CHAPTER 3

TREATMENT REQUIREMENTS

3-1. General considerations. Before treatment plant design is begun, treatment will be determined on the basis of meeting stream and effluent requirements set by the Federal and state governments.

a. Standards. The regulatory agencies will issue effluent standards covering the discharge of toxic pollutants. Strict limitations on discharges and, in some cases, complete prohibition may be imposed.

b. Pretreatment. Public Law 92-500, with subsequent amendments, requires pretreatment of pollutants which may interfere with operation of a sewage treatment plant or pass through such a plant untreated.

c. State regulations. The designer must review the applicable state guidelines before setting the treatment level or selecting the treatment processes.

d. Local regulations. In general, local governments do not specify requirements for wastewater treatment facilities per se. Construction of wastewater treatment facilities must conform to applicable zoning, Occupational Safety and Health Administration (OSHA) requirements, and to AR 200-1.

3-2. Evaluation of wastewater treatment processes. Table 3-1 provides a summary evaluation of wastewater treatment processes to be considered for mobilization construction. Tables 3-2 and 3-3 illustrate the applicable processes and their possible performance. All of the above will be used for guidance in selecting a process chain of treatment units.

Table 3-1. Evaluation of Wastewater Treatment Processes

Treatment Process	Application	Advantages and Capabilities	Disadvantages and Limitations
1. PRELIMINARY			
Screening	Waste streams containing large solids (wood, rags, etc.)	1. Prevents pump and pipe clogging	1. Maintenance required to prevent screen plugging, ineffective for sticky solids
2. PRIMARY TREATMENT			
Sedimentation	Waste streams containing settleable suspended solids	1. Reduces inorganic and organic solids loadings to subsequent biological units	1. Possible septicity and odors
		2. By far the least expensive and most common method of solid-liquid separation	2. Adversely affected by variations in the nature of the waste
		3. Suitable for treatment of a wide variety of wastes	3. Moderately large area requirement
		4. Requires simpler equipment and operation than other processes	
		5. Demonstrate reliability as a treatment process	

Table 3-1. Evaluation of Wastewater Treatment Processes (Continued)

Treatment Process	Application	Advantages and Capabilities	Disadvantages and Limitations
3. SECONDARY TREATMENT			
a. Activated Sludge (aeration and secondary sedimentation)	Biologically treatable organic wastes	1. Flexible -- can adapt to minor pH, organic and temperature changes	1. High operating costs (skilled labor, electricity, etc)
		2. Produces high quality effluent--90% BOD and suspended solids removal	2. Generates solids requiring sludge disposal
		3. Small area required	3. Some process alternatives are sensitive to shock loads, and metallic or other poisons
		4. Available in package units	4. Requires continuous air supply
		5. The degree of nitrification is controllable	
		6. Relatively minor odor problems	
b. Aerated Pond (with secondary sedimentation)	Biologically treatable organic wastes	1. Flexible -- can adapt to minor pH, organic, and temperature changes	1. Dispersed solids in effluent

Table 3-1. Evaluation of Wastewater Treatment Processes (Continued)

Treatment Process	Application	Advantages and Capabilities	Disadvantages and Limitations
		2. Inexpensive construction	2. Affected by seasonal temperature variations
		3. Minimum attention	3. Operating problems (ice, solids settlement, etc)
		4. Moderate effluent (80-95% BOD Removal)	4. Moderate power costs
			5. Large area required
			6. No color reduction
c. Aerobic-Anaerobic Ponds[1]	Biologically treatable organic wastes	1. Low Construction costs	1. Large land area required
		2. Non-skilled operation	2. Algae in effluent
		3. Moderate quality effluent (80-95% BOD Removal)	3. Possible septicity and odors
		4. Removes some nutrients from wastewaters	4. Potential weed growth, mosquito, and insect problems
d. Trickling Filter	Biologically treatable organic wastes	1. Moderate quality effluent (80-90% BOD Removal)	

Table 3-1. Evaluation of Wastewater Treatment Processes (Continued)

Treatment Process	Application	Advantages and Capabilities	Disadvantages and Limitations
		2. Moderate operating costs (lower than activated sludge and higher than oxidation pond)	1. Clogging of distributors or beds
		3. Good resistance to shock loads	2. Snail, mosquito, and insect problems
e. Solar Evaporation	Dissolved salts in concentrated solutions, as well as general wastewaters	1. Low initital cost	1. Large land area
		2. Inexpensive operation	2. Dependent on geographical location for evaporation
		3. Waste volume reduction	3. Solids disposal
4. SLUDGE			
a. Anaerobic Digestion (Pretreatment)	Biodegradable solids	1. Methane production	1. Heat required
		2. Solids stabilization and conditioning	2. Process upsets when excess volatile acids generated
		3. Liquefaction of solids	3. Odors
		4. Minimum land required	4. Skilled labor
		5. Use of digested sludge as fertilizer or soil conditioner	5. Explosion hazard

