Wastewater Engineering

Class 3 Screens

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Screening

- First unit operation used at wastewater treatment plants.
- 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.
- Objective: To remove coarse materials from the flow steam, such as rags, paper, plastics, metals, and the like.
- These objects, if not removed,
  - Damage subsequent process equipment;
  - Reduce overall treatment process reliability and effectiveness;
  - Contaminate waterways;
  - Protect process equipment;
  - Eliminate materials that may inhibit the beneficial reuse of biosolids.

Types of screenings used for wastewater treatment

Operation	Application	Device
Screening, coarse (6 to 150mm)	Removal of coarse solids such as sticks, rags, and other debris in untreated wastewater by interception (surface straining)	Bar rack (parallel bars or rods)
Screening , Fine (<6mm)	Removal of small particles	Fine screen (perforated plates, wedgewire elements, wire cloth having smaller openings)
Screening, Micro(<50μm)	Removal of fine solids, floatable matter and algae	Microscreen (removing fine solids from treated effluents)

Coarse Screens

Type	Location	Description
Bar racks or bar screens	Ahead of pumps and grit removal facilities	May be manually or mechanically cleaned.
Coarse woven wire media screens	Behind racks or ahead of trickling filters	These are flat-, basket-, cage, or disk-type screens used to remove relatively smaller particles. Cleaned by removing from the channel. Openings vary from 3 to 20 mm.
Comminutor	Used in conjunction	Grinders that cut up the materials retained over screens. Provisions to bypass the comminutor is always made.

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Fine Screens

- Fixed or moving screens.
- 20~35% SS and BOD_5 removal; grease removal, increased DO

Moving Screens

Type	Description
Band screens	Consist of an endless perforated band which passes over upper and lower rollers. A brush may be installed to remove the material retained over the screen. Water jet is also used to flush the debris.
Wing or shovel screenson	Consist of circular perforated radial vans that slowly rotate a horizontal axis. The vans scoop through the channel.
Strainers or Drum screens	Consist of a rotating cylinder that has screen covering the circumferential area of the drum. Openings vary from 0.02 to 3 mm.

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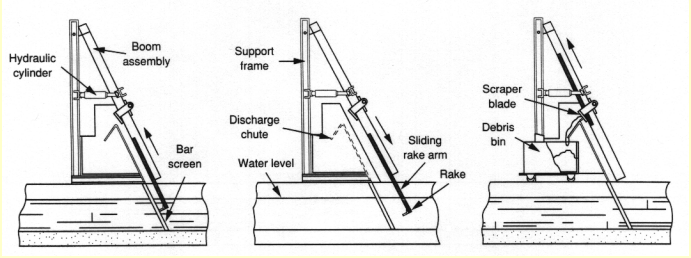
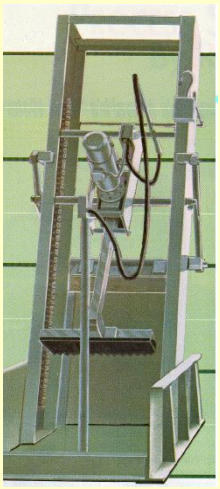
Screening

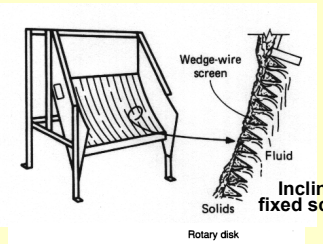
- A device with openings of uniform size to retain coarse solids found in wastewater
- Consists of parallel bars, rods/wires, grating, wire mesh, or perforated plate with circular or rectangular shape
- Bar racks/screens: used to protect pumps, valves, pipelines, and other appurtenances from damage or clogging



