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Technical Brief®

CUSTOMER SYSTEMS GROUP

Ozone Laundering: A Better Wash Process for Commercial Laundries

Less detergent, less water, less time, less energy: a new electrotechnology-based method of laundering offers commercial establishments all of these advantages. There's evidence to back these claims, too. Since 1990, ozone laundry systems have been installed in commercial laundries, correctional facilities, hospitals, and hotels across the country.

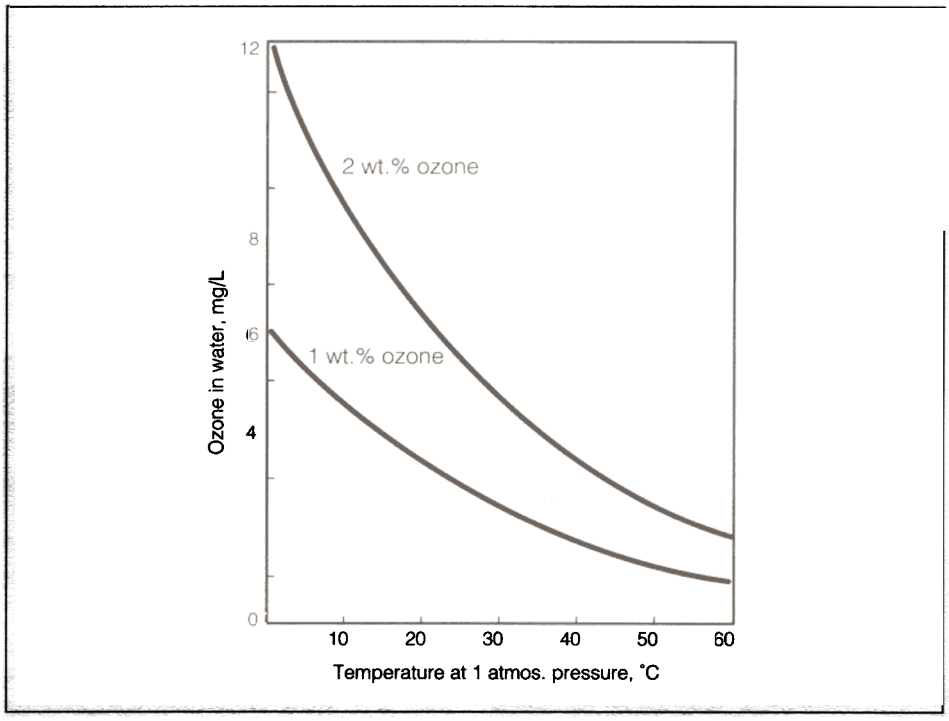
What Is Ozone Laundering?

Ozone laundering means using water that contains or is saturated with ozone—instead of using fresh water—throughout the wash cycle. Ozone is a highly reactive, naturally occurring gas (O_3); in ozone laundering systems, it is generated on site and replaces some or all of the detergent and other chemicals that are ordinarily required for desoiling, itself accomplishing or enhancing the cleaning process. Cutting down on detergent automatically reduces the need for rinse cycles, thereby minimizing water requirements and shortening the wash time. And, because ozone concentrates best in cold water, ozone laundering nearly eliminates the need for hot water, thereby saving significant energy.

Why Ozone?

In addition to its emerging role as a cleaning agent for textiles, ozone is commonly used as the better alternative to chlorine for purifying drinking water and disinfecting swimming pools and waste water: it destroys bacteria 3000 times faster than chlorine and has no residual odor. Ozone is also a powerful oxidizing agent, deodorizer, and bleach.

While at the molecular level ozone and its reactions are well understood, there is some debate about exactly how ozone desoils or plays a role in cleaning fabric in the complex chemistry of the wash tub. According to some proponents, ozone reacts chemically with insoluble soils, oxidizing them and transforming them into smaller molecules or soluble soils that are easily freed from the fabric by the mechanical agitation of the washing machine and drained off with the wash water. One ozone system manufacturer proposes that the energy inherent in ozone reduces water surface tension, resulting in "wetter" water, a better solvent. Another idea, which supports the use of ozone in combination with detergents, is that ozone amplifies the effects of the alkalies and surfactants in a wash formula. Regardless of these variations in explanation, users agree, and tests show, that whether ozone is itself accomplishing the cleaning or is simply enhancing the action of other agents, for most kinds of soiling, the ozone laundry process achieves brighter whites and cleans just as well or better



Solubility of Ozone in Pure Water

Tri-O-Clean offers a patented closed-loop system that provides for complete recycling of wash water. This system is more expensive to install than open-loop systems but proves a cost-effective option in situations where sewer or water rates are high. While all ozone marketing highlights the environmental benefits of these systems, the closed-loop system is the most environmentally benign because of its water-sparing focus.

