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Automated spray control pays dividends

It focuses on the bottom line by reducing maintenance and cutting waste

By William J. Kohley, Ph. D.

While spray applications are regarded as simple on-off valves and regulation systems, the reality is that spray nozzles are precision components designed to yield specific performance under specific process conditions. Just because nozzles are spraying doesn't mean that they are spraying precisely, and precision spray performance can bring rewards in terms of throughput, quality and bottom-line profits.

Many plants have processes that require spraying, and maintenance professionals can attest to the complexity of maintaining them. In addition, poor spray performance often can't be detected by the naked eye, so operators might not notice if nozzles need maintenance.

Spray optimization offers significant savings

Every nozzle in your plant has its own performance characteristics, including flow rate, spray pattern (full cone, hollow cone, flat or solid stream), atomization droplet size, spray impact and coverage. A nozzle is optimized when it's performing as designed and is contributing to high-quality production and maximum throughput.

If a spraying system isn't calibrated, monitored and maintained properly, it can be a drain on profits. The cost of wasted water alone in a system with worn nozzles can amount to tens of thousands of dollars annually, even with relatively minor performance problems. If wastewater needs to be captured, treated and recirculated, the cost of waste can easily double and more likely triple. Moreover, keep in mind the many related expenses involved if your spray system is not performing at maximum efficiency:

- Excess chemicals.
- Mixing, reclaiming and treating the overspray.
- Wasted energy to deliver the fluids.
- Scrap resulting from overspray or poor coverage.
- Unscheduled production downtime.
- Unnecessary maintenance.

The idea behind optimizing a spray system is to minimize these expenses. Keeping nozzles at optimal performance often falls into the maintenance technician's job description.

Monitoring manually has limitations

Numerous conditions affect spray performance, including erosion and wear, corrosion, caking and bearding, clogging, improper assembly and accidental damage. Nozzles must be monitored and maintained on a regular basis to ensure that these conditions are not degrading optimal performance. However, manually monitoring dozens, or even hundreds, of nozzles in use presents a difficult task that can require a significant investment in labor to achieve.

Even with this effort, there is no guarantee that maintenance professionals will be able to improve nozzle performance significantly. It's important to remember that visual inspection alone doesn't always tell the full story. Spray patterns from worn nozzles often look identical to those of new nozzles even when spraying 20 percent or more over tolerance (see Figure 1).

The difficulty of detecting problems with the naked eye may cause maintenance professionals to neglect routine maintenance processes, ultimately leading to increased production costs and quality control issues.

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Controls can automatically compensate for wear

The most basic function of an automated spray controller is to maintain optimal nozzle performance by delivering fluids precisely to the desired location at the proper time. This boosts throughput, maintains product quality and reduces system wear, maintenance time and waste stream volume.

Traditionally, the spray functions have been controlled either manually or with PLCs. While it's possible to program PLCs to manage spray functions, dedicated spray controllers shorten programming time with pre-defined, pre-tested spray control modules and built-in nozzle performance data. Spray controllers optimize nozzle performance because they also provide fast response times. Manufacturers that sacrifice this response time compromise system performance and consume more fluid to produce a quality product.

Dedicated spray controllers adjust other system components to compensate for spray system variation. For example, a worn orifice often causes line pressure to decrease. A spray controller detects this immediately and adjusts the pump to maintain adequate flow and coverage. Variations that the spray controller can't correct immediately can trigger alarms or shut down the system. Furthermore, controllers also can monitor nozzle use throughout the line and notify operators when maintenance or a replacement is needed.

Most importantly, dedicated spray controllers can link spray performance to production variables. If it's possible to make a precise measurement of color, temperature, water content, size, texture, weight or other key variables related to fluid delivery, the spray controller can monitor the variable and adjust the spray appropriately. This eliminates the need to monitor and adjust the spray manually.

Spray controllers enable maintenance engineers to manage spraying operations more accurately, making adjustments automatically to maintain efficiency. Data logging also enables tracking system performance and more accurately predicting when spray systems will need maintenance.

Examples prove payback

Spray controllers have improved worker safety and increased throughput in baked goods production. Excess spray of butter and oil solutions on baked goods can cause hazardous work conditions. The plant floor can become dangerously slick near these processes. Floor cleanup was an ongoing maintenance challenge and the cost of wasted materials was high.

Programmed specifically for food coating applications, a spray controller was used to monitor and adjust the closed-loop system by regulating liquid and air flow to low-mist air atomizing headers equipped with special nozzles. Air pressure and liquid pressure were both maintained within a precise range, and the distance between the spray header and the conveyor belt was adjustable for maximum efficiency. The controller also regulated liquid and air heating systems to maintain the optimum temperature for the butter and oil solution. A liquid recirculation feature saved on the amount of solution being sprayed.