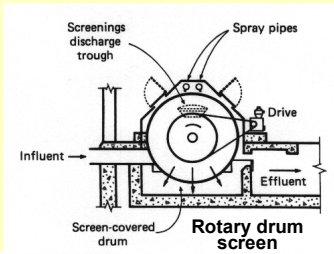
Reciprocating rake



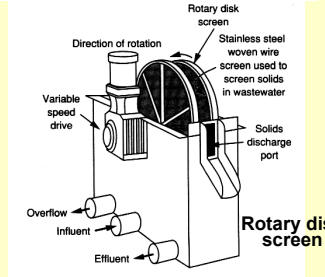
Typical Screening Devices



Inclined fixed screen

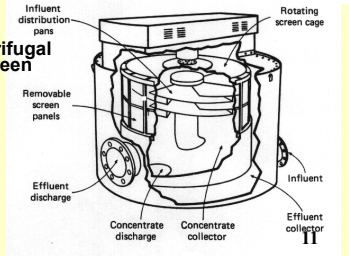


Rotary drum screen



Rotary disk screen

Centrifugal screen



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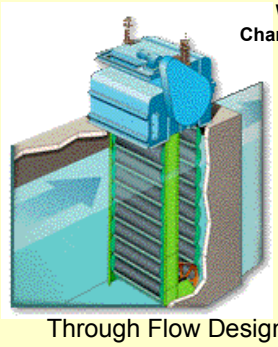
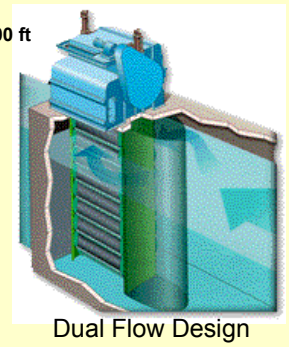
Bar Screens

Width: 2 to 14 ft
Channel depths: >100 ft



Through Flow Design

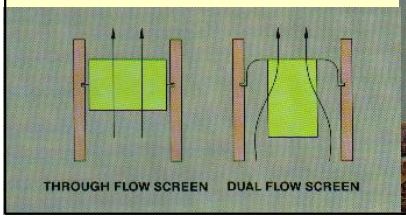


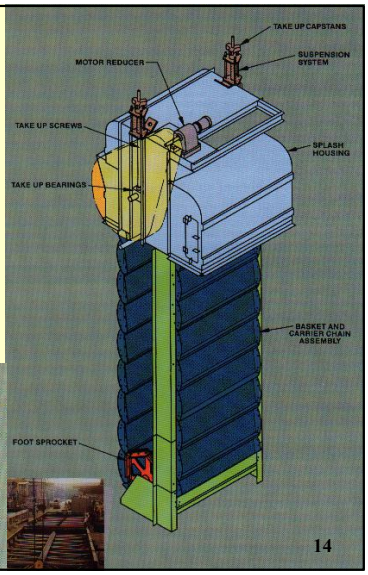
Dual Flow Design

Most commonly used at medium- and large-size wastewater treatment plants

Fine screen

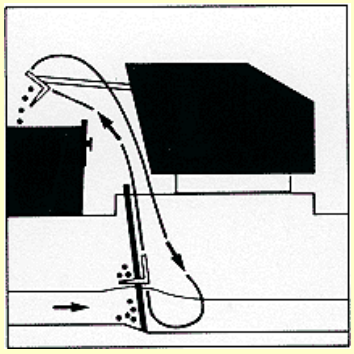
Bar Screens





Frontloader Bar Screen

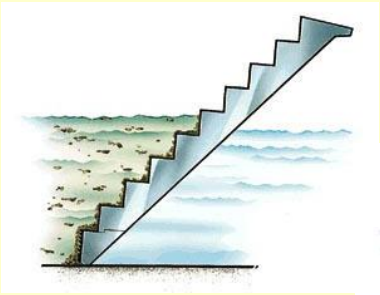
- A back-cleaned unit, which enables the rake to catch the captured material and keep it from dropping back into the flow.
- The teeth of the rake extend through the bars and raise the material on the upstream side.
- Can be used in channels up to 4.5 feet deep and 4 feet wide with bar spacing down to 1/2" clear openings.
- The headroom required for the unit is only 8 feet.

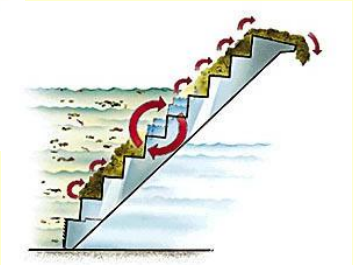


Climber® Screen

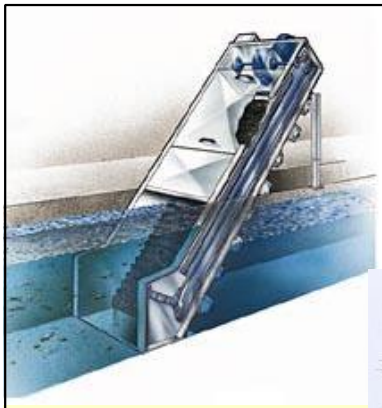
- Removes solids from the bar screen by means of a precision gear-driven cleaning rake running in guide rails.
- Designed to eliminate moving parts below the water line - low maintenance time and expense
- Width: 18" to over 30’
- Lift: 2' to over 125',
- Bar spacing: 1/4" to 6”
- Equipped with overload protection device