In the Tri-O-Clean closed-loop process, clean water is injected with ozone gas from an on-site generator, and the ozone-saturated water is held in a "contact tank" until needed. It is then pumped into the washers, where, according to Tri-O-Clean, the ozone reacts with the oxidizable soils, rendering them soluble, so they drain off with the water and no rinse cycle is needed.

The water drained from the wash cycle is filtered to remove particulate and lint and dropped into a holding tank; there it undergoes additional filtering to remove particulate above 20 microns in size, and then flows into a storage tank. To complete the water recycling process, ozone is injected into the bottom of the storage tank, creating small bubbles that collect any remaining particulate and fat-based molecules and carrying them to the surface. The film of debris that subsequently develops at the surface of the tank is eventually drained off to the sewer. The reclaimed water is then available for transfer to the contact tank, and the cycle begins again. Make-up water is supplied to the system from the facility's regular incoming water line; a water softener is sometimes required. For very fine textiles, a five-micron "polishing filter" is added between the storage and contact tanks.

than other systems. Clothes and linens smell fresher, too.

What Is the Process?

Three U.S. manufacturers are currently leasing and selling ozone laundry systems: Cyclo$_3$pss Textiles, Oxygen Technologies (OxyTech), and Tri-O-Clean Systems. All three are targeting businesses and institutions that have laundering requirements of at least 1500–2000 pounds per day. The systems are suitable for new construction and are easily retrofit to existing operations, the common application to date. Most current installations are in large commercial laundries, correctional facilities, and hotels. In these facilities, soiling is predominantly animal- or vegetable-based (e.g., body oils and foods), but ozone is gaining ground on proving itself with the more difficult petroleum-based soils common to industrial laundries.

All three manufacturers sell open-loop ozone laundry systems in which used wash water drains to the sewer. Tri-O-Clean also offers a patented closed-loop system that recycles a significant amount of the wash water. The three open-loop systems differ with respect to when and how much ozone is injected into the wash water and with what additional cleaning components. In each case, existing wash formulas must be redesigned for compatibility with ozone and to achieve the best savings in chemicals.

Cyclo$_3$pss makes special note that ozone is a very unstable molecule. Hence, the Cyclo$_3$pss process involves multiple injections of ozone and other chemicals into the wash cycle at different stages, so that fresh ozone is available in what the company calculates is the optimal amount. Each system is automated and customized to meet the particular demands of the site.

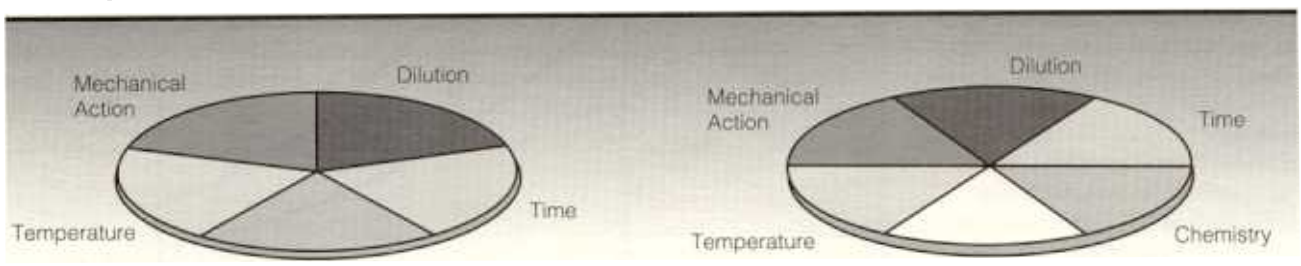
The OxyTech equipment package includes an ozone generator and a sidestream circulation system for each washer; each generator is sized and modified according to the needs of the facility. The sidestream system circulates water out of the washer, mixes ozone into the wash liquor, and returns the water to the washer.

The Tri-O-Clean system is designed to saturate the wash water with ozone in a "contact tank" just prior to pumping the water to the washing machines at the start of the wash cycle. Customized "pre-rinse" formulas are utilized depending on the type of textiles and soiling typically handled at the facility.

How Is Ozone Laundering Better?