Table 3-1. Evaluation of Wastewater Treatment Processes (Continued)

Treatment Process	Application	Advantages and Capabilities	Disadvantages and Limitations
b. Aerobic Digestion (Pretreatment)	Biological solids	1. Relatively little odor 2. Solids stabilization and conditioning 3. Unsophisticated operation	1. Moderate land area required 2. High energy usage 3. Reduced dewatering ability
c. Sand Beds (Dewatering)	Organic or inorganic sludges	1. Solids concentration 2. No chemical costs 3. Low capital costs	1. Land area required 2. Weather problems: a. Winter--freezing b. Summer--odor
d. Land Disposal (Disposal)	Stable biological sludge	1. Low investment 2. Postpones ultimate sludge disposal process installation or 3. Provides ultimate disposal, if land is available	1. Large land area required 2. Possible odor problem

Table 3-1. Evaluation of Wastewater Treatment Processes (Continued)

	Treatment Process	Application	Advantages and Capabilities	Disadvantages and Limitations
e.	Sanitary Landfill (Disposal)	Dewatered biological sludges (30-35% solids)	1. Low investment	1. Ground-water contamination
			2. Suitable for undigested sludges, odorous or toxic materials	2. Requires cover material and compaction
			3. Land reclamation	3. Hauling costs

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Table 3-2. Approximate Performance Data for Various Wastewater Processes[1]

Process	Constituent, effluent from process, mg/l (influent concentration mg/l in parentheses)						Ultimate Disposal
	SS (200)	BOD (200)	COD (450)	N (30)	NH_3 (15)	P (10)	
Imhoff Tank	80	120	350	25	15	9	Sludge
Trickling Filter Processes:							
Conventional (low rate)	25	18	100	20	1	7	Sludge
Conventional (high rate)	30	20	100	25	15	7	Sludge
Tower Filter	30	20	100	25	15	7	Sludge
Activated Sludge Process:							
Complete Mix	20	15	90	20	12	7	Sludge
Contact Stabilization	20	15	90	20	12	7	Sludge
Extended Aeration	20	15	90	15	2	7	Sludge
Aeration Lagoon (with settling)	20	15	90	25	2	7	Sludge
Oxidation Ditch (with settling)	20	15	90	25	2	7	Sludge
Stabilization Pond Processes:							
Aerobic (aerated)	170	60	200	25	1	9	Sludge[3]
Aerobic-anaerobic (natural aeration)	120	40	150	15	1	4	Sludge[3]
Anaerobic[2]	100	40	140	15	1	4	Sludge[3]

[1] Under ideal conditions.
[2] Usually followed by aerobic or facultative ponds.
[3] Following pretreatment.

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Table 3-3. Operational Characteristics of Various Treatment Processes

Process Characteristics	Trickling Filters	Activated Sludge	Wastewater Treatment Ponds	Land Disposal
Reliability with respect to:				
Basic process	Good	Good	Good	Excellent
Influent flow variations	Fair	Fair	Good	Good
Influent load variations	Fair	Fair	Good	Good
Presence of industrial waste	Good	Good	Good	Good
Industrial shock loadings	Fair	Fair	Fair	Good
Low temperatures (20 degrees C.)	Sensitive	Good	Very Sensitive	Good (to 0°C)
Expandibility to meet:				
More stringent discharge requirements with respect to:				
Suspended Solids	Good; add filtration or polishing ponds	Good; add filtration or polishing ponds	Add additional solids removal unit	
BOD	Improved by filtration	Improved by filtration	Improved by solids removal	
Nitrogen	Good	Good	Fair	---
Operational complexity	Average	Above Average	Below Average	Below Average
Ease of operation and maintenance	Very Good	Fair	Good	Excellent
Power requirements	Low	High	Low to High	Moderate
Waste products	Sludges	Sludges	Sludges	---

Process Characteristics	Trickling Filters	Activated Sludge	Wastewater Treatment Ponds	Land Disposal
Site Considerations				
Land area requirements	Moderate plus buffer zone	Moderate plus buffer zone	Large plus buffer zone	Large plus buffer zone.
Topography	Level to moderately sloped	Level	Level	Level to moderately sloped