CaseHistory

Thickened Waste Activated Sludge Pumping Made Easier

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With three major plant expansions since 1957, the City of Las Vegas Water Pollution Control Facility (WPCF) capacity has steadily increased. Because of this increase in population growth and treatment capacity, new equipment has been installed to further enhance the treatment of influent, effluent, storage, discharge, and disposal of waste by-products. An integral part of this treatment is the processing of thickened waste activated sludge (TWAS) from the facility's thickened sludge systems to its anaerobic digesters.

TWAS the Problem

In the past, the WPCF used two PC pumps to transfer the TWAS to eight digesters, with the furthest units located at about one-quarter mile from the TWAS building. Since the TWAS is thickened to between 5 and 6%, this distance created a pumping bottleneck. The single-stage pump units were simply unable to transfer the 6% TWAS to the most distant digesters. Excessive pressure on the pumps caused an overload condition, in which the pumps would automatically shut down. To continue production, the facility had to thin out the TWAS to 4% solids. This meant losing digesting capacity as unnecessary water filled the system.

At the same time, the previous pumps required continuous maintenance. It required between 15 to 20 work hrs/wk for operators to inspect the pumps and flush out the system to keep the TWAS operation free flowing. It is common with all progressive cavity pumps to derate the pressure capacity on abrasive applications, which is one of the reasons that the installed units failed so frequently.

Looking for Solutions

To remedy the situation, WPCF first considered installing four-stage pumps, which were recommended by the original pump supplier. Original thought was that no more than 30 psi per stage (pressure) was prudent for satisfactory longevity on sludge. This was an expensive alternative, not only because the units would cost more, but also because modifications to the TWAS building would be required, such as the plumbing system and centrifuge discharge chutes. Increased electrical costs to drive the larger pumps and the larger variable frequency controls would be incurred as well.

When they were operational, the original single-stage pumps operated at an overall efficiency of nearly 60%. The four-stage pumps would operate at only 37% efficiency and repair parts, in some cases, would be four times as expensive as the single-stage pumps.

In light of this, Cortech Engineering, an Anaheim, CA-based fluids handling firm, supplied the facility with two Model BTQP pumps manufactured by Seepex, Inc., of Enon, OH. Each two-stage pump consists of a carbon steel housing, Duktil-coated hardened tool steel rotor, and a molded-to-size Buna N stator. In addition, the units are equipped with a special feature designed to keep maintenance costs low while pumping high-solids sludge: a device for readjusting stator tension.

The two-stage pump became a crucial element in TWAS treatment.

The adjustable stator retensioning device, which consists of an adjustable stainless steel sleeve with an internal rubber lining and a series of adjusting bolts, reduces the circumference of the worn stator. In this way, the original compression force between stator and rotor can be restored, increasing the time between stator replacements. The device, which costs less than half of a replacement stator, typically increases stator service life by 300% and saves labor costs when disassembling the pump to replace a stator. The two-stage pumps operate at 47%

efficiency and spare parts costs are half of what the four-stage pumps cost. The stator retensioning device has increased longevity for the WPCF equal to or better than the four-stage pumps.

Tangible Results

Originally built in 1957 with a design capacity of 20.5 MGD, the expanded plant now operates at about 54 MGD, with a design capacity of 66 MGD, and expects to increase capacity another 33% by the year 2000.

The facility employs a conventional activated sludge process that produces a final treated effluent much lower than the limit of 30 mg/L for both BOD and suspended solids, and a seasonal limit of 138 lbs/day phosphorous, 401 lbs/day on ammonia which is discharged into Lake Mead. It is in operation 24 hrs a day, 365 days per year.

After wastewater goes through primary and secondary treatment, waste activated sludge (WAS) in the WPCF's six clarifiers is transferred to its sludge thickening building, which houses two 250 GPM centrifuges, only one of which is used at a time. The high rotational speed of the centrifuges concentrates the WAS from about 0.7% solids to approximately 6% solids. The system operates 24 hrs a day, 5 days per week, and occasionally longer.

From the centrifuge building, the TWAS is pumped to one of eight digesters, which incorporate a continuous sludge recirculation system. During the process, sludge gets removed from the system, is dewatered, and the resulting 23 to 25% solids sludge cake is taken to a landfill at a rate of about 250,000 lbs a day.

The 0.7% solids WAS is dewatered by the centrifuges to 6% solids and gravity flows into hoppers, located above the PC pumps. From there, the dewatered sludge enters a pump's feed hopper, and since the conveying capacity of the feed screw is greater than that of the pump, internal pressure and shear builds up, continuously filling the cavities between rotor and stator with the TWAS. The new pumps then transfer the sludge to even the most distant digesters at 35 GPM, without interruption.

The pumps were installed with only minor modifications between the centrifuge drop chute and the new pumps. Power supply and VFD requirements remain unchanged, and the pumps have experienced no overheating conditions.

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