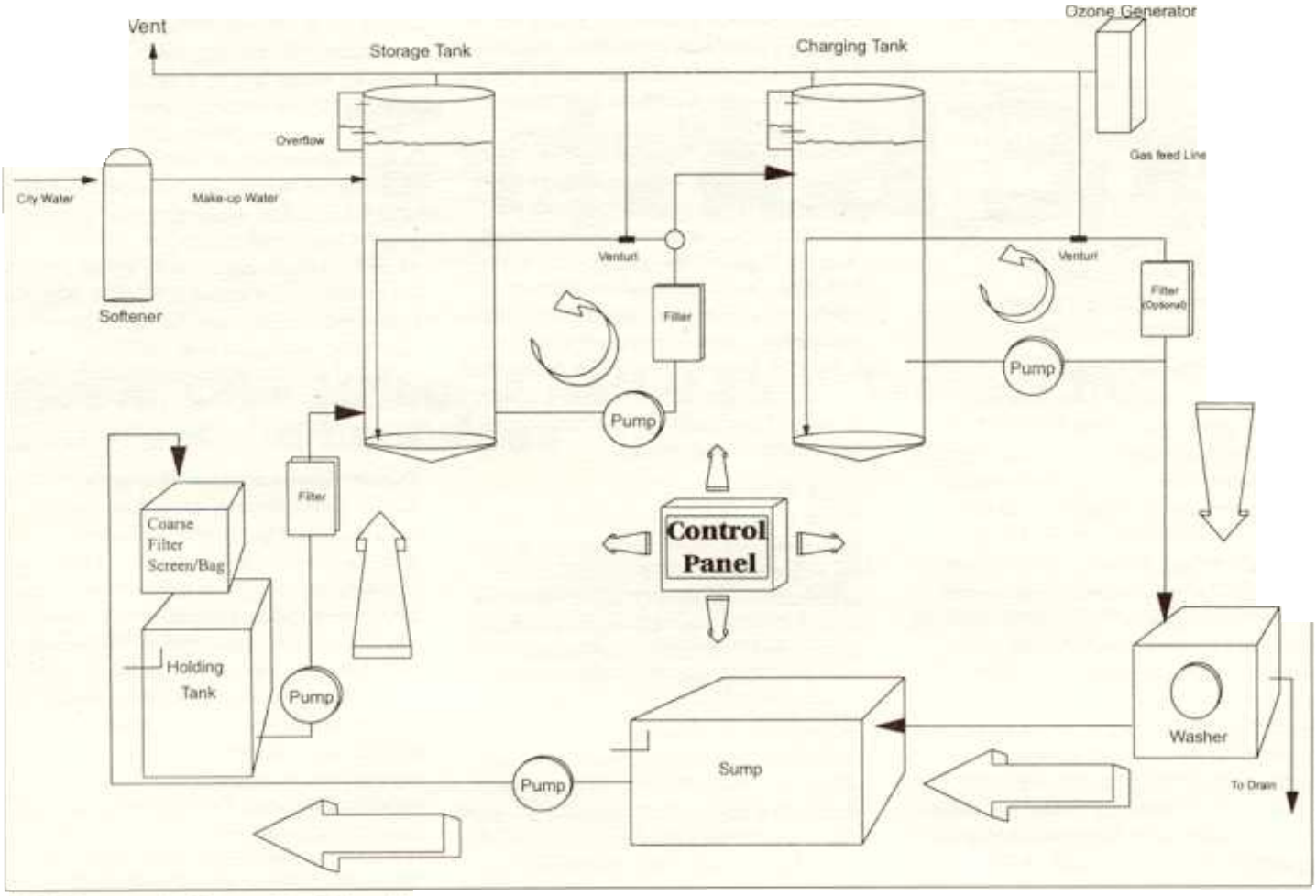
Ozone laundering offers users immediate cost savings through reductions in water volume, energy for water heating, detergent and other chemical costs, wash-cycle time, and wastewater volume

Washing is a function of:



Chemistry **Ozone**

with the addition of ozone all of the factors are reduced.



Tri-O-Clean Laundry Systems Flow Schematic

and contamination. Moreover, the quality of the washed product is equal to or better than that achieved by conventional methods: whites are brighter, clothes and linens smell fresher, and the fabrics are less stressed because of the absence of high heat and harsh chemicals.

Water Volume

Tri-O-Clean estimates that its closed-loop ozone system can save 50–75% of total water volume through recycling. Estimated water savings for the open-loop systems range from 12–31% compared to conventional methods. These savings accrue because of the reduced need for rinse cycles.

