Freeing Process Water of DebrisWithout Filter Maintenance

Self-cleaning filters eliminate problems without downtime

'Heat exchangers, molds, pipes, tubing, sensors, monitors and other parts become fouled when dirt particles in the water settle out on warm surfaces.' 'Installing self-cleaning filters in three lines in the plant eliminated buildup and the need to shut down equipment for maintenance.' By Gideon Brunn

[1]

Water is the life force in process manufacturing operations. It cools and cleans, and it can be counted on to run pure and steady unless it becomes contaminated with dirt and other pollutants that gum up systems, impede operations and impair product quality as shown in Figure 1. Heat exchangers, molds, pipes, tubing, sensors, monitors and other parts become fouled when dirt particles in the water settle out on warm surfaces. This particulate is then cemented onto the equipment by calcium and magnesium. It doesn't take much calcium and magnesium to accelerate fouling. Chemical analysis shows that they are less than 2 percent of the fouling material. The rest is made up of airborne particles, rust, sand, biological organisms and other contaminants. The result is scale formation, which reduces the heat transfer rate and increases the water pressure drop through the heat exchanger and pipes. One study from the Carrier Corp. in Syracuse, NY, demonstrated that 0.002 inches of fouling increases pumping needs by 20 percent. Further, fouling of 0.006 inches means that pumping requirements increase by around 65 percent as depicted in Figure 2.

Filtration Alternatives

[2]

It is important to understand that not all water filtration systems are alike. Carbon and sand filters, for example, require regular maintenance that can result in downtime and higher labor costs. Similarly, cartridge filters can become very expensive over time, either due to the high cost of cartridges or because plant staff consume too many hours in changing filters. A possible alternative is a self-cleaning filter. The best ones actually require no maintenance. Such filters are being used in the process field by companies such as Smuckers, DuPont, Colgate, Proctor & Gamble, Dow Chemical, Milliken, Bruce Foods and Indiana Packers. As dirt particles collect on the screen, the line pressure at the filter outlet drops. When the pressure reaches a preset differential, the backwash cycle begins. Within seconds and without interrupting the main flow, vacuum nozzles aggressively suction the dirt from the inside of the screen. This inline full-flow automatic filter is one solution for

cleaning dirty water and preventing unscheduled shutdowns for maintenance and cleaning. Such an automatic, self-cleaning filter is suitable for a range of applications.

Example: Corn Wet Milling

Grain Processing Corp. (GPC), for example, is one of the country's largest corn wet milling companies. Founded in 1943, it manufactures and markets corn-based products worldwide for the food and beverage, industrial, pharmaceutical and other industries. While its primary corn materials are simple, the array of products it produces would make George Washington Carver &#151 the agricultural chemist who found more than 300 uses for peanuts &#151 proud. GPC makes corn starches for food additives, grain alcohol for beverages and industrial applications, ingredients for pharmaceutical and beauty products, animal feed, super absorbent polymers for aqueous solutions and de-icing products. Recently, it even launched its own line of cat litter. Its headquarters, R&D and main production facility are in Iowa. It also owns a secondary production facility in Indiana, which makes grain alcohol, corn starch and feed byproducts. Unfortunately, solids in the process water were clogging heat exchangers and nozzles. These heat exchangers helped the plant cut its power costs but only as long as the water could move freely through them. Yet GPC measured this particulate running as high as 12 percent. As the solids built up, the equipment would have to be pulled offline every two to four months for cleaning. This task would take a maintenance crew several days to complete. GPC had tried some cartridge filters, but they needed frequent cleaning. As a result, it decided to experiment with self-cleaning filters. Installing self-cleaning filters in three lines in the plant eliminated buildup and the need to shut down equipment for maintenance. It also reduced maintenance manpower costs, cut maintenance materials costs, extended useful life of materials and boosted energy efficiency. "We use self-cleaning filters in the feed and milling area where we bring the corn in and do all the separation," says Derrick Biggs, the maintenance supervisor who works at the Indiana facility. "Our main goal is to get the corn starch out, convert the starch to sugar and the sugar to alcohol." These filters incorporate an automatic cleaning mechanism that allows an uninterrupted flow of filtered water even while the cleaning takes place. The procedure uses a fraction of the water that normal back-flushing requires. The filters also use stainless steel as the standard rather than a special order option in order to provide a longer lasting filter. In this design, the dirty water flows in around the outside of a coarse filter that removes the larger particles. This pre-filtered water then flows to the other end of the filter housing where it passes from the inside to the outside of the final filter and then through the outlet. Over time, as the filter removes particles from the water, those particles clog the filter, reducing water flow and water pressure. At the outlet is an adjustable pressure differential switch, typically set at five to seven pounds. When that threshold is crossed, it opens the small flush valve, which initiates the cleaning procedure. [3]

