A Schott in the Arm

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Extra space is a luxury not afforded by most processing plants. As companies look to diversify their product ranges, new equipment is squeezed onto ever-shrinking plant floors. The footprint stamped out by processing equipment has moved up the specification hierarchy to become one of the most important characteristics highlighted on product releases.

But if space weren't an issue, it would be theoretically possible to expand operations beyond general processing as market conditions create demand for certain products. This is exactly what happened at Schott's pharmaceutical packaging plant in Lebanon, PA, where the installation of a water treatment system and cleanroom formed the basis for an entirely new product line.

A Glass House

Built in 2004, the facility replaced Schott's smaller plant in nearby Cleona and carried on with the production of pharmaceutical vials, dental cartridges and ampules. Glass-forming equipment supplies molded glass containers to a controlled area where products are constructed and packaged to customer specifications.

"We built the plant as a way to hold onto our employee base, and we knew that we wanted to go into other product areas," explains Schott North America Vice President and Schott Pharmaceutical Packaging General Manager Renard Jackson. But at the time, it wasn't certain if existing product lines would be expanded or if new products would be added.

Only about 50 percent of the plant floor was in use until recently, when advances in protein and mammalian cell research led to an increase in the use of injectable drugs, opening the door for Schott to fill the demand created by this shift in pharmaceutical delivery methods.

"The product portfolio for biotech companies is going in the direction of injectables, and we see a growth of these types of products in the double-digit range, whereas the market for vials, ampules and cartridges is somewhat flat with single-digit growth."

With glass-forming equipment already in place, the decision was then made to install a ready-to-fill syringe line at a cost of $14 million, with a capacity of 100 million syringes annually or approximately one-third of the current U.S. market. The line would need to be accompanied by an ISO 7 (Class 10,000) cleanroom, and a water-treatment system capable of purifying and maintaining the sterile water-for-injection (WFI) used to wash the syringes. Instead of building the infrastructure to support one syringe line, Schott again looked to the future and installed systems capable of supporting four syringe lines, enough to exceed total U.S. demand.

The company was able to draw on experience from its facility in St. Gallen, Switzerland, where a similar syringe line was installed eight years earlier. This internal experience, combined with help from reputable engineering contractors, helped Schott get the line up and running on time, on budget and without any unexpected regulatory roadblocks.

A vapor compression distillation system and dual circulation pumps produce and maintain the sterile water-for-injection used to process syringes.

Water for Injection

An 1,800-square-foot room houses the pumps, tanks, pipes, compressor, heat exchanger and monitoring equipment used to convert municipal water into sterile WFI through a process known as vapor compression distillation. Municipal water is brought in using redundant centrifugal pumps and sent through a carbon filter to remove the chlorine. Chlorine is removed not only because it is an unwanted impurity, but also because it could degrade the stainless steel tanks and pipes.

The distillation process begins when the filtered water enters the large still where it is heated and converted to steam. The steam then passes into a compressor where it becomes pressurized, increasing the temperature and allowing for latent heat transfer. When the steam is passed through the heat exchanger inside the still, the steam condenses and transfers its heat back into the system—the energy is recovered.

The condensed water flows out of the system as WFI-grade distillate, and is then tested for conductivity in order to verify the purity level of the water. If the purity level is incorrect, the water automatically flows to a drain.

A heating system keeps the WFI between 175° and 185°F while dual circulation pumps keep the water moving in order to sustain its sterile state. The constant circulation also removes the need to clean the holding tank. If temperature or conductivity falls out of spec, the automated monitoring system immediately alerts the operator.

The system is capable of producing 1,200 gallons per hour of distillate—enough to support two complete syringe wash lines. It is also designed to accommodate an additional still, which would allow four wash lines to operate simultaneously.

Under Pressure

Similar to chemical, food or pharmaceutical processing, keeping particulates out of the product is a huge focus that affects the entire plant. Sterilization is used to kill bacteria, but it doesn’t necessarily remove particles. Dirt and fibers can easily blow into the plant, or be carried in on shoes or clothing. For this reason, a pressure gradient is maintained across the plant, causing air to flow from the most clean areas to the less clean areas and eventually outside.

While a controlled area already existed within the plant, the syringe line required an even higher level of air quality. The result is a cleanroom where access requires workers to pass through two gowning stations in which clothing and shoes are replaced with smocks, Crocs footwear and goggles.

Inside the cleanroom, a modular Bausch & Ströbel syringe line is shrouded by a clear plastic curtain that keeps the air immediately surrounding the line at the highest air quality and pressure within the plant, meaning that air flows away from the line and out of the room. Pressures across the plant are monitored, and if the pressure gradient changes so that air flows back into the cleanroom, a shut-down procedure is initiated and line cleaning takes place.

Walk the Line

The Schott plant in St. Gallen forms the syringe glass barrels and delivers them to the Lebanon facility in Rondo trays holding about 20 units each. The goal now is to get the syringes cleaned, sprayed with silicone, capped, packaged and sterilized—ready for biotech companies to fill.

Silicone is injected inside the syringes using the eight small pumps shown above.

The first of the line's three major components simply removes the syringes from the Rondo trays and feeds them into the cleanroom where they enter the wash line. Much like the tank-cleaning methods used across the processing field, hundreds of individual nozzles spray the syringes inside and out with WFI before drying them using compressed air. A sensor then checks for clogged syringes, and a small amount of silicone is sprayed inside the glass body to allow the plunger to move in a smooth manner. After siliconization, a closure system (cap) is applied to the syringe, and any syringes with clogged tips or misaligned closures are automatically ejected.

As the syringes come off the wash line, they are fed into nests and tubs covered with protective Tyvek sealing foil. A tub-sealing system uses heat to seal the foil onto four tubs at a time. Each tub is then sealed in a labeled bag. This is where the automation ends, and line workers pass the packaged tubs through an air lock into storage.

When operating at full speed, the line pumps out 300 ready-to-fill syringes an hour. However, as most processors are familiar with, production regularly stops for daily cleaning and line changeovers, which allow syringes of differing sizes and configurations to be processed. Schott's best practices for cleanroom line cleaning involve a daily cleaning regimen, combined with a more thorough monthly cleaning. To assist with washdown, the wash line is covered with stainless steel.

The highly automated wash line sprays each syringe inside and out with sterile water-for-injection before drying them using compressed air.

Injected with Quality

The porous material used to package the syringes allows them to be sterilized after packaging using an ethylene oxide sterilization process. But before and after sterilization, quality control procedures are undergone to ensure the product meets manufacturing requirements.

Samples are taken at regular intervals during production runs and after sterilization to verify that all quality attributes are acceptable, and the product is ready to ship. In the event that a customer has any questions on material or product quality, recording processes allow for full traceability of the product and materials used during production.

In the end, a forward-thinking approach to plant infrastructure puts Schott in a position in which expansion is more of a relief than a headache. And proactive planning is not by itself the recipe for success: Big aspirations—made apparent by the ability to expand operations well above 100 percent of current market demand—also play a part.

By monitoring the marketplace and being flexible with its product portfolio, the company is able to take advantage of growth opportunities as they present themselves, even in a less than favorable economic climate.

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