# What every operator should know about screening and headworks

*Ken Schnaars*

| Knowledge | Principle | A practical consideration |
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| Headworks | The headworks, or preliminary treatment processes, collect and remove coarse solids and grit early in the wastewater process so these materials do not clog, wear out, or damage pipes and/or equipment. | Early headworks facilities usually were designed with one screening device and a standard grit removal system. Today's designs may include multiple screening technologies and more sophisticated grit removal systems.<br><br>Modern water resource recovery facilities (WRRFs) receive standard debris such as, rags, plastic bottles, wood, branches, leaves, and other coarse solids. However, they are also receiving a greater quantity of finer solids, such as, disposable wipes which require finer screening technologies. |
| Know your collection system | Wastewater collection systems come in various sizes and contain a variety of coarse solids. Sanitary sewer systems contain primarily sanitary waste, whereas combined sewer systems also bring stormwater and runoff. | Understanding the typical type and quantity of coarse solids entering the WRRF helps determine the type and number screening devices required. At larger WRRFs, some headworks facilities require multiple barriers of screening devices, such as trash racks, coarse screens, and fine screens. |
| Screening systems (general) | Screening devices remove coarse solids, such as rags, sticks, bricks, wood, plastics, and other larger materials. | There are three main classifications of screens used at WRRFs:<br>■ trash racks,<br>■ coarse screens, and<br>■ fine screens. |
| Trash racks | Trash racks remove the largest debris. | Trash racks have clear openings that are greater than 38 mm (1.5 in.) and can be as large as 150 mm (6 in.). These units typically are used at WRRFs with combined sewers. They remove logs, branches, stones, and other large debris.<br><br>WRRFs with combined sewers normally follow trash racks with coarse screening. |
| Coarse screens | Coarse screens, also called bar screens, remove smaller solids than trash racks, but they can still allow some solids into the WRRF. | Coarse screens (bar screens) have clear openings between 13 and 38 mm (0.5 to 1.5 in.). These screens collect material to protect pumps and equipment, but the openings are still large enough to allow some debris into the WRRF that could affect equipment and processes.<br><br>Coarse screen come in many designs: front clean, chain-driven, reciprocating cog wheel driven, catenary, and more. |

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| Fine screens | Fine screens remove smaller solids than coarse screens and are used in WRRF designs that incorporate more efficient or sophisticated treatment processes that require the removal of finer solids. | Fine screens typically have openings between 3 and 6 mm (0.12 and 0.24 in.), but can have openings as large as 10 mm (0.4-in.).<br><br>Types of fine screens include perforated plate, wire mesh, or wedge wire. Fine screens usually follow coarse screens because the coarse screens protect fine screens. However, fine screens can be used as the first and only screening device where the WRRF is not receiving large debris.<br><br>Today's WRRFs use fine screens more extensively to help remove more fibrous material that could collect on valves, collector mechanisms, mixers, and other devices downstream.<br><br>Fine screens also are needed to remove finer solids that could affect the operation of some newer grit removal systems, solids handling equipment, membrane bioreactors, and other newer treatment technologies. |
| Choosing the right option | If your WRRF is adding new coarse or fine screens, then as operators, when you review design plans, there are several questions you should ask. | **What is the approach velocity to the screen?**<br>The approach velocity should be approximately 0.6 m/s (2 ft/s), but can be slightly higher or lower. If the approach is too low, solids could settle in the channel in front of the screen. If the velocity is too high, it could affect the operation of the screen.<br><br>**Is a passive overflow system provided in the design should the screen(s) become clogged?**<br>Without a passive overflow system, if the screen(s) clog due to solids, the screening influent channel could back up and possibly overflow.<br><br>**What is the capacity of the screening device and what screen blinding percentage was used during the design?**<br>Ensure that this capacity and amount of blinding match with typical influent parameters.<br><br>**What are the water requirements for screen cleaning?**<br>Know the flow rate and pressure requirements for screen cleaning. Also make sure each screen contains an isolation valve for maintenance purposes.<br><br>**How is screen cleaning controlled?**<br>Options include upstream channel level measurement, differential head across screen, timer, or a combination of level and timer.<br><br>**What angle will the screen be set in the channel?**<br>A screen set at an angle of 75 degrees exposes less screening face than a screen set at 45 degrees, but space considerations of the facilities sometimes determine the angle of the screening unit.<br><br>**What are the requirements of the grit system after the screening facilities?**<br>Some new and modern grit removal processes require that upstream screens remove a certain size solids before grit removal so the grit process can be efficient. |
| Screening compactors | Material that collects on the screens can be simply raked off and disposed of in a dumpster or other type grit container or passed through more complicated handling equipment, such as screenings compactors. | Screenings that are removed from influent screens are collected and usually sent to a landfill for disposal. Smaller facilities usually deposit their screenings directly into a dumpster and then haul them to a landfill. At larger facilities, a compactor typically is used to remove excess water from the screenings before the material is transferred to a dumpster, container, or truck.<br><br>Many landfills do not like to accept material that is too wet.<br><br>Compactors squeeze water out of the screenings using a pressure above 6900 kN/m$^3$ (1000 lb/in.$^2$). The dewatered screenings are pushed through a pipe to a dumpster, container, or truck. |