Instead of taking the full water flow to initiate a complete backwash, self-cleaning filters have a number of small cleaning nozzles arrayed around a central shaft. Opening the flush valve lowers the water pressure within the cleaning unit, and the nozzles vacuum the dirt from the inside surface of the filter screen. A

hydraulic motor and piston cause the nozzles to rotate and move axially in order to cover the entire screen surface in five to 10 seconds. At that point, the flush valve closes and the cleaning mechanism returns to its starting position. Other than a small control voltage for the differential pressure sensor to actuate the flush valve, all motions involved in cleaning the filter are performed using the water pressure as shown in Figure 3. Biggs started experimenting with the filters on one of the heat recovery exchangers and, after it had proven its value, installed a filter on a second one. "They definitely saved us a lot of manpower in cleaning the heat exchangers and replacing gaskets," he says. "The gaskets are extremely, extremely expensive, and every time you take the heat exchangers apart, you most likely have to replace them." From there, he started using them on a cloth wash system, which uses rotary vacuum drum filters. Particulates were clogging the nozzles in the cloth wash, requiring the operators to go in and unplug them. By using self-cleaning filters, the nozzles stayed open and the cloth wash did a better job, allowing them to get more capacity out of each cloth. Biggs reports that he now has four filters in use, and based on the success at the Indiana facility, GPC also started using them at its main facility in Iowa. And that is just the beginning. "Self-cleaning filters have performed beautifully, and we will continue to find new uses for them," says Biggs.

Example: Cooling Tower Pollution

Another application of this technology to the process field concerns the subject of cooling tower pollution in the chemical industry. Even if a chemical plant starts out with the world's purest process water, the water won't remain that way for long. It may manage to stay relatively clean on its first trip through the plant's plumbing but won't once it passes through the cooling tower. "Cooling towers make good air washers," explains Lee Munday, senior mechanical engineer at one of Milliken & Co.'s chemical plants in Blacksburg, SC. "They'll pull all sorts of stuff out of the air." In addition to its chemical and textile factories, the company also maintains its own textile research center, considered the world's largest, and holds more than 1,800 patents. Out of that research came a product Milliken Chemical and its Industrial Specialties Division markets under the name Millad 3988. It's a sorbitol-based clarifying agent for polypropylene plastics. Polypropylene normally forms into crystals that are larger than the wavelength of visible light, causing it to refract the light and giving the plastic a hazy appearance. Millad causes the formation of smaller polypropylene crystals, resulting in as little as one-seventh the normal amount of haziness. In 2000, Milliken built a new plant in Blacksburg to produce Millad. Although it was the world's largest facility of its type, it still wasn't enough to meet growing demand. As a result, Milliken installed a new continuous batch manufacturing line in 2004 for Millad and other specialty chemicals used by the plastics industry. To ensure an uninterrupted supply of high-quality process water for this new line and prevent unnecessary shutdowns, Milliken needed to install filters on the cooling towers. "The plant has a high requirement for uptime so we didn't want to spend any more time than necessary to clean cooling towers," says Munday. "Shutdowns are expensive so we endeavored to have as clean of water as we can get within reason." He says the chemical plant uses surface water that it gets via the filtration plant located at another Milliken facility in Blacksburg. Although the water was of adequate quality to begin with, he knew that it wouldn't necessarily stay that way once it was put to use. The cooling towers were a

particular problem. As mentioned earlier, cooling tower water is often contaminated by airborne dust, sand, pollen, algae and pipe scales as illustrated in Figures 1 and 2. Therefore, Milliken wanted to install water filters on both of the towers to keep contaminants out. And, since downtime was such a costly issue, it didn't want to have to shut down the water supply in order to replace filter cartridges or put the filter through a backwash cycle. Selecting self-cleaning filters eliminated that problem because they don't interrupt the flow of clean process water during the cleaning.

The company purchased six self-cleaning filters (Figure 4) with each one containing a five-square-foot stainless steel screen. "We looked at a number of manufacturers, but one plant requirement is that it had to be all stainless steel," Munday says. Such filters are available in a variety of sizes and configurations accommodating flows from less than 30 gpm on a 1-inch line to 20,000 gallons on a 36-inch line and with screen mesh as small as 5 microns. Special designs are also available to accommodate harsh chemicals as well as high temperatures and high pressures. Two of the Milliken units had 10-micron screens installed inline to filter 100 percent of the water for one cooling tower. The rest came with 25-micron screens and were installed for side stream filtration on the other cooling tower. "The inline one just took a couple fittings and some valves to install," says Munday. "The side stream filters required a pump and some associated piping to put in, but it was still a fairly simple installation."

Conclusion

Ensuring a steady supply of clean water is essential for reducing equipment maintenance costs, eliminating unplanned shutdowns and upgrading product quality. As the experience of GPC and Milliken show, improving water quality doesn't have to be an expensive or arduous undertaking. In fact, it cuts costs and frees up staff time for other essential maintenance activities. The key is selecting self-cleaning filters made of the right materials that do not interrupt the water flow during the cleaning process. *Gideon Brunn is the application engineer for Automatic Filters, Inc., 2672 S. La Cienega Blvd., Los Angeles, CA 90034, which manufactures automatic self-cleaning water filters. He has been in the water filtration industry for more than 30 years. More information is available by calling 310-839-2828 or visiting www.tekleen.com.*

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