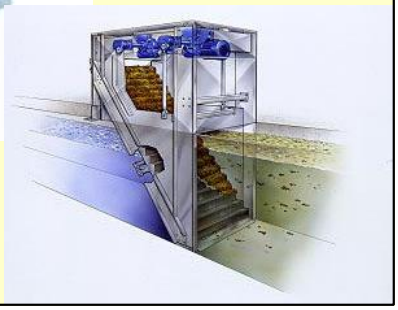
Step Screen®



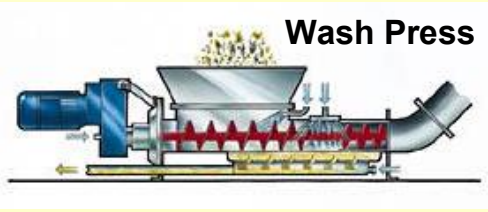


Step Screen®



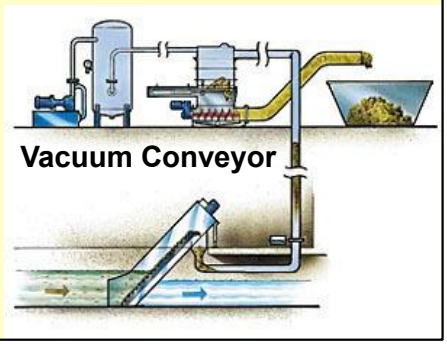


Wash Press



Designed for effective washing of organic material from screenings

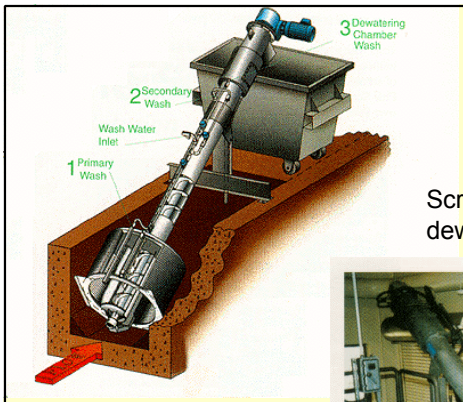
Vacuum Conveyor



Designed for long transport distances, i.e. up to 15 meters (50 feet) vertically and/or up to 50 meters (165 feet) horizontally

Rotamat® Fine Screen

- Removes, transports, compacts, and dewaters screenings.
- Simple operation and low equipment costs by combining four procedures into one piece of equipment
- Used for screening raw wastewater, septage, and sludges.
- All stainless steel construction
- Only one moving part
- No metal-to-metal wearing parts
- One machine with a single motor to screen, wash, compact, and dewater the debris from wastewater.

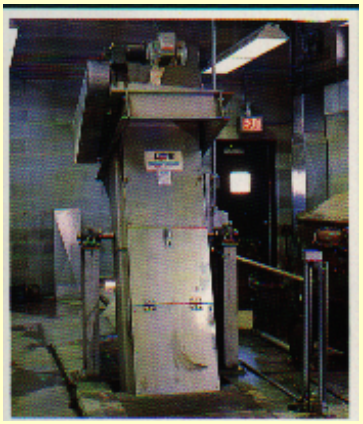


Rotamat® Fine Screen

Screens, washes, and dewaters with a single unit

Easily installs into open channels for reduced installation costs

Mechanically Cleaned Bar Screens



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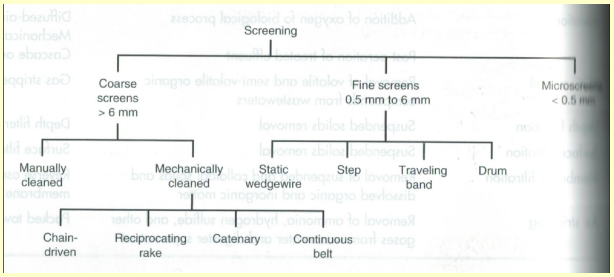
Classification of screens



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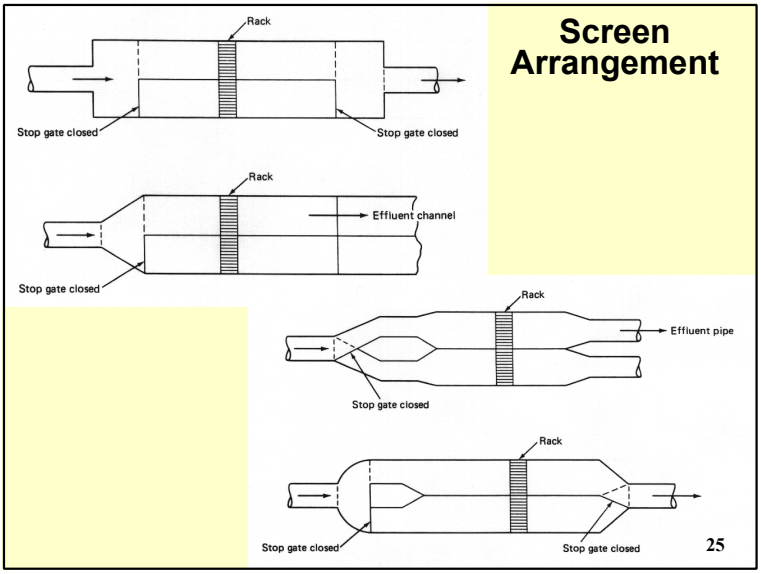
Screens/Racks

