; Can produce a fuel;
digesters moisture content soil conditioner;
cannot treat
wastewater

Aquaculture W Land area; climate; Pretreatment required;
topography; crops potential
adverse health effects

Imhoff tank W/S Detention time; Treats wastewater
overflow rate and sludge; low-cost
energy; requires
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maintenance; may
attract flies; may
cause odors

(*) W = wastewater; S = sludge.

LAND TREATMENT

Land treatment relies on bacteria and organisms present in soil as well as the soil's physical characteristics to stabilize pretreated sewage. The sewage is stored in lagoons prior to being spread over fields through channels or piping systems. If the sewage has been thoroughly, treated the crops grown in these fields can be used for animal feed. However, for sewage that has not been treated adequately, the land application site should be set aside and no crops on it should be consumed by animals or humans. Care should be taken in selecting sites so that pollution of ground water or surface water cannot occur due to percolation or runoff from the land treatment site.

COMPOSTING

Composting of sludge and/or human and animal waste offers a means to solve an environmental problem and create a useful product. This product, a soil conditioner, contains some nutrient value in the form of nitrogen and phosphorous. Composting is a natural process that occurs when aerobic microorganisms live in an optimum environment that is a function of the carbon to nitrogen (C to N) ratio of the mixture. Care must be taken to keep this ratio at approximately 25 to 30 parts of carbon to 1 part of nitrogen, to maintain an adequate supply, and limit the moisture content to approximately 60 percent. In many cases, a bulking agent such as wood chips or leaves is added to help achieve these conditions. Temperatures in a properly composted mixture exceed 40 [degrees] C for several days. The compost process requires approximately 10 to 14 days, and should be followed by several weeks of curing. Oftentimes, the composted product is screened to recover the bulking agent before it is used. The screened material, if it has aged long enough, can be bagged and stored or sold in bulk for use as a soil conditioner. Adding compost to farmland can reduce the amount of fertilizer required for crops.

LEACHING FIELDS

Leaching fields are generally used in conjunction with a pre-treatment device (e.g., septic or interceptor tank). They are a means to dispose of wastewater without having to discharge it to a watercourse. Proper soil types are necessary for the construction of leaching fields. A tight, nonporous clay soil is generally unsuitable since the leached sewage cannot pass through it. The sewage then comes to the surface, causing odors and potential health problems. The length of a leaching field depends on the amount of sewage to be treated (i.e., number of persons connected), the type of sewage, and the types of soils present.

Where an excess of evaporation occurs, evapotranspiration systems are effective. These systems employ a raised distribution field with the crops or trees grown on top. The vegetation draws up the

moisture and transpires it, leaving the residual solids trapped in the ground to be further broken down by the microorganisms present there. These systems are generally limited to small clusters of homes, but several can be scattered throughout a community. A sketch of a typical leaching and evapotranspiration system is given in Figure 2.

