



# Pumping Acid and Alkaline Fluids

Thermoplastic materials provide needed strength and corrosion resistance when needed.

>> BY LAWRENCE LEWIS, PRESIDENT, VANTON PUMP & EQUIPMENT CORP.

**K**aneka Texas Corporation, the U.S. subsidiary of the Kaneka Corporation of Japan, manufactures a variety of specialty polymers and fine chemicals. For several applications handling wastewater and circulating scrubbing liquids to control air quality, the company's Pasadena site relies on tough thermoplastic pumps to ensure reliable operation under corrosive conditions.

## Handling acidic and alkaline effluents

One of the site's three main processing units manufactures MBS, a methacrylate butadiene styrene copolymer. This white powder is used as an impact strength modifier for PVC. For applications such as clear PVC plastic bottles, adding around 10 percent of MBS increases the impact resistance of the PVC without decreasing its transparency.

Like most fine chemical operations, the MBS plant needs a plentiful supply of demineralized water, explains former plant technical manager Paul Franks, who retired

and now works for the company on a contract basis.

In the plant's utility area are several water demineralization units. The largest of these, installed in 1997, uses ion-exchange technology to remove dissolved substances from the incoming raw water. To maintain their performance, the ion-exchange beds need to be periodically regenerated using strong acids and alkalis. The regeneration process yields an acidic effluent from the cation resin bed and an alkaline effluent from the anion bed.

Both streams discharge into a lined sump measuring 25 by 13 by 8 feet deep. An agitator in the sump combines the acidic and alkaline streams to create a mixture with a pH close to neutral. This mixed effluent is then pumped to the site's common wastewater pit, from where it is transferred by pipeline to a public waste treatment plant three miles away.

## Polypropylene pump prevents corrosion

The pump originally installed to empty the agitated sump



was prone to corrosion despite being made from stainless steel. Because it proved to be unreliable and was not self-priming, Franks said the pump was circumvented as standard practice.

Instead, operators allowed the liquid effluent to overflow from the agitated sump into a backup sump that had been installed when an additional demineralization unit was added to meet an expansion in plant capacity. The backup sump is equipped with a thermoplastic vertical sump pump whose corrosion resistant, chemically inert thermoplastic components were impervious to the aggressive fluids. The pump has performed reliably since being installed, and indeed became the usual means of transferring demineralizer effluent received from the agitated sump to the plant's common wastewater pit.

Because the stainless steel pump in the agitated sump was inactive, a failure of the thermoplastic pump in the backup sump would require plant operators to use a portable air-operated diaphragm pump to empty both sumps – a time-consuming and potentially hazardous procedure. If the wastewater could not be pumped out quickly enough, the resulting shortage of demineralized water would limit plant production. Kaneka sought to avoid this situation by finding an alternative to the stainless steel pump for the agitated sump.

Corrosion resistance was a priority, because the individual effluent streams are strongly acidic and alkaline – and are highly corrosive until achieving near-neutral pH when fully mixed in the ideal proportion. If volumes of the acidic or alkaline streams vary, however, the resulting mixture attacks metals, as evidenced by corrosion of the stainless steel pump, as well as the steel walkway supporting the pump and fiberglass reinforced plastic (FRP) agitator.

“We knew we wanted a thermoplastic pump for corrosion resistance,” said Franks. “We did consider plastic-lined steel pumps, but we opted for all-plastic pumps because we previously had good experience with [previous] pumps.... A vertical sump pump would have required structural steelwork, so we decided to avoid that cost by specifying a self-priming, horizontal pump.”

The self-priming horizontal centrifugal pump chosen has 2 inch nozzles and is rated for flows of 120 gallons per minute (gpm) against 90 feet of head. All wetted components of the pump are injection molded chemically inert polypropylene, eliminating any fluid/metal contact.

With a suction lift of around 8 feet, there were some initial concerns about the pump's net positive suction head requirement, but local pump representative Ron Merrill of RE Merrill & Associates, Houston, confirmed that the horizontal pump would do the job.

### Protecting against dirt and dry running

The waste streams from the demineralizer also contain dirt and organic compounds removed from the raw water by



The cantilevered design of Vanton's SGK PY1200 sump pump eliminates wetted bearings, allowing indefinite run-dry capability and reliable starts following extended idle periods. All wetted components are made of solid CPVC, which is abrasion resistant, and inert to the broad range of acidic and caustic fluids collected.

the ion exchange beds, as well as particles of ion exchange resin. “It's not the cleanest fluid, and there is a persistent residue of foam on the walls of the pit,” said Franks.

