TECHNICAL ARTICLE SERIES

Thermoplastic Pumps

ARTICLE # TL-115

INDUSTRY: Chemical

ENTITY: Wheaton Glass Products

SOLUTION(S) PUMPED: Hydrofluoric acid

PUMP TYPE(S): CHEM-GARD Horizontal Centrifugal Pump

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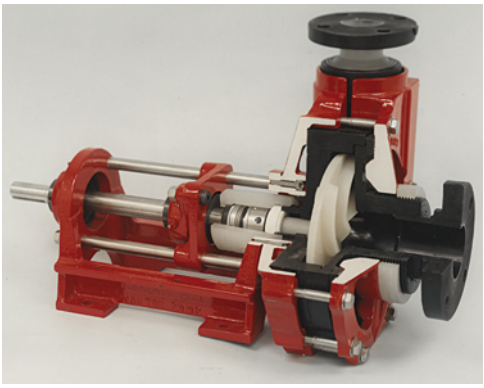


Cut-away of Vanton Chem-Gard® polypropylene pump with PVDF impeller and PVDF thick sectioned shaft sleeve. These horizontal centrifugal pumps helped solve the severe corrosion/abrasion problem created by the pumping of an etching solution of hydrofluoric acid and a proprietary powder compound. Both metal and FRP pumps previously specified for this service resulted in repeated failures and costly maintenance.

Thermoplastic Pumps

Reprinted from CHEMICAL PROCESSING
By Brayton O. Paul, Technical Editor

Plastics, alloys meet challenges of hydrofluoric acid etching

Wheaton Glass doubles production without speedup, reduces rejects to almost zero.

The Decora Division of Wheaton Glass Products, a division of Wheaton Industries in Millville, NJ, eliminated downtime, doubled production and reduced its output of rejected product to almost zero by eliminating slurry settling and hydrofluoric (HF) acid corrosion problems in its frosting process.

The frosting department was having difficulty using a slurry of HF acid and solids to etch designs onto glass bottles. The content of the proprietary gritty solid compound was between 30% and 50%. If the slurry stagnated, abrasive particles settled out of the solution to form a concrete-hard solid. But Wheaton Glass Products' larger problem was corrosion.

"When I transferred from corporate engineering in 1984, I was told the problem in the frosting department was solids settling out of suspension in the etching tanks. As I started to investigate, I found settling was only part of the problem; corrosion was a major issue. I had to solve the whole problem," says Peter R. Shadinger, P.E., project manager for the Decora Division.

Production: out of control

Every two hours, operators of the two existing lines —one manual and one automatic —needed to stop production to stir the HF slurry with a wooden paddle. On the manual production line, operators briefly immersed 30 to 50 bottles for frosting in the vat. On the automatic line, which resembled the manual line, the bottles were attached to a stainless-steel chain. Neither the wood nor the carbon vat, both of which were about 2 cu. ft., had sufficient space for agitators. Production personnel also experienced problems with a new glass formula that would not frost properly.

Before Shadinger became project manager, one ½-hp plastic circulation pump with stainless internals operated adjacent to each of the two vats. Each vertical centrifugal pump was too small to keep the vat agitated. After about two months of continuous service, the stainless-steel internals within the preserved plastic casing would corrode, resulting in the need to replace the pump. These frequent replacements continued for three years.

"The process was out of control. Production had no temperature or solids-mixing controls. Sometimes production stopped for hours because the temperature was wrong." Glass does not frost below 70°F, and HF acid fumes above 90°F.

System redesigned with plastics

"Someone before me had purchased a 3-½-hp plastic pump with 120-gpm capacity. There were no provisions for its use or process modifications. I had to redesign the whole system before I could install the pump.

"First, I redesigned the vat on the manual line." The vat's pump handled the corrosive nature of the slurry, but its capacity was undersized. Shadinger designed a holding tank to feed the pump. The pump discharge went to the existing vat and then overflowed into a new holding tank.

This system was a significant improvement because the operators only needed to stir the slurry once during each eight-hour shift, rather than every two hours. (The vat still had to be cleaned weekly.)

Next, Shadinger redesigned the vat, adding a mixer. After the redesign, the operators needed to stir the vat only once a week.

Shadinger tested many materials to handle the severe corrosive nature of the HF acid slurry. Originally, he specified only polyvinylidene fluoride (PVDF), but he found that some components of the system were unavailable in that material. Then, he tried polypropylene, which, at half the cost, has become the preferred material of construction for the vats and pump casings. The pump impellers are still specified in PVDF. To maximize corrosion resistance, the pump design eliminates all metal contact with the slurry. The stainless-steel shaft is isolated from the fluid by a thick-sectioned PVDF sleeve. The mechanical seal is reverse-mounted, so metal components are outside of the wetted area.

