Global Wastewater Challenges Place Pressure on Aging Infrastructure

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Part 2 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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Second of Six Parts

Because of new challenges in sewage transport and handling as described in Part 1 of this series (Pumps & Systems, November 2015), innovative solutions are needed to address the problem of modern sewage requirements. While pumps that cut or squeeze are often specified for difficult wastewater applications, users must consider the whole process and compare the different methods and options.

Experience in drainage pressure systems over many years can indicate that cutter or grinder pumps in large collecting systems may have side effects. Some treatment plants claim that the fouling process is more likely to begin in the pipework if chopping or cutting processes are incorporated. If raw sewage is ground or chopped in the early stages, the loads will consist of small parts and the total surface area will be much larger than before. The organic parts will have this larger contact surface. This phenomenon causes the fouling process to begin in the pipework.

Normally, treatment plants must have full control of the processes to recycle sewage. Fouling before treatment may greatly increase odor in the pipes and pumping stations.

Biological treatment is a vital part of the process that produces the required water quality of the effluent. However, when substances that are normally filtered out by the screen become smaller, they have a much higher chance of passing through. Also, the specific weight of the materials is not high enough for them to settle down later in the precipitation tank.

What happens if non-biological waste makes it to the biological treatment process?

If all equipment is well-designed and the processes are running normally, the activated sludge is similar to water but with a brown mass of bacteria. The dry substance content, also called the TS value, may be approximately 2 to 3, while the bacteria may be visible as fine brown substances.

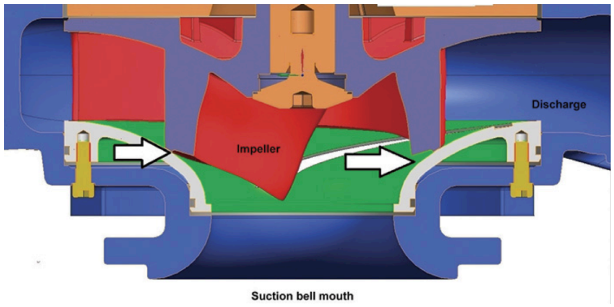

Figure 1. This diagram shows pumps with small free passage that need to squeeze or chop. The white arrows show the area where additional energy is needed, and the material affects the wear. (Images and graphic courtesy of KSB)

In some systems, however, pieces of fibers, hygiene products and other synthetics may be visible in the biological tanks (see Image 1). These materials cannot be recycled at this stage by biological treatment. The screen—one of the first steps in the treatment plant—should remove these non-biological materials. All the remaining non-biological ingredients are obstructions in the treatment process. If pumps continue to chop the braided wipes and other loads, treatment plants may increase the disposal and treatment challenges.

Image 1. A sludge tank for biological treatment contains disposals that should not be found in this step of the sewage-treatment process.

Image 2. The biological tank containing sludge is part of the sewage treatment process.

While breaking non-biological materials into smaller parts can pose challenges for the biological treatment process, these rags and fibers in sewage are difficult for any facility to handle, especially in the modern world when people are using more wipes and other synthetics that enter wastewater.

One possible solution for these challenges is a type of pump that could handle any wastewater load without an extra chopping process. Some manufacturers refer to the high efficiencies of pumps that chop but do not have the free passage required in the 10 States Standards from the Great Lakes-Upper Mississippi River Board. But the high efficiencies are not performed in the real wastewater world. Pumps that are tested in clean water and do not need a large free passage (minimum of 3 inches) show good efficiencies in factory tests. In real-world operation, however, these pumps are faced with large quantities of fibers, rags and synthetic materials that negatively affect those efficiencies.

Any cutting, chopping or shearing process requires additional energy. Especially in pump models with retractable impellers, the reduction in efficiency is significant (measured up to 25 percent). Extending the wear of the clearance to pass the loads will impair the impeller blades' efficiency. Pumps in fiber- and wipe-laded fluids that have to chop and squeeze cannot perform at the same efficiencies certified from tests in clean water.

Engineers who select chopper pumps often put additional energy reserves into the motors. Power use can increase by 25 percent as compared with normal power, usually taken for the duty point.

When the pump is in operation, the shear process begins to wear much more than for any other hydraulic because of friction—this is where the additional energy travels. It starts at the edge of the blades, but it does not stop there. Often, the complete hydraulic is attacked. After a certain time operating in wastewater, the pump will face a decline in efficiency as compared with water-tested values. To minimize this effect, the impeller could be adjusted, but this effort often will be skipped.

Handling today's wastewater—laden with high loads of wipes and rags—with free passage to get the fibers through instead of shearing the load may help prevent:

- High wear and tear on blades
- Less efficiency from fast wear
- Higher lifetime costs because of the need for spare parts

- Higher expenses because of special hard materials against the additional wear
- More effort required for adjusting the impeller
- Fouling in the pipework
- Odor in the wastewater collection system
- Small parts of synthetics passing the screen and reaching biological treatment, where the tank cannot get rid of it

While some chopper pumps may pose disadvantages, they can help prevent equipment breakdowns in the station. Depending on the application and specific situation, different technologies and methods may be employed. Either way, users must understand all of the benefits and disadvantages of each option.