To shield the pump's single mechanical seal from suspended particles, the seal has a simple, once-through water flush via a 10-micron, single-element cartridge filter. “We might have gotten away without a seal flush, but I believe in protecting seals,” said Franks.



The pump's primary protection against dry running is a low-level shutdown switch installed in the sump. In the unlikely event of a switch failure, secondary protection is afforded by a 3 gpm flow of clean water to the pump suction, protecting the pump case, seals and bearings from overheating.

The polypropylene pump was installed in August 2010 and has been reliably running since, according to Franks. "After its initial priming, the pump has not lost prime, and it empties the pit in approximately two and a half hours," he said. Should the agitator ever break down, the pump would have no trouble handling the unmixed acidic and alkaline effluent streams.

### Handling acidic wastewater

Another unit at the Pasadena site manufactures CPVC (chlorinated polyvinyl chloride), which is widely used for fire-resistant piping, electrical fittings and other products requiring high temperature and impact resistance as well as broad chemical resistance.

Maintenance engineer Peter Whitley explains that CPVC's main ingredient is PVC powder, which is received by rail. The powder is suspended as slurry in water, and chlorinated via a photochemical reaction. The resulting CPVC powder is then washed in a series of centrifuges, dried and then packed. Any free chlorine left after



Vanton's Prime-Gard PY450 horizontal self-priming thermoplastic centrifugal pump efficiently transfers demineralizer effluent.



the chlorination reaction ends up as hydrochloric acid in the wash water, so wastewater treatment must be carefully addressed and corrosion is a potential problem.

Under normal operating conditions, the pH of the wastewater from the CPVC plant is close to neutral. Previously, the wastewater collected in a sump from where it flowed by gravity to the site's common wastewater pit before being pumped to the municipal treatment plant.

But occasionally, a process upset would occur, and the wastewater from the CPVC plant would become acidic to the point where direct discharge to the offsite treatment plant would have violated the plant's discharge consent. The company therefore decided to install a second sump, approximately 4 by 6 by 8 feet deep, in which any acidic wastewater could be neutralized by adding powdered limestone. This has now become the standard method of operation.

To transfer wastewater from the first to the second sump, the company installed a thermoplastic vertical cantilevered sump pump.

The pump has 3 by 2 inch nozzles and is rated at 340 gpm against a total dynamic head of 85 feet. All fluid contact parts are of solid, inert polypropylene. The large-diameter, stainless steel, cantilevered shaft, which is sleeved in thick-sectioned polypropylene, eliminates the need for a submerged bearing, allowing the pump to run dry for indefinite periods with no damage.

In normal operation, the pump starts frequently and runs for a few minutes at a time, controlled by low- and high-level float switches. The pump has operated in this manner since being installed in February 2009, and according to Whitley, has run without incident.

### Circulating hydrochloric acid

Following the washing process noted above, the CPVC powder is dried using heated air, which picks up acid vapors. Before this air can be discharged to the environment, the acid is removed by a venturi scrubber, and then a 20 inch diameter packed tower.

For both devices, the scrubbing liquid – a 1.5 percent hydrochloric acid solution – is circulated by another thermoplastic pump.

All wetted components of the pump are injection molded of inert PVDF. The pump has 4 by 3 inch nozzles and runs at 1,800 rpm, providing a flow rate of 340 gpm against an 85 foot total dynamic head. Although corrosive, the fluid is fairly clean, Whitley said, requiring a single mechanical seal with an external water flush.

This pump dates from the original construction of the CPVC plant, in July 2008, and was supplied

with CPVC and FRP pipework as a packaged unit. Since then it has run continuously, according to Whitley, halting only when the plant shuts down for three days once a month, and has otherwise operated without interruption. ■

Lawrence Lewis is the president of Vanton Pump & Equipment Corp. Call (908) 688-4216 to ask for more information on this project.

# COMPARE

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All wet end components of Vanton centrifugal pumps are molded of solid PVC, PP or PVDF, and handle flows to 1450 gpm (330 m<sup>3</sup>/h), heads to 400 ft (122 m) and temperatures to 275°F (135°C).

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