Adaptability Comes To A Head With Wastewater Screening Technology

Effective wastewater screening during normal flow looks very different from screening during peak flow events. Under most circumstances, however, it isn't possible to address both effectively. As such, engineers and municipalities design their screening with peak flow in mind. This means debris bypass or larger screen opening sizes and slower scraper speeds, a compromise that results in suboptimal screening during normal flows. Unfortunately, letting more debris through the screen during normal flow can lead to costly problems, such as pump clogs and more frequent cleanouts of the clarifier and digester.

Going the reverse direction and using too fine a screen size can result in a whole new set of challenges. Excessive head loss can cause backups in the collection system during peak events, leading to upstream issues or unintended bypass. In addition, running the scrapers at too high a speed for too long can result in premature wear.

For years there was no way to have it both ways — bar screens and scraper systems could not be designed for both normal and peak flow. But newer screening technologies are doing just that.

Sensing Flow Rates

The bulk of fine debris occurs during normal flow rates and the "first flush" at the early stage of high flows. This is when finer screening is the most useful. However, as flow rates reach peak levels, the fine debris loads decrease.

Adaptable screening technology uses water level sensors upstream and downstream in the headworks to detect peak events (Figure 1). Under normal conditions, the difference between the two levels is typically less than 4". As the flow rate increases, so does the head loss and blinding, which exacerbates this difference.

When the upstream and downstream water level difference crosses a

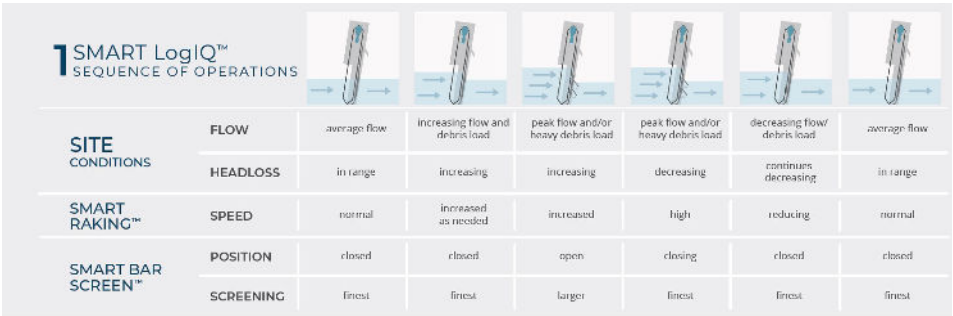

Photo courtesy of Duperon

Figure 1. The sequence of operations of an adaptable bar screen system. As flow increases, a portion of the screen opens, increasing the spacing between the bars to reduce head loss and prevent backups. When the flow decreases and debris load increases, the screen closes again, reducing the space to capture and remove fine debris.

predetermined threshold, the screen can respond in two ways. First, it increases the speed of the scrapers to adapt to the increased flow rate and solids loading. Redesigned scrapers can handle up to four times the amount of debris as earlier models. If the scrapers reach their maximum speed and head loss continues to rise, the bars will shift to a larger opening to allow more water to flow through (Figures 2 and 3).

The benefit of an adaptable bar screen is that it removes fine debris during the period when it is most concentrated and thus a potential problem for downstream processes. However, during peak events the screens will continue to filter out larger debris while mitigating the risk of potential backups.

Photos courtesy of Duperon

Figures 2 & 3. Adaptable bar screen in the closed/low-flow position (left) compared to the open/peak-flow position (right).

In addition, the ability to automatically adjust scraper speeds provides a number of significant benefits. First, it reduces labor as operators don't have to manually adjust speeds as flow increases. Second, it reduces the risk of rapid blinding during "first flush" events, which can cause dangerous backups and other problems.

As populations grow, many WWTPs begin to experience greater and greater peak flows. Initially, operators may choose to accept more frequent bypassing. Other times, plants may choose to change the bar screen to a larger opening. In rare cases, they may even look to install additional bar screens.

With this new technology, however, the same site can continue to screen at finer levels during normal flow. When peak flows exceed hydraulic capacity, operators can take advantage of the larger opening.

Accounting For Unknowns

When installing a new bar screen, there are a lot of unknowns. One of the primary unknowns is the speed at which flow increases and the size of peak events, which adaptable screens attempt to account for.

Another thing that's hard to anticipate is oversized debris. This can include construction debris, logs, and more. Oversized debris can force some screen systems to shut down until the object or objects can be removed manually. Those that can handle large debris often do so by lifting the entire scraper mechanism away from the screen until a scraper is able to grab the object. Once this oversized object has been removed, the scrapers then reengage the screen.

However, in situations like this, as the system is handling the oversized object, none of the other scrapers are removing debris. During high flows, this can result in excess blinding, head loss, and potentially dangerous backups.

Among the more advanced screen features is the ability to disengage scrapers one at a time. When large debris is presented at the screen, the links can disengage a single scraper (or two as needed) to remove that debris. The leading and trailing scrapers remain in the engaged position in the bar screen. This prevents blinding the screen while the larger debris is removed from the channel.

There are myriad variables in the WWTP environment, and each can present a risk. A bar screen is the first step in the wastewater treatment process. The more adaptable a screen system is, the more equipped it will be to handle the variety of challenges that can occur. ■