CHAPTER 70
SLUDGE HANDLING AND DISPOSAL

71. DESIGN CONSIDERATIONS

71.1 Process Selection

The selection of sludge handling and disposal methods should include the following considerations (See Chapter 40 also). In addition to Chapter 60, only items with a - apply to drinking water sludge treatment:

a. Energy requirements;

b. Cost efficiency of sludge thickening and dewatering;

c. Complexity of equipment;

d. Staffing requirements;

e. Sludge digestion or stabilization requirements, including the toxic effects of heavy metals and other substances on sludge stabilization and disposal;

f. Treatment of side-stream flow such as digester and thickener supernatant;

g. Sludge storage requirements;

h. A backup method of sludge handling and disposal, and;

i. Methods of ultimate sludge disposal.

72. SLUDGE THICKENERS

As the first step of sludge handling, the need for sludge thickeners to reduce the volume of sludge should be considered. Particular attention should be given to the pumping and piping of the concentrated sludge and possible onset of anaerobic conditions in sewage sludge. Sewage sludge should be thickened to at least 5% solids prior to transmission to digesters.

73. ANAEROBIC SLUDGE DIGESTION

73.1 General

73.1.1 Multiple Units

Multiple tanks are recommended. Where a single digestion tank is used, an alternate method of sludge processing or emergency storage to maintain continuity of service shall be provided.
73.1.2 Depth

For those units proposed to serve as supernatant separation tanks, the depth should be sufficient to allow for the formation of a reasonable depth of supernatant liquor. A minimum sidewater depth of 20 feet (6.1 m) is recommended.

73.1.3 Maintenance Provisions

To facilitate draining, cleaning, and maintenance, the following features are desirable:

73.1.3.1 Slope

The tank bottom should slope to drain toward the withdrawal pipe. For tanks equipped with a suction mechanism for withdrawal of sludge, a bottom slope not less than 1:12 is recommended. Where the sludge is to be removed by gravity alone, 1:4 slope is recommended.

73.1.3.2 Access Manholes

At least two 36 inch (91 cm) diameter access manholes should be provided in the top of the tank in addition to the gas dome. There should be stairways to the access manholes.

73.2 Sludge Inlets and Outlets

Multiple recirculation withdrawal and return points, to enhance flexible operation and effective mixing, should be provided, unless mixing facilities are incorporated within the digester. The returns, in order to assist in scum breakup, should discharge above the liquid level and be located near the center of the tank.

Raw sludge discharge to the digester should be through the sludge heater and recirculation return piping, or directly to the tank if internal mixing facilities are provided.

Sludge withdrawal to disposal should be from the bottom of the tank. This pipe should be interconnected with the recirculation piping to increase versatility in mixing the tank contents, if such piping is provided.

An unvalved vented emergency overflow shall be provided to prevent damage to the digestion tank and cover in case of accidental overfilling. This overflow shall be piped to an appropriate point and at an appropriate rate in the treatment process to minimize the impact on process units.

73.3 Tank Capacity

The total digestion tank capacity should be determined by rational calculations based upon such factors as volume of sludge added, its percent solids and character, the temperature to be maintained in the digesters, the degree of extent of mixing to be
obtained, and the degree of volatile solids reduction required. Calculations should be submitted to justify the basis of design.

When such calculations are not based on the above factors, the minimum combined digestion tank capacity outlined below will be required. Such requirements assume that a raw sludge is derived from ordinary domestic wastewater, that a digestion temperature is to be maintained in the range of 90°F to 100°F (32°C to 38°C), that 40% to 50% volatile matter will be maintained in the digested sludge, and that the digested sludge will be removed frequently from the system.

73.3.1 Completely-Mixed Systems

Completely-mixed systems shall provide for intimate and effective mixing to prevent stratification and to assure homogeneity to digester content. The system may be loaded at a rate up to 80 pounds of volatile solids per 1,000 ft³ per day (1.28 kg/m³*d) in the active digestion units. When grit removal facilities are not provided, the reduction of digester volume due to grit accumulation should be considered. (Complete mixing can be accomplished only with substantial energy input.)

73.3.2 Moderately-Mixed Systems

For digestion systems where mixing is accomplished only by circulating sludge through an external heat exchanger, the system may be loaded at a rate up to 40 pounds of volatile solids per 1,000 ft³ per day (0.64 kg/m³*d) in the active digestion units. This loading may be modified upward or downward depending upon the degree of mixing provided.

73.4 Gas Collection, Piping, and Appurtenances

73.4.1 General

The entire gas system shall be designed so that under all normal operating conditions, including sludge withdrawal, the gas will be maintained under positive pressure. All enclosed areas where any gas leakage might occur shall be adequately ventilated.

73.4.2 Safety Equipment

All necessary safety facilities shall be included where gas is produced. Pressure and vacuum relief valves and flame traps, together with automatic safety shutoff valves, shall be provided. Water seal equipment shall not be installed. Gas safety equipment and gas compressors should be housed in a separate room with an exterior entrance.

73.4.3 Gas Piping and Condensate

Gas piping shall be of adequate diameter and shall slope to condensate traps at low points. The use of float-controlled condensate traps is not permitted.
73.4.4 Gas Utilization Equipment

Gas-fired boilers for heating digesters shall be located in a separate room not connected to the digester gallery. Such separate rooms would not ordinarily be classified as a hazardous location. Gas lines to these units shall be provided with suitable flame traps.

73.4.5 Electrical Fixtures

Electrical fixtures and controls, in places enclosing anaerobic digestion appurtenances, where hazardous gases are normally contained in the tanks and piping, shall comply with Section 32.3.5. Digester galleries should be isolated from normal operating areas, in accordance with Section 73.4.7, to avoid an extension of the hazardous location.

73.4.6 Waste Gas

Waste gas burners shall be readily accessible and should be located at least 50 feet (15.2 m) away from any plant structure if placed at ground level, or may be located on the roof of the control building if sufficiently removed from the tank.

All waste gas burners shall be equipped with automatic ignition, such as pilot light or a device using a photoelectric cell sensor. Consideration should be given to the use of natural or propane gas to insure reliability of the pilot light.

In remote locations it may be permissible to discharge the gas to the atmosphere through a return-bend screened vent terminating at least 10 feet (3.0 m) above the ground surface, provided that the assembly incorporate a flame trap.

73.4.7 Ventilation

Any underground enclosures connecting with digestion tanks or containing sludge or gas piping or equipment shall be provided with forced ventilation in accordance with Section 32.7.2. The piping gallery for digesters should not be connected to other passages. Where used, tightly fitting, self-closing doors should be provided at connecting passageways and tunnels to minimize the spread of gas.

73.4.8 Meter

A gas meter with bypass should be provided to meter total gas production.

73.5 Digester Heating

73.5.1 Insulation

Wherever possible digestion tanks should be suitably insulated to minimize heat loss.
73.5.2 External Heating

Pipe shall be designed to provide for the preheating of feed sludge before introduction to the digesters. Provisions shall be made in the layout of the piping and valving to facilitate cleaning of these lines. Heat exchanger sludge piping should be sized for heat transfer requirements.

73.5.3 Heating Capacity

Heating capacity sufficient to consistently maintain the design sludge temperature shall be provided. Where digester tank gas is used for sludge heating, an auxiliary fuel supply is required.

73.5.4 Hot Water Internal Heating Controls

73.5.4.1 Mixing Valves

A suitable automatic mixing valve shall be provided to temper the boiler water with return water so that the inlet water to the heat jacket can be held below a temperature at which caking will be accentuated.

Manual control should also be provided by suitable bypass valves.

73.5.4.2 Boiler Controls

The boiler should be provided with suitable automatic controls to maintain the boiler temperature at approximately 180°F (82°C), to minimize corrosion and to shut off the main gas supply in the event of pilot burner or electrical failure, low boiler water level, low gas pressure, or excessive boiler water temperature or pressure.

73.5.4.3 Thermometers

Thermometers shall be provided to show temperatures of the sludge, hot water feed, hot water return, and boiler water.

73.6 Supernatant Withdrawal

73.6.1 Piping Size

 Supernatant piping should not be less than 6 inches (15.2 cm) in diameter.