Water Heating

Most commercial laundries use water heated to 140°F, and water heating (via natural gas) typically dominates the laundry energy bill. Since cold water has a higher saturation point for ozone than does warm water, and heat itself destroys ozone, ozone laundering uses primarily cold water, especially for light to moderately soiled laundry, roughly 80% of a typical establishment's volume. For more heavily soiled loads, all three manufacturers' systems use water heated to 100–110°F (temperatures depending on site-specific requirements). The proclaimed savings in natural gas is about 30%. In one reported application, a Westin hotel laundry retrofit with a Tri-O-Clean system was able to turn off its main 800-gallon water heater (producing a 60% reduction in natural gas usage). OxyTech estimates savings of 25% on "utility expenses" with installation of its system.

Less Chemicals

According to manufacturers' projections and accumulating experiential data, use of ozone as a washing agent translates into a 30–70% decrease in wash chemicals—detergents, brighteners, water softeners—with a corresponding decrease in chemical costs.

Shorter Wash Time

By minimizing the need for rinse cycles, the ozone laundry process can cut total wash time by 20–42% per load. For operations looking to expand, this means an opportunity to increase productivity around the clock. Alternatively, it's an opportunity to cut back a shift and save labor costs.

Reduced Sewage Costs

A smaller volume of wastewater results in lower sewage fees. According to Cyclo$_3$pss' data on a large commercial laundry, sewer fee savings were nearly $1900 per month as a result of a more than 338,500-gallon reduction in overall water use. In addition, wastewater from ozone systems is less contaminated—

a boon for the environment and likely a long-range cost savings for society.

Textile Life

The combination of less exposure to chemicals, less mechanical agitation, and lower water temperature can improve textile longevity. OxyTech claims that fabric degradation is commonly reduced by as much as 35%. Manufacturers also state that there is no noticeable difference in the fading of colored fabrics washed with ozone versus conventional laundry chemicals.

Benefits to Electric Utilities

Ozone's high reactivity necessitates on-site generation at the laundry facility, typically on an as-needed basis. Ozone is generated by passing an electrical charge through compressed air in a sealed chamber. (The same effect occurs during a thunderstorm; indeed, ozone gives these storms their distinctive, refreshing smell.) Ozone laundering generally turns a laundry's energy consumption pattern on its head, significantly reducing use of natural gas and boosting use of electricity—to run pumps, an air compressor, and the ozone generator. (Caveat: ozone's shorter wash time may mean that electrically powered washing machines are operated fewer hours each day.) A monitoring study conducted by Georgia Power Company found that the Tri-O-Clean closed-loop system reduced a laundry facility's gas consumption by 32% and increased electricity consumption by 55%. The ozone system also showed consistent, flat electrical demand.

Field Data

Commercial Laundry

$Cyclo_3$pss has installed systems in 14 large commercial/ industrial laundries across the United States and reports that independent evaluations of its systems demonstrate savings of 20–40% in laundry costs. Specific data provided for a facility doing about 4.5 million pounds of laundry each year show a 27% reduction in average cycle time, resulting in a 25% capacity increase at the facility. Other savings include a chemical cost reduction of $2000 per month, water and sewer savings of $2900 per month, and water heating energy savings of $670 per month (including the cost of ozone generation). The total annual savings for this type of facility are $84,500. Given an initial investment of $200,000 to purchase the ozone system, this yields a simple payback in less than 2.5 years. $Cyclo_3$pss is in the process of introducing a smaller unit with a first cost of $20,000–$50,000 for the hospital and hotel institutional market.

Large Hotel

Since 1984, OxyTech has designed and manufactured ozone systems for a variety of commercial and light industrial applications, including hotels. Data collected for a 267-suite Embassy Suites hotel in the Crystal City section of Arlington, Virginia, documents a savings of $2400 per month on the costs of water/sewage, chemicals (57% drop in detergent use), and laundry labor, as well as a 17% savings on gas (by reducing the wash water temperature from 140°F to 115°F). Based on these results, the hotel is implementing ozone water treatment for its swimming pool and spa, as well as using ozone for sanitation of its dishwashing system and walk-in refrigerators and freezers.

Correctional Facility

Tri-O-Clean boasts installations in 17 locations—commercial laundries, hotels, nursing homes, and five correctional facilities. In 1994, Georgia Power Company studied a closed-loop Tri-O-Clean system at a prison and training facility operated by the Georgia Department of Corrections. The utility metered the laundry prior to system installation and then measured the changes in water, gas, and energy use. The study found savings of 78% in hot water use, 40% in cold water consumption, 65% in chemical costs, and 32% in natural gas use. Standard laboratory tests for whiteness and sanitation showed that the ozone system provided superior results. Based on these data, Georgia Power estimates that a commercial facility in its service territory, processