Optimizing Performance in Industrial Wastewater Treatment



This article will illustrate how an integrated wastewater treatment system, with many different types of equipment working hand-in-hand; specifically metering and peristaltic (hose) pumps, and polymer make down systems - can be used in a straight-line treatment process.

By Greg Kriebel & Ravi Prasad

Since the beginning of time, people have had the need to treat the water they consume, and use for cooking, bathing and washing their homes and cooking utensils.They have also needed to find ways to properly treat and dispose of the water that has been fouled through the course of its use-in latter centuries most commonly during industrial production activities.

When people hear the phrase "water treatment," however, the first thought that comes to mind is taking water that will be used in domestic settings and removing any impurities, in the process making it safe to drink, cook with, bathe in and wash clothes with; in otherwords, "municipal" water treatment. But from a broader perspective, the term water treatment can have a number of completely different meanings. In industrial applications, for instance, water can be taken from a nearby river and used for boiler or cooling-tower make ups. In the oilfield, water that is used or produced during the drilling and recovery process can be treated and sold to farmers for use in field-irrigation activities.

This article will illustrate how an integrated wastewater treatment system, with many different types of equipment working hand-in-hand; specifically metering and peristaltic (hose) pumps, and polymer make down systems - can be used in a straight-line treatment process.This will deliver the most cost-effective and efficient way to treat industrial wastewater, all while making it safe for disposal or reuse in any number of additional activities.

The Challenge

Most of the water used or produced in industrial applications contains some level of solid particles. It goes without saying that these particles should not be consumed, but particle-laden water also can't be used, for example, in a boiler that provides steam to a turbine during power generation, lest the turbine become fouled and damaged.

Recognizing the presence of particulates in water and successfully removing them, however, are two different things. Some of the particles - which can be anything from bacteria and plant material to dirt or minuscule pieces of crushed stone - are so small that their response to gravity is very low.

In other words, they don't fall through water at a consistent rate because their mass is so small and not impacted by gravity. This means that it may take many hours, days or even weeks for the particles to settle as little as a foot. This is an unacceptable, and unpredictable, settling rate for a water or wastewater treatment system, so the particles need some help insettling or clumping.

To speed along the settling or clumping process, the water-treatment facility must turn to the introductionof a coagulant or flocculant that helps the tiny particles clump together in a mass that is called a "floc," which is easier to remove. Two of the more popular types of coagulants/flocculants that are used in water/wastewatertreatment are:

- **Alum:** A more economical way to say "hydratedpotassium aluminum sulfate," alum has been used since Roman times to aid in the purification of drinking and industrial process water. Alum coaxes negatively charged colloidal particles to clumptogether so they will be able to be more easily removed from settling basins.

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- **Ferric chloride:** Another name for Iron (III) chloride, ferric chloride undergoes hydrolysis when dissolvedin water, which gives it the ability to sufficiently form suspended solid particles into flocs.

While quite effective in creating flocs, the flocs that are formed by alum and ferric chloride are held together rather loosely, which means that they can break apart if agitated as they settle in the clarifier or settling basin. Eliminating this break-up potential requires the introduction of a polymer solution that helps form more efficient flocs. The polymer takes the neutralized solid particle clumps and binds them together more tightly.

The clumps that settle in the basin form a material that is called "sludge." The use of alum by itself leads to thegeneration of a large amount of sludge; the introduction of polymer helps further coagulate the sludge. However, the sludge that is produced still needs to be removed and disposed of. Accumulated sludge can be collectedand sent away to some place like a centrifuge, or just piled up on the ground outside the water treatment facility, allowed to dry and then removed via front-end loader and dump truck.

Removing the sludge from the water requires a pump that can run dry and won't be bothered by abrasive materials. In other words, a pump that has the capability to take whatever flows into it - no matter its makeup – and deliver it out the discharge side in that same form.

The Solution

Industrial water or wastewater treatment, then, is a three-stage process that must work hand-in-hand:

- initial floc formation with alum and ferric chloride
- clump strengthening with polymer
- removal and disposal of the sludge.

Not all manufacturers of wastewater treatment equipment are able to offer full lines of pumping and polymer-blending technology for the required water treatment applications. However, PSG®, a Dover company, does feature fulllines of pumping and polymer-blending technology for industrial water or wastewater treatment applications. Specific water treatment technology includes:

Neptune™ 7000 Series Mechanical Diaphragm Metering Pumps

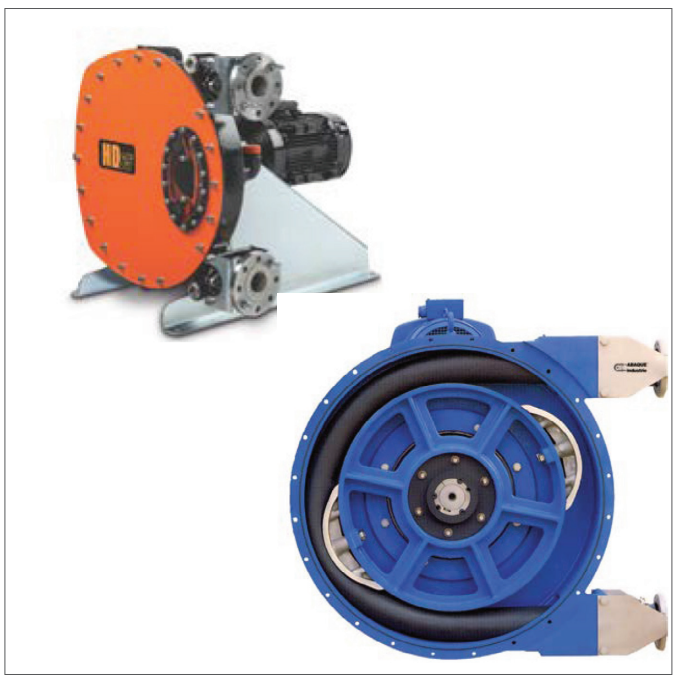
- **Mechanical Metering Pumps:** Ideal for dosing alum and ferric chloride, these mechanically actuated pumps eliminate the use ofcontour plates on the liquid side of the diaphragm, resulting in a simple, straight-through valve and head design that allows improved flow characteristics.They have been designed to handle clear liquids with viscosities ranging from water like to 5,000 cPs, making them ideal for use in industrial water and wastewater treatment applications. The capacity of the 7000 Series pumps is manually adjustable viamicrometer dial while the pump is running. This allows the pump to produce flow rates ranging from10 gph to 450 gph (38 L/hr to 1,710 L/hr) at head pressures up to 150 psi (10 bar). The pump's liquidends are constructed of PVC, 316 stainless steel or Kynar. Wash down duty and explosion-proof motors, as well as variable frequency drive options, arealso available. The pumps are also self-priming.

- **Liquid Polymer Blending Systems:** Fluid Dynamics, which is a division of Neptune, has designed the dynaBLEND with a non-mechanical mixing chamber that allows it to deliver an unequalled degree of reliability whenactivating all types of liquid polymer for use inwater or wastewater treatment. The system's injectioncheck valve has been designed with easy disassemblyand inspection in mind, eliminating a maintenanceconcern that troubles other systems. These features allow the dynaBLEND to apply ultra-high mixing energy at the point of initial polymer and watercontact to prevent polymer gelling and agglomeration. The prolonged turbulence that the dynaBLEND process creates allows the polymer to complete theblending process gently and fully. Finally, after thepolymer is initially activated, the dynaBLEND's gentle mixing energy does not break the fragile long polymerchains that have been formed.

- **Peristaltic (Hose) Pumps.** Featuring a design that ensures that "whatever goes into thepump comes out of the pump," Abaque pumps can handle solid particles up to 18 mm (0.7") and softparticles as large as 31 mm (1.2"), making them a top choice for sludge removal. They feature a seal-freedesign that eliminates leaks, which enablesthem to handle the wastewater industry's toughestpumping applications, from abrasive and aggressivefluids to shear-sensitive and viscous materials. Thepumps, which can run in either forward or reverse, are self-priming, dry-running and offer suction-lift capabilities to 9 meters (25.5 feet), as well as theability to

Abaque_skid-system

dynaBLEND™ Liquid Polymer Blending Systems



Abaque® Peristaltic (Hose) Pumps

run dry continuously without adverselyaffecting the pump's performance. Ductile-iron andsteel construction lets the pump produce discharge pressures as high as 16 bar (232 psi). The Abaque's pump hoses are available in three materials ofconstruction: natural rubber, EPDM and Buna N.

Conclusion

A wide variety of industries uses untold millions of gallons of water and produces untold millions of gallons of wastewater each and every day. Properly handling and disposing (or reusing) this wastewater requires a numberof stages that must work together seamlessly, from alum and ferric chloride introduction, to polymer injection, to sludge removal. Each stage requires a different type oftechnology, which can often have the wastewater-plant operator moving in many different directions to identifya solution.

About The Authors

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