

Ozone

Puts a Fresh Spin on Laundry

Recent increases in energy costs and dwindling fresh water supplies have put a real squeeze on light industrial and commercial operations, such as laundries. The industry faces several additional challenges such as escalating labor costs, shrinking profit margins and increasingly stringent health and environmental requirements.

Tremendous amounts of water, energy and complex chemicals are consumed in traditional laundry operations. Increasingly, industrial and commercial laundries are turning to ozone laundry systems to reduce costs in these areas while increasing quality, satisfaction and safety.

For example, in one verification study at a large multi-hotel commercial laundry, annual cost savings for water and natural gas alone were projected to be \$165,000.

Ozone (O₃)—the allotropic form of oxygen (O₂)—is an extremely effective sanitizer. Ozone gas is injected into water to produce a powerful oxidizer that is 50 times more effective than chlorine and kills bacteria 3,000 times faster.

Ozone has been successfully applied in commercial laundry facilities for several years. Ozone laundry system installations are growing due to increasing operating costs and the many important cost-saving benefits that ozone provides to laundry operators. And such systems create no adverse effects on washing equipment built with synthetic seals, in order to resist the affects of chlorine bleach as well as ozone.

Energy savings

Ozone is more stable and most effective at ambient water temperatures, thereby greatly reducing demand for hot water in commercial laundries. This translates into significant energy savings.

For light-soil applications, cold ozonated water alone may be sufficient to effectively clean and sanitize. For heavy-soil applications, hot water may still be necessary to break down oils and grease and ozone facilitates this interaction.

Typical energy savings from ozone laundry systems run from 65 to 95 percent. A verification study for a large multi-hotel laundry recorded a 93.7 percent reduction

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in hot water usage resulting in 92.6 percent savings in the energy costs (estimated at \$115,200 per year).

Water/sewage cost savings

Ozone laundry systems can reduce water and sewage costs in two ways. Ozone-injected water can simultaneously rinse and sanitize the laundry, effectively eliminating one or two rinse steps.

In some instances, the use of ozone can reduce the chemical load in the wash, also lowering the number of rinse steps. Water and sewage cost savings of 10 to 30 percent are typical. The multi-hotel laundry study cited above showed a 27.3 percent decrease in water usage resulting in an estimated annual savings of \$33,400 in water and sewage costs.

Labor savings

Labor savings from shorter laundry cycle times are due to reduced rinsing, which further results in more loads per shift. In addition, ozone laundry systems can decrease labor-intensive re-washes of heavily soiled or stained articles.

The cold-water power of ozone also may permit white linens to be washed with colored fabrics. This can cut sorting time and labor allocation costs.

Savings in washing and drying cycle times are the easiest labor savings to quantify. Typical wash cycle timesavings are reported to be 10 to 45 percent.

A study of the ozone laundry operations at a large 650-bed rural regional hospital determined that labor costs for overtime were reduced 10 percent due to the dramatic 93 percent reduction in re-washing of heavily soiled items, from 600 pounds to 43 pounds (272.1 to 19.5 kg) per day.

Linen replacement savings

Ozone laundry systems increase linen life through shortened washing and drying times, as well as lower heat and chemical usage. This is most apparent by the dramatic reduction in lint production.

Linen inventories may also be reduced by shorter cycle times achieved by ozone laundry systems. Linen savings can be very significant, but tough to quantify and usually become evident months after the ozone system installation.

Typical linen savings have been estimated at 15 to 50 percent. Specific studies of linen savings in nursing homes reveal savings of 60 to 66 percent.

Additional benefits

In addition to the quantitative benefits produced by ozone laundry systems, many institutions and customers report important qualitative benefits. This includes brighter whites and colors as well as a softer feel of sheets and fluffier towels.

Also, it should be noted that ozone returns to diatomic oxygen (O₂) and leaves no residual chemical odors. Reducing hot water usage lowers the overall tempera-



Figure 1. An integrated ozone system

ture of the laundry facility, providing a more comfortable work environment for laundry staff.

Rapid return on investment

The simple payback period for most ozone laundry systems is 12 to 18 months. This is the number of months required to accrue savings equal to the cost of the ozone laundry system.

Results of individual analyses of cost savings and break-even time will vary depending on the size, scope and cost of the ozone system. Another fluctuating variable to consider is the volume of laundry processed.

System design

Ozone laundry system designs vary depending on the chosen method for injecting the ozone into the water and delivering the water to the washing machines. The simplest method is to inject ozone gas from the ozone generator directly into the washing machine.

This method suffers from poor ozone mass transfer that results in high levels of undissolved ozone gas. This action may damage the washing equipment and create a health hazard in the work environment.

Applying ozone to any light industrial or commercial application must take all four basic elements of ozone into consideration. They include:

- Oxygen/feed gas preparation
- Ozone generation
- Mass transfer
- Monitoring and control

All four components must be present and well-designed to create a smooth-running ozone system.