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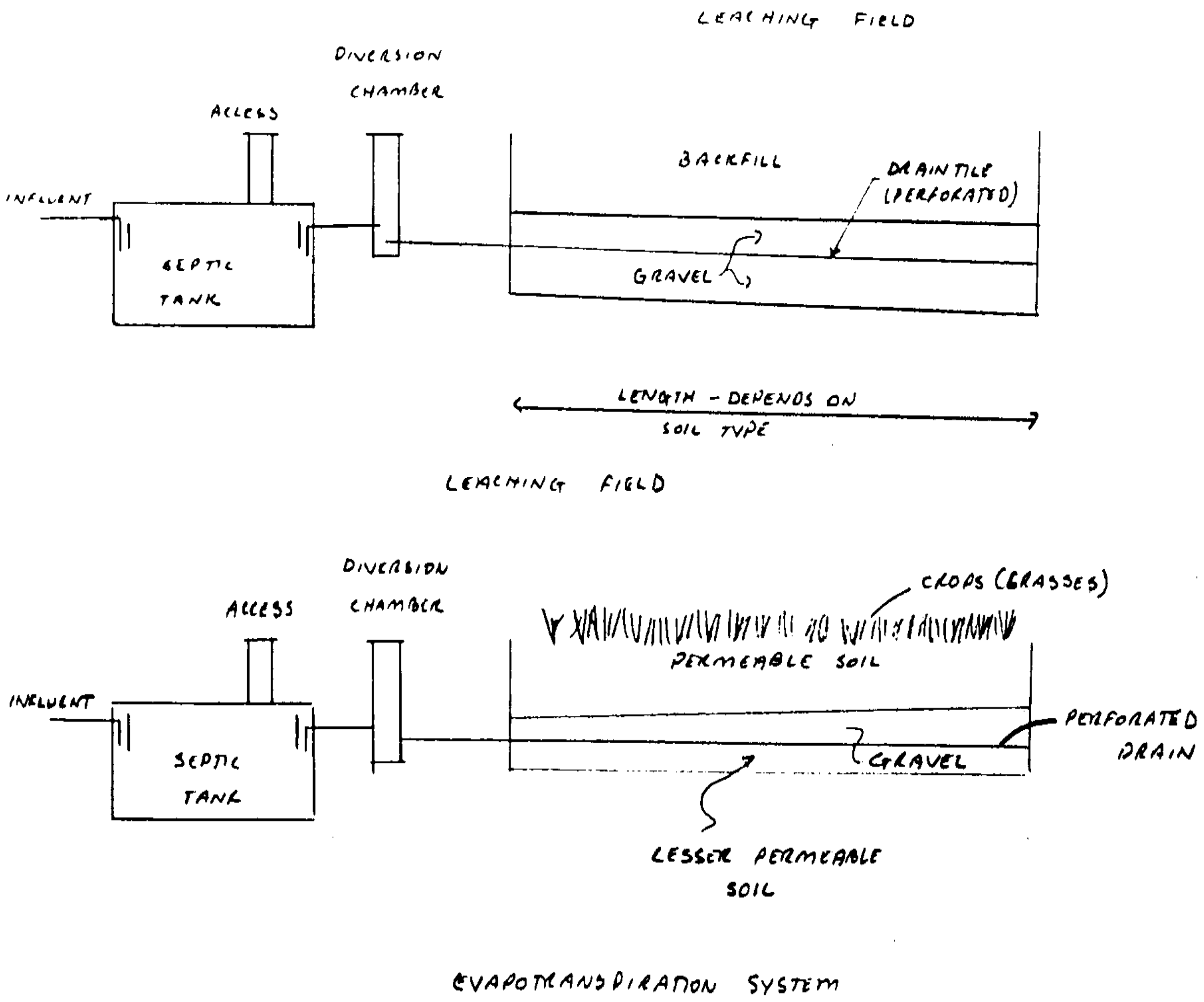

Figure 2. Leaching and Evapotranspiration Systems

ANAEROBIC DIGESTERS

Biogas generators are process units that make use of anaerobic digestion as a means to stabilize waste and produce fuel. These systems are designed to digest animal and human solid wastes; or they can be used as a treatment mechanism for sludge. The solid waste decomposes with the aid of anaerobic microorganisms to produce methane gas, which can be recovered and used as a fuel. As with composting, an optimum carbon to nitrogen ratio (i.e., 25 to 30 parts of carbon to 1 part of nitrogen) is required for proper operation. A detention time of at least 30 days is required for stabilization. Adding the correct amount of waste material to the unit as well as mixing the material thoroughly and removing the digested product from the unit are important operational parameters. Biogas generators can be designed for small-scale use in one or several homes in many countries; but they only partially solve the sewage problem. Because they cannot handle wash water or other types of wastewater, an additional means of sewage treatment for these wastes must be provided.

AQUACULTURE

Aquaculture systems have become popular as a relatively low-cost means to provide advanced treatment where it is required. Utilizing specially selected aquatic vegetation, large amounts of biodegradable material, suspended solids (SS), and other nutrients can be removed from wastewaters. Water is allowed to flow through channels at a slow rate where aquatic plants are grown. These plants are harvested periodically and can then be composted further or digested anaerobically. The complete aquaculture system is labor intensive, but requires minimum energy and equipment. Pretreatment of the waste such as in a series of lagoons must be provided to remove the solids and partially treat the sewage prior to its disposal. The resulting system requires large land areas on which to operate.

IMHOFF TANKS

lmhoff tanks offer a treatment means that is relatively low in cost, produces a good effluent, and is mechanically simple. An Imhoff tank, shown in Figure 3, is a large, deep tank employing