Design guidelines

Design factor	Manually cleaned	Mechanically cleaned
Velocity through screen/rack (m/sec)	0.3~0.6	0.6~1
Bar size (mm)		
Width	4~8	8~10
Depth	25~50	50~75
Clear spacing between bars (mm)	25~75	10~50
Slope from horizontal (°)	45~60	75~85
Allowable headloss, clogged (mm)	150	150
Max. headloss, clogged (mm)	800	800

Screen Arrangement



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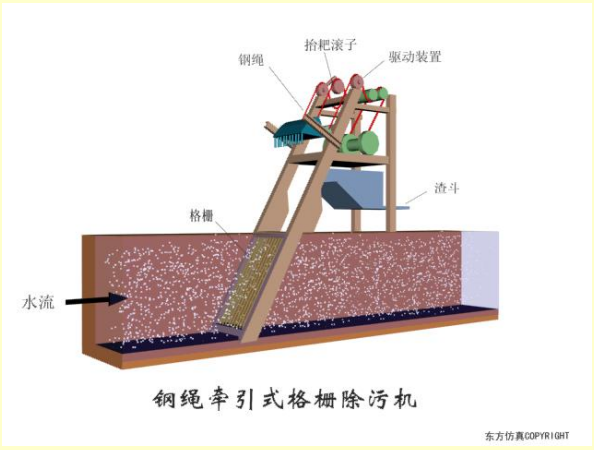
Screenings



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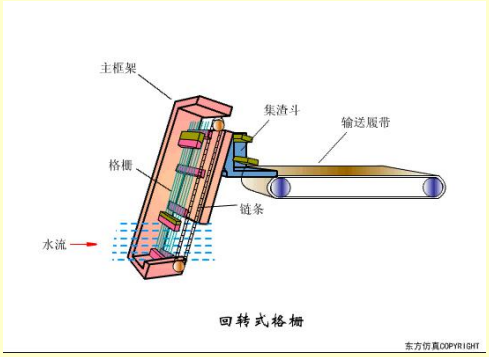

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Common Operating Problems

Obnoxious odors, flies, and other insects around the bar rack
- Increase frequency and removal and disposal of screenings

Excessive screen clogging
- Caused by unusual amount of debris, low velocity through the rack, or slow removal of debris
- Identify the source causing excessive discharge of debris and stop it; provide a coarser rack, or reset the timer cycle or install level controller override

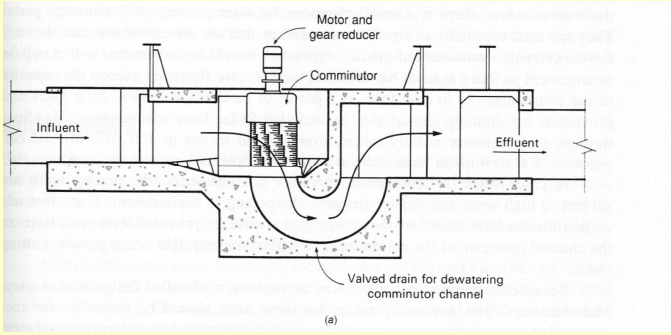
Excessive grit accumulation in the chamber
- Caused by low velocity in the channel
- Clean bottom regularly, reslope the bottom, rake the channel, or flush regularly with a hose

A jammed raking mechanism
- Remove the obstruction immediately

A broken chain or cable

A defective remote control circuit or motor

Comminutor - Grinder



Maintenance

- Daily inspection: raking chain, sprocket, teeth, and other moving parts
- Lubricate and adjust all moving parts
- Perform routine maintenance
- After dewatered, check for painting, cable, chain, or teeth, remove obstructions, and straighten bend bars
- Screenings: odorous and attract flies and insects
- The bar screen area should be thoroughly hosed off daily with chemical solution (chlorine or hydrogen peroxide)

Information Required for Bar Racks

- Width and water depth in the channel
- Clear spacing between bars
- Velocity through screens
- Type of cleaning equipment
  - Front-cleaned
  - Back-cleaned: does not jam easily due to obstruction at the base of the screen
  - Operation – intermittent by a timer or preset differential headloss across screen

Disposal of screenings

- Removal by hauling to disposal areas (landfill) including codisposal with municipal solid wastes;
- Disposal by burial on the plant site (small installations only);
- Incineration either alone or in combination with sludge and grit (large installations only);
- Discharge to grinders or macerators where they are ground and returned to the wastewater.