Global Wastewater Challenges Place Pressure on Aging Infrastructure

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Part 5 of 6

Shifting trends in water use and a changing sewage composition cause complex problems for the world's sewer systems.

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Fifth of Six Parts

Parts 1 through 4 of this series (Pumps & Systems, November 2015, December 2015, January 2016 and March 2016, respectively; read them here) discussed what engineers and facilities can do to minimize the risk of breakdowns resulting from new challenges in wastewater transport, including the increased use of so-called "flushable" wipes.

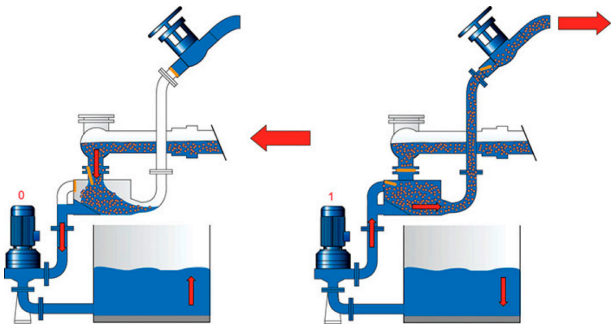
It is important to note that special side conditions or particular requirements that cannot be changed are increasing the risks associated with wastewater handling. One example is sewer pressure drainage systems that have long pipelines (high pressure) but low flow.

The combination of low flow, high pressure and high solids content with wipes should be a red flag that prompts engineers to consider more details in early stages of a project. Applications such as large stormwater retention tanks, which collect a lot of rags and have to be emptied in a short period of time, or pump stations that have dischargers but also low flow, such as those near retirement homes or hospitals, must be addressed carefully during the planning stage.

As mentioned previously in this series, sewage grinders can solve some of the issues with larger ragballs at these types of pumping stations; however, problems at the treatment plant will increase if the screen cannot stop the smaller particles going through the system. The chance that this content, full of small waste particles, will enter rivers and oceans is pretty high. As a result, it would be much better to pump the wastewater as it is up to the screen in front of the treatment plant and remove the wipes and fibers there.

Many of these challenges have been solved successfully in real-world applications, so some specific technical solutions are available. Outlined below are two proven options for very heavy cases.

As mentioned above, pressure drainage systems often are used for residential development areas. Most of the time, grinder pumps or pumps with vortex impellers are used. Both kinds of pumps have limits, especially when it comes to very high heads and low flow. In this case, it makes sense to use a solid-separation system. This innovative technology temporarily prevents solids and other sewage content from reaching the pump while allowing the pump to handle the complete content afterward (see Images 1 and 2). This process enables the hydraulic to use smaller free passages without clogging, leading to higher efficiency and a less limited head.



Images 1 & 2. A solid-separation system in the filling mode while the pump is not running. The system in the pump mode pushes the complete wastewater out in Image 2 (right)(Images courtesy of KSB)

The pumping process of the station runs in two phases. In the first step, wastewater runs into the

system. The pump and motor are not running. Because of a separating module in front of the pump, only pre-cleaned water goes into the pump and into the collecting sump. In the second phase, the pump will move the pre-cleaned water and push the other content, which was stored in the separation chamber on the pressure side. Cutting and shearing are not necessary, and the content can be transported up to the screen in front of the treatment plant.

This system has several options. It can be used as a wet pit system and with dry pit pumps. The combination with submersible dry pit pumps is also possible. While this system is proven in many heavy cases, it is not as well-known in the U.S. wastewater market.

To avoid trouble caused by clogging, another option is available for applications that face heavy conditions but need smaller equipment such as 4- or 6-inch pumps. These cases can incorporate a special impeller, which is based on the vortex principle but was designed especially for solving issues with wipes.

It is also a good option for applications where pumps that were running without breakdowns for a long time are no longer running reliably because of the new composition of sewage created by flushable wipes. Existing pumps can be outfitted with this particular impeller version.

The modification of this impeller makes it easy for the wipes to slide out, preventing the formation of a ragball. This impeller type also does not require a cutting or a chopping process. However, the efficiency will be a little lower than other designs, but the benefit of reliable operation is higher.

This impeller type is especially recommended for pumping stations that do not run continuously and are far in field. The effort and service time that would be required in the case of clogging would cost much more than the increased efficiency could save in the short time the pump actually runs.

In some cases, contents need to be handled at a smaller station for a treatment plant. After several years of good and reliable operation of one set of 4-inch dry pit pumps, the pumps began to clog because of wipes that were braiding. It was found out that a newly built nursing home was connected as a discharger. During previous years, the pumps worked fine with normal vortex impellers with a free passage of 4 inches. However, the pumps began to face new conditions.

The extended use of wipes and non-woven articles caused breakdown of the previously reliable pumps. The challenges of this particular case have been solved by the special vortex impeller.

The pumps and motors remained the same, but the impellers have been changed to a slightly different shape but with the same free passage.

Image 3. This normal wastewater hydraulic of 4-inch pumps faced too many so-called “flushable” wipes. The specially designed impeller solved the problem without needing to change the pump and motor.

Another case of a smaller pumping station (also using 4-inch pumps), which had to pump the combined wastewater of five stormwater retention tanks, also has been solved by the special impeller. A lake and a little harbor for boats are located close to the stormwater tanks. If the tanks are emptied after the storm, too many wipes and non-woven articles enter the flow, which needed to be pumped by the 4-inch pumps. Changing the normal vortex impeller to the specially designed impeller for handling wipes solved this application’s problems.

These two examples show that it is not always necessary to cut and chop the content of wipes. Different technology options are available to solve the unique challenges presented by modern sewage. Still, the best solution is to minimize the amount of non-flushable contents that are thrown into the sewers.