System operation

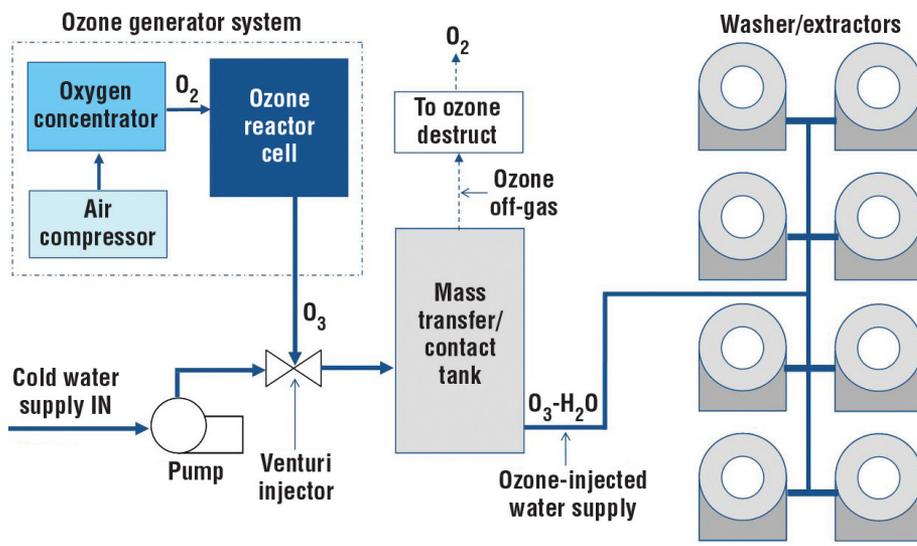
A typical ozone system is shown in Figure 1. The ozone generator system includes a compressor and oxygen concentrator for feed gas preparation.

This sub-system delivers nearly pure oxygen to the ozone reactor cell. Within the reactor cell, the oxygen gas is passed through a high-voltage electrical field. The energy of the electric field causes some oxygen molecules to split into single-oxygen atoms, which in turn bond with diatomic oxygen to form ozone (O_3).

The ozone gas—typically four to eight percent by weight—is drawn by vacuum into a Venturi injector and dissolved into water, then delivered to the mass transfer or contact tank. A dissolved ozone detector monitors the concentration of ozone in the water at the outlet of the mass transfer tank.

The information is fed to a propor-

Figure 2.



tional integral derivative (PID) controller, which adjusts the voltage of the field in the ozone reactor cell. This is done to maintain the desired concentration of dissolved ozone in the mass transfer tank.

Mass transfer

Mass transfer via an integrated mass transfer system is far safer and more effective than direct injection. An integrated mass transfer system—comprised of a Venturi injector, a mass transfer tank and a degassing system—is typically 90 to 95 percent efficient, leaving very little undissolved ozone to manage.

Residual ozone gas collects in the headspace of the mass transfer tank and is vented through an ozone destruct device that safely converts ozone back to diatomic oxygen before returning it to the environment. The mass transfer tank also ensures that the systems will maintain sufficient capacity to meet the demand requirements of laundry.

In concept, the mass transfer tank is similar to the role that a hot water tank plays in providing a consistent supply of hot water. It provides a buffer against brief periods of high demand on the system.

A schematic of the overall system is diagrammed in Figure 2. Cold city water is delivered to the ozone system while hot water is piped directly to the washing machines.

Implementation

Implementing an ozone laundry system requires an understanding of the quantities and types of loads the laundry runs as well as the characteristics of the supply water and laundry chemicals. Lightly soiled hotel linens will require different chemicals, water temperatures

and wash formulae than heavily soiled tablecloths and napkins, bar rags and mop heads.

Ozone is a strong oxidant and sanitizer, but it is not a detergent. Ozone alone will not remove fats, oils and greasy stains. Heavily soiled loads will require hot water and conventional detergents to remove oily materials.

In such cases, ozone can be employed in cold rinsing and sanitizing steps to increase the effectiveness of these steps. Ozone minimizes soil redeposition, which reduces energy and water consumption as well as cycle time.

Forming a relationship with the laundry's chemical supplier will accelerate successful implementation. The ozone system provider must work closely with the laundry manager and chemical supplier to optimize the washing formulae and program the washers for reliable and reproducible results.

Two other important considerations in implementing ozone laundry systems are personnel training and maintenance. When properly implemented and optimized, the ozone laundry system will be nearly transparent to the customer; however, a little education and training of laundry management and staff will go along way to prevent problems and increase satisfaction with the ozone laundry system.

Similarly, a little preventative maintenance will save a lot of headaches. Maintenance can suffer from poor training and turnover of on-site personnel, as well as a lack of understanding of ozone technology. A program of ongoing maintenance and service should be designed and offered by the ozone laundry system provider.

The bottom line

Ozone laundry systems provide substantial, measurable savings in the key operational costs of industrial and commercial laundries. These cost savings yield a high return on investment and a short break-even period.

Care must be taken to design and implement ozone laundry systems in harmony with the practices and chemicals used in the laundry. This will ensure optimal performance and customer satisfaction.

About the author

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About the company

◆ *Pacific Ozone is a leading supplier of air-cooled, corona discharge ozone generators and integrated ozone/oxygen systems and process controls, including the eCycle™ ozone laundry system. In addition to ozone products, Pacific Ozone offers engineering support and development services that meet their customer's application-specific requirements.*

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- O₃** Ozone Generation
- MT** Mass Transfer
- CN** Control/Monitoring

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