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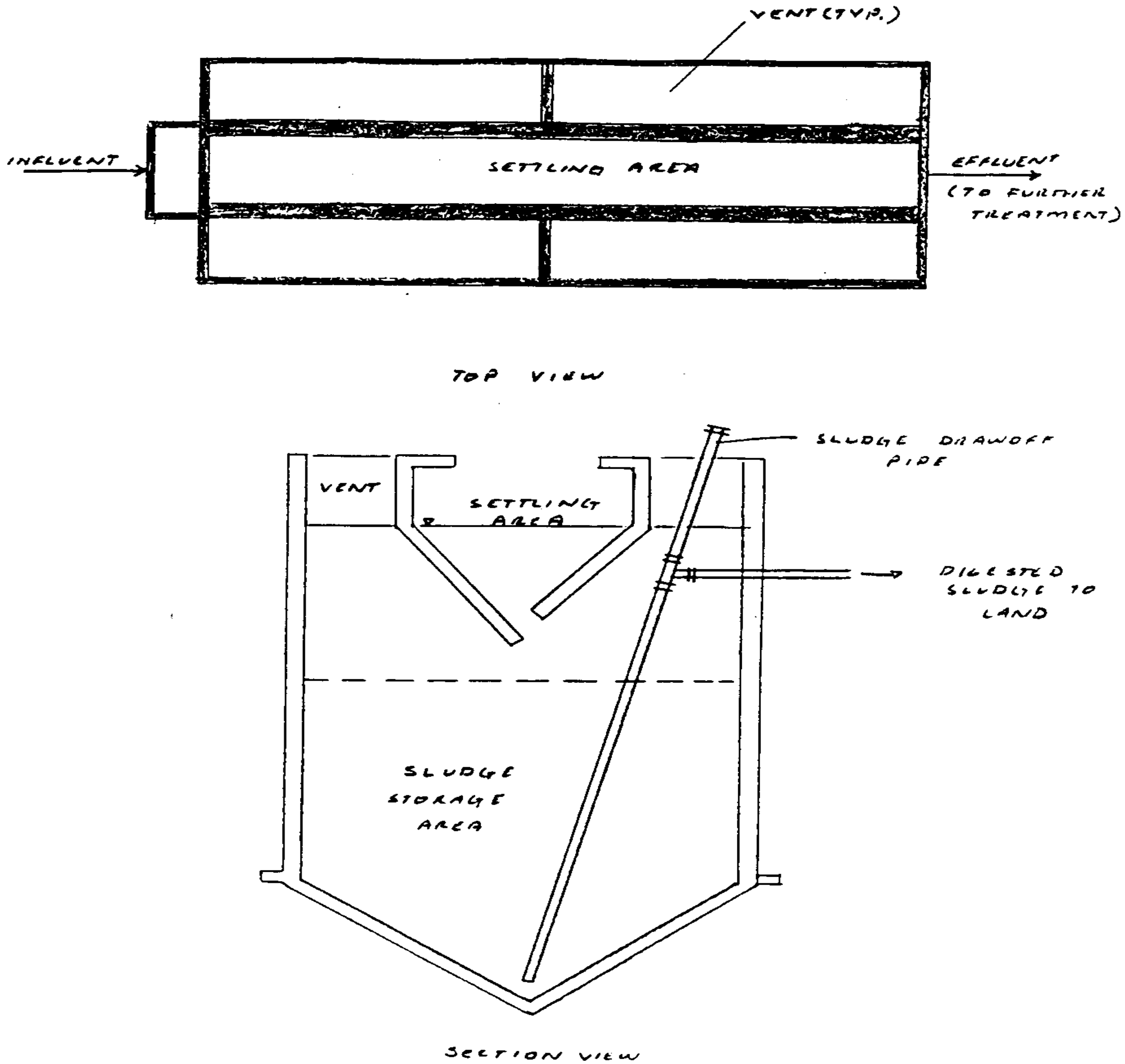

Figure 3. Diagram of an Imhoff Tank

an upper compartment for settling and a lower compartment for anaerobic digestion. Gases escape through vents along the sides of the tank. Proper tank design can limit operating problems such as foaming, scum formation, and malodorous sludge. In tropical climates where the temperature does not vary greatly, the foaming and odor problem will be reduced. Proper operation, including daily cleaning of the side vents, will promote optimum operation of the system. Sludge withdrawal should occur only two or three times a year, and the resulting digested product can be spread over land directly or applied to drying beds for subsequent disposal. Since the discharge from these tanks is not of high quality, it may require further treatment in lagoons or leaching fields.

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AGENCIES TO CONTACT FOR ADDITIONAL INFORMATION

1. American Society of Agricultural Engineers
2950 Niles Road
St. Joseph, Michigan 49085 USA

2. American Society of Civil Engineers
345 East 47th Street
New York, New York 10017 USA

3. EPA Small Wastewater Flows Clearinghouse

Centennial House
Morgantown, West Virginia 26526 USA

4. Environmental Research Information Center
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268 USA

5. Inter-American Association of Sanitary Engineering
AIDIS-USA Section
18729 Considine Drive
Brookeville, Maryland 20833 USA

6. National Sanitation Foundation
Technical Services Division
3475 Plymouth Street
Ann Arbor, Michigan 48106 USA

7. Pan American Health Organization
525 23rd Street, N.W.
Washington, D.C. 20037 USA

8. University of Wisconsin - Extension
College of Engineering and Applied Science
432 North Lake Street
Madison, Wisconsin 53706 USA

9. Water Pollution Control Federation
2626 Pennsylvania Avenue, N.W.

Washington, D.C. 20037 USA

10. World Bank
1818 H Street, NW
Washington, D.C. 20433 USA

11. World Health Organization
20 Avenue Appia
1211 Geneva 27
Switzerland

GLOSSARY OF TERMS USED IN SEWAGE TREATMENT AND DISPOSAL

Activated Sludge System: A biological treatment system employing forced aeration, aerobic growth, and recycled sludge.