This spray system resulted in a cleaner, safer work environment and significant savings:

- Reduced plant maintenance time —$10,000.
- Raw material savings —$45,000.
- Increased throughput —$155,000.
- Total annual savings —$210,000.

These spray systems also find application in the basic metals industry. Steel mills generate hot gases and dust that must be removed in a baghouse. Before the dirty air stream can enter the baghouse, its temperature and volume must be reduced to avoid damaging the filters. Evaporative cooling is critical to the mill's productivity.

Insufficient cooling melts and burns the baghouse filters. Excessive cooling leads to soggy, ineffective filters, and the

Subtle difference

Figure 1. It's difficult to tell the difference between new (left) and worn (right) spray nozzles with the naked eye. Differences are easier to see using an optical comparator.

wetted duct walls cake up with dust, eventually reducing air flow. The accumulated dust cake falls into a cleanout chamber, where it must be removed. A wetter, heavier cake increases the disposal costs associated with this hazardous waste.

An automated system produced effective evaporative cooling without wall-wetting for this steel mill. Using closed-loop temperature control, a dedicated spray controller monitored multiple sensors and adjusted the flow and maintained the optimal droplet size at 10 air-atomizing nozzle lances for precise cooling without wetting. Performance improvements netted the following estimated savings:

- Eliminated damaged baghouse filters —$50,000.
- Reduced hazardous waste penalty —$75,000.
- Reduced maintenance costs —$60,000.
- Total annual savings —$185,000.

Strip mill's require uniform oil coverage before coiling to maintain the highest possible line speeds and to protect coiled material from rusting. An automated strip oiling system featuring two spray manifolds and a dedicated spray controller provided many benefits to another steel manufacturer. The spray manifolds — above and below the strip — provided five user-selectable spray widths for strip widths ranging from 24 to 62 inches. The system also included a pumping unit, strainers and control valves.

The automated strip oiling system applied a uniform thickness of oil film across the strip immediately before coiling, regardless of line speed, which varied considerably. The automatic adjustment ensured product quality while reducing oil consumption.

The system provided consistent product quality and allowed almost a 20% increase in line speed. It generated savings of more than $1,000 each day by reducing oil consumption alone, quickly paying for itself.

Even relatively simple applications can benefit from automated spray control, as in the case of a contract metal stamper producing parts for the automotive industry. Metal stampings require a uniform application of lubricant but without the misting sometimes associated with spray lube systems. Most importantly, this stamper needed to reduce oil consumption significantly.

The solution to this problem came in the form of mobile carts with a spray controller and air atomizing spray nozzles that deposited a fine mist of drawing oil on the metal parts to be stamped. Precise timing of the spray and consistent coverage of the part were critical for product quality, while low liquid and atomizing air pressures prevented misting and overspray. The spray controller helped this customer maintain product quality and reduce oil consumption almost 40 percent.

Dedicated spray controllers adjust other system components to compensate for spray system variation.

Numbers tell the story

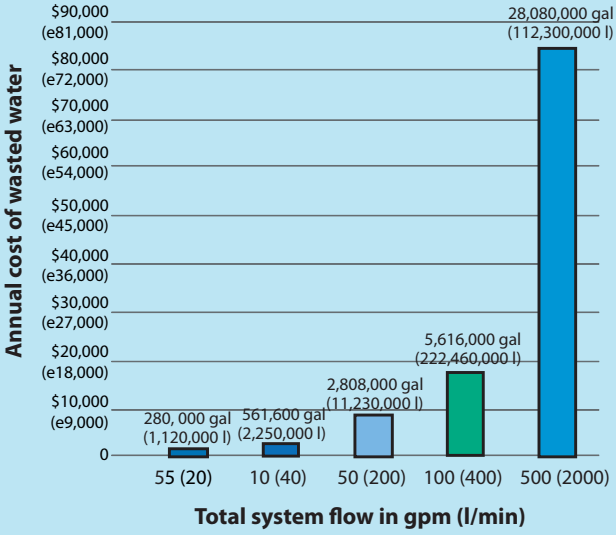

Figure 2. Savings are based on a spray system operating five days per week, 24 hours per day with 15% waste rate, water cost of $0.003 (€0.0027) per gallon, sewage cost of $0.00079 (€0.00071) per liter.

Technology offers quick return

Automated spray systems can pay for themselves quickly through productivity gains and cost reductions (see Figure 2). Experts in spray technology, who understand your existing manufacturing needs, can evaluate your existing setup and suggest nozzles types that can deliver the best results for your application. After you have selected the proper nozzles, an automated spray controller may further improve performance while reducing the ongoing costs associated with monitoring and maintaining spray nozzles.

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