Shadinger replaced the original corroding stainless-steel pipe with new schedule 80 polyvinyl chloride (PVC) glued and backwelded pipe and fittings.

Stainless-steel immersion heat exchangers were installed to control the temperature to ±2°F. "They cost a fortune, and they didn't last long." To save money, the plant eventually replaced the original heaters with units made of standard freon-grade copper tubing assembled with 45% silver brazing alloy.

The chain on the automatic line rides on a metal angle about 1 in. directly above the acid vat. Splashing corroded the original ¼ x 2 x 2 stainless-steel angle continuously, necessitating its annual replacement. Shadinger replaced the stainless steel with a nickel-based-alloy fabricated angle.

The chain's original stainless-steel sprockets also needed frequent replacement. Four years ago, Shadinger replaced them with sprockets made from ultra-high molecular-weight polyethylene (UHMW-PE).

No more paddles

Today, the tanks are twice their original size and the pumps three times the original capacity. The polypropylene pumps with PVDF impellers are driven by 7-½-hp electric motors at 1,750 rpm and are rated at about

300 gpm. At about 200-gallon slurry volume in the tanks, the turnover rate is 1.5 per minute. "We eliminated the hand paddle," Shadinger says.

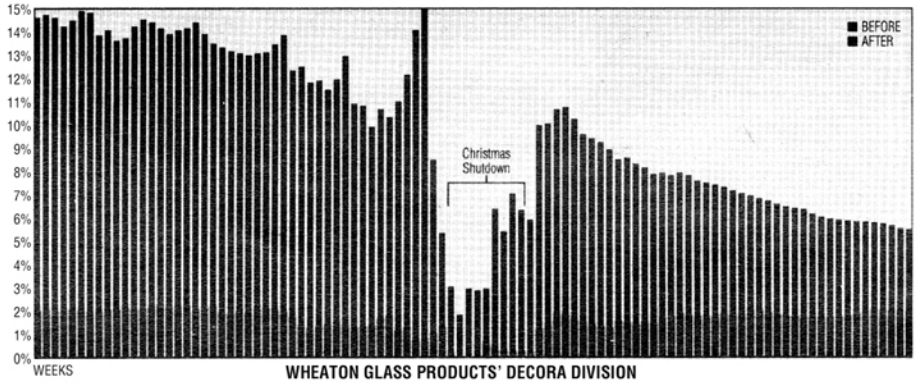
"Originally, we stirred the vat four times per shift with a wooden paddle. We drained it every weekend. After the larger pump was installed, we didn't use the wooden paddle, but we still drained the vat every weekend. Now we don't do anything, we just run it. We haven't drained the tank in six or eight months, and there is zero settling in the bottom."

Shadinger says that production has increased 10% per year since 1989. Water consumption is down 10-fold. The increase in production is the direct result of keepinq the production line operating without shutting it down for stirring or temperature control. There is no unscheduled downtime.

Improved quality

Before Shadinger's transfer, 5% held ware (rejected product) was the target production standard, although 20% was common. Today, the product is more uniform. Held ware, which is near zero, is no longer recorded.

Changes in materials of construction have reduced maintenance. Neither the nickel-based alloy angle that conveys the production chain above the automatic system vat nor the polyethylene sprockets for the chain have been replaced since installation four years ago. Shadinger says each copper heat exchanger lasts for several years. The only problem the plant is having with the pump is that the seal lasts only about one year, but Shadinger says, "We are really happy with that."



An Analysis of Wheaton Glass Products' Decora Division's rejected items shows a reduction from 14% to less than 2% after corrosion and settling problems in the glass-etching process were solved.

WHEATON INDUSTRIES 100TH ANNIVERSARY

Wheaton Industries celebrated its 100th anniversary in 1988. The company began as T. C. Wheaton Co., when Dr. Theodore C. Wheaton, a pharmacist and practicing physician in Millville, NJ, purchased a fledgling glass company after having loaned it money. T. C. Wheaton Co. became nationally recognized as a manufacturer of drug and tablet vials. The company provided glass products to scientific laboratories, pharmacists, physicians, manufacturing chemists and perfumers. Today, Wheaton Industries is still a privately held firm.

Wheaton Glass Products, a division of Wheaton Industries, produces containers for the pharmaceutical, health-care, cosmetic fragrance, personal care, beverage, food and household industries. In addition to the manufacturing plant in Millville, NJ, Wheaton Glass Products, which has 3,400 employees, comprises five companies with 19 plants in the United States and Puerto Rico. The company specializes in executing challenging glass container designs.