Aerobic: With oxygen. Refers to the addition of oxygen to the treatment or stabilization process of wastewater and sludge.

Ammonia: A nitrogen compound that, in combination with phosphates or by itself, promotes algal growth. In large concentrations this compound is toxic to aquatic life.

Anaerobic: Without oxygen. The treatment or stabilization of wastewater or sludge in the absence of oxygen.

Aquaculture: A method of sewage treatment employing aquatic plants to absorb pollutants.

Biochemical Oxygen Demand (BOD): A measure of the organic materials present in wastewater and the amount of oxygen they consume over a length of time, usually five days, at 20 [degrees] C.

Biological Treatment: Facilities that promote the growth of microorganisms to reduce the strength of organic material in wastewater.

Chemical Treatment: The addition of chemicals to wastewater or sludge to neutralize harmful compounds or enhance thickening or settling capabilities.

Combined Sewers: Sewers that carry wastewater from homes and businesses as well as runoff from rain.

Composting: An aerobic treatment method generally used for sludges or animal or human wastes that are essentially solids.

Detention Time: The time a unit of sewage is retained in a treatment unit.

Disinfection: A means, usually chemical, to treat wastewater to kill pathogens.

Equalization: Reduction of the variability of flows by holding the sewage in a tank so that the flow to the treatment plant is equalized over the day.

Eutrophication: The excessive growth of algae in a body of water.

Evapotranspiration: A treatment means using plants to take up moisture and release it to the atmosphere. Some is removed directly through evaporation.

Filtration: A physical treatment process used to remove solids by forcing wastewater through a graded medium.

Gravity Sewers: Sewers that are installed at a downward slope to convey wastewater without the use of pumps.

Grit: Larger solids of primarily inorganic nature in wastewater, including sand, egg shells, coffee grounds, which settle out quickly when the velocity is decreased in the grit chamber.

Infiltration: Water entering sanitary sewers from springs or storm sewers.

Inflow: Water entering sanitary sewers through leaky pipe joints or manholes.

Lagoons: Shallow ponds that hold wastewater and use aerobic and/or anaerobic methods to stabilize wastes. They are designed to store water for long periods of time.

Leach: To remove soluble constituents from (a substance) by the

action of a percolating liquid.

Methane: The major gas generated from the anaerobic decomposition of sludges or solid wastes.

Moisture Content: The amount of water contained in a known volume of solids (e.g., sludge).

On-Site Disposal: A means of sewage treatment designed for one or a small group of households without connections to a central facility.

Organics: Carbon substances that break down in the presence of oxygen.

Oxygen Content: The amount of dissolved oxygen in wastewater.

Pathogens: A name given to a group of organisms known to cause diseases or to upset human body functions.

pH: Potential hydrogen. The symbol that denotes a measurement of the effective hydrogen ion concentration. On a scale of zero to 14, seven represents neutrality. Numbers less than seven indicate acidity; greater than seven indicate alkilinity.

Phosphates: Phosphorous compounds that are known to promote excessive growth of algae if present in high concentrations.

Physical Treatment: Physical units such as pumps, filters, screens, or tanks, that serve to move, screen, or contain wastewater.

Pollutant: An overall term used to characterize unwanted material, chemicals, or substances in the environment.

Pressure Sewers: Pipes of small diameter used for conveying wastewater after it is pumped; these pipes are usually preceded by some pretreatment device.

Pretreatment: First stage of treatment, usually screening, to remove large solids or grit.

Reuse: A term employed when talking about using treated wastewater as a water source.

Sanitary Sewers: Sewers designed to carry only wastewaters from homes, businesses, and industries.

Sludge: The material that settles out from wastewater.

Soil Conditioner: Soil additive that acts as a bulking agent and holds moisture.

Suspended Solids (SS): A measure of the amount of solids present in wastewater; the solids are removed by drying at a low temperature (105 [degrees] F).

Toxic Material: A material, usually man-made, that at certain concentrations can kill aquatic life or be a hazard to human health.

Treatment Systems: Physical, biological, or chemical systems or combinations used to reduce the strength of pollutants.

Trickling Filter: A biological treatment system using aerobic means to stabilize wastewater by trickling through a medium of rocks.

Wastewater/Sewage: A combination of human waste and used water from households, businesses, and industrial processes.

Weir: An obstruction placed across a stream to divert the water to make it flow through a desired channel, which may be a notch or opening in the weir itself.

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