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| Manual screening | Manual screens typically are used in small WRRFs or as back-up screens in mid- to large-WRRFs. These screens, usually are bar screens, with larger openings between the bars to capture larger solids while reducing the need to clean the screen very often. | Operators use a rake to remove the solids caught on manually cleaned screens. Typically, they have clear openings of 25 to 50 mm (1 to 2 in.).<br><br>The top of manually cleaned bar screens usually are set several feet below top of the channel in case the screen becomes blinded with debris. This clearance allows the water to flow over the top of the screen and not overflow the channel if the screen is blinded with solids.<br><br>The screenings that are removed manually from the screen are scraped onto a drain pan where water drains from the screenings. The water from the drain pan falls back into the channel. |
| Screenings transportation systems | Screenings removed from a screening device are transported to compactors, dumpsters, trucks, containers, or other screenings disposal locations using various transportation means. | Screenings can be moved to a final disposal location by many means:<br>■ Screenings can fall directly into a dumpster, container, or truck from the screen.<br>■ Screenings can fall into a compactor that presses the water from the screenings and then pushes the dewatered screenings into a disposal bag.<br>■ A conveyor can be used to move them to from the screening unit or compactor to a dumpster or truck.<br>■ Screenings can be transported to a screenings compactor and then pumped through a pipe to a dumpster or truck.<br>■ A water sluice can move screenings along a trough to screening compactor, which, in turn discharges to a dumpster or truck.<br><br>The type of transportation system selected depends on such factors as the size of the WRRF, the existing site conditions, the recommendations of the engineer, and other factors.<br><br>Screenings transportation systems can become the bottleneck in preliminary treatment if there is no redundant equipment. Operators should ensure there are redundant screenings transport options. |
| Screening grinders | Grinding devices typically are used to reduce the size of coarse solids in the wastewater without removing the material from the wastewater stream. | Grinding devices still are used, mainly in small WRRFs, but changes in the solids (disposable wipes) entering WRRFs allows material to re-weave in downstream processes. This leads to plugging and maintenance issues.<br><br>Current WRRF designs, especially mid- to larger-facilities remove coarse solids using screening equipment.<br><br>Grinder use at WRRF headworks may have declined, but grinders still are used in other locations of a WRRF, such as a primary tank to reduce the solids size of the primary sludge before it is pumped to solids handling facilities. |
| Paint filter test | The paint filter test is used to determine the presence of free liquids in a representative sample. | The paint filter test is used to determine compliance with 40 *CFR* 264.314 and 265.314.<br><br>This test is used to ensure that material, such as screenings and grit sent to a landfill, does not contain moisture that could hinder the performance of the landfill or drip onto the roadway during hauling.<br><br>U.S. Environmental Protection Agency Test Method 9095B, Paint Filter Liquids Test, describes the procedure for this test. Basically, a Number 60 ± mesh filter is placed in a glass funnel above a 100-mL graduated cylinder. A sample of the material to be tested is placed in the filter; if any water from the material passes through the filter within 5 minutes, the material is deemed to contain free liquid and the material cannot be taken to the landfill. |

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