

5-1 SCREENING

The first unit operation generally encountered in wastewater-treatment plants is screening. A screen is a device with openings, generally of uniform size, that is used to retain solids found in the influent wastewater to the treatment plant or in combined wastewater-collection systems subject to overflows, especially from stormwater. The principal role of screening is to remove coarse materials from the flow stream that could (1) damage subsequent process equipment, (2) reduce overall treatment process reliability and effectiveness, or (3) contaminate waterways. Fine screens are sometimes used in place of or following coarse screens where greater removals of solids are required to (1) protect process equipment or (2) eliminate materials that may inhibit the beneficial reuse of biosolids.

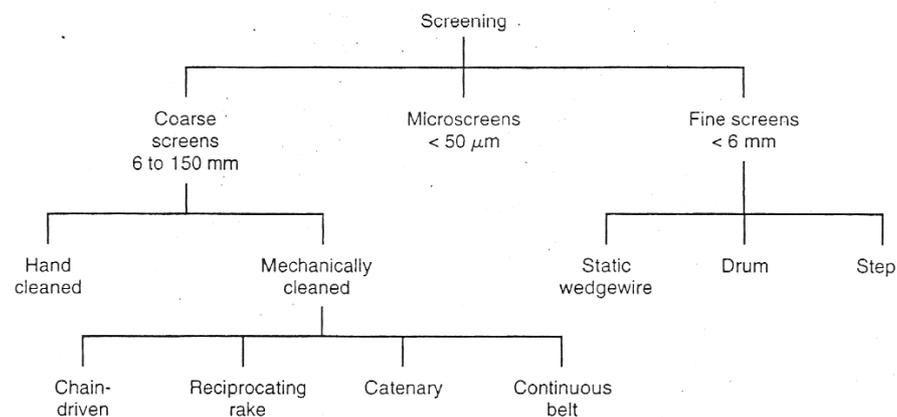
All aspects of screenings removal, transport, and disposal must be considered in the application of screening devices, including (1) the degree of screenings removal required because of potential effects on downstream processes, (2) health and safety of the operators as screenings contain pathogenic organisms and attract insects, (3) odor potential, and (4) requirements for handling, transport, and disposal, i.e., removal of organics (by washing) and reduced water content (by pressing), and (5) disposal options. Thus, an integrated approach is required to achieve effective screenings management.

Classification of Screens

The types of screening devices commonly used in wastewater treatment are shown on Fig. 5-2. Two general types of screens, coarse screens and fine screens, are used in preliminary treatment of wastewater. Coarse screens have clear openings ranging from 6 to 150 mm (0.25 to 6 in); fine screens have clear openings less than 6 mm (0.25 in). Microscreens, which generally have screen openings less than 50 μm , are used principally in removing fine solids from treated effluents.

The screening element may consist of parallel bars, rods or wires, grating, wire mesh, or perforated plate, and the openings may be of any shape but generally are circular or rectangular slots. A screen composed of parallel bars or rods is often called a "bar rack" or a coarse screen and is used for the removal of coarse solids. Fine screens are devices consisting of perforated plates, wedgewire elements, and wire cloth that have smaller openings. The materials removed by these devices are known as *screenings*.

Figure 5-2
Definition sketch for types
of screens used in
wastewater treatment.



Coarse Screens (Bar Racks)

In wastewater treatment, coarse screens are used to protect pumps, valves, pipelines, and other appurtenances from damage or clogging by rags and large objects. Industrial waste-treatment plants may or may not need them, depending on the character of the wastes. According to the method used to clean them, coarse screens are designated as either hand-cleaned or mechanically cleaned.

Hand-Cleaned Coarse Screens. Hand-cleaned coarse screens are used frequently ahead of pumps in small wastewater pumping stations and sometimes used at the headworks of small- to medium-sized wastewater-treatment plants. Often they are used for standby screening in bypass channels for service during high-flow periods, when mechanically cleaned screens are being repaired, or in the event of a power failure. Normally, mechanically cleaned screens are provided in lieu of hand-cleaned screens to minimize manual labor required to clean the screens and to reduce flooding due to clogging.

Where used, the length of the hand-cleaned bar rack should not exceed the distance that can be conveniently raked by hand, approximately 3 m (10 ft). The screen bars are welded to spacing bars located at the rear face, out of the way of the tines of the rake. A perforated drainage plate should be provided at the top of the rack where the rakings may be stored temporarily for drainage.

The screen channel should be designed to prevent the accumulation of grit and other heavy materials in the channel ahead of the screen and following it. The channel floor should be level or should slope downward through the screen without pockets to trap solids. Fillets may be desirable at the base of the sidewalls. The channel preferably should have a straight approach, perpendicular to the bar screen, to promote uniform distribution of screenable solids throughout the flow and on the screen. Typical design information for hand-cleaned bar screens is provided in Table 5-2.

Table 5-2
Typical design information for manually and mechanically cleaned bar racks

Parameter	U.S. customary units			SI units		
	Unit	Cleaning method		Unit	Cleaning method	
		Manual	Mechanical		Manual	Mechanical
Bar size						
Width	in	0.2-0.6	0.2-0.6	mm	5-15	5-15
Depth	in	1.0-1.5	1.0-1.5	mm	25-38	25-38
Clear spacing between bars	in	1.0-2.0	0.6-3.0	mm	25-50	15-75
Slope from vertical	°	30-45	0-30	°	30-45	0-30
Approach velocity						
Maximum	ft/s	1.0-2.0	2.0-3.25	m/s	0.3-0.6	0.6-1.0
Minimum	ft/s		1.0-1.6	m/s		0.3-0.5
Allowable headloss	in	6	6-24	mm	150	150-600

Mechanically Cleaned Bar Screens. The design of mechanically cleaned bar screens has evolved over the years to reduce the operating and maintenance problems and to improve the screenings removal capabilities. Many of the newer designs include extensive use of corrosion-resistant materials including stainless steel and plastics. Mechanically cleaned bar screens are divided into four principal types: (1) chain-driven, (2) reciprocating rake, (3) catenary, and (4) continuous belt. Cable-driven bar screens were used extensively in the past but largely have been replaced in wastewater applications by the other types of screens. Typical design information for mechanically cleaned is also included in Table 5-2. Examples of the different types of mechanically cleaned bar screens are shown on Fig. 5-3 and the advantages and disadvantages of each type are presented in Table 5-3.

Chain-Driven Screens Chain-driven mechanically cleaned bar screens can be divided into categories based on whether the screen is raked to clean from the front (upstream) side or the back (downstream) side and whether the rakes return to the bottom of the

Figure 5-3

Typical mechanically cleaned coarse screens:
 (a) front-cleaned, front-return chain-driven,
 (b) reciprocating rake,
 (c) catenary, and
 (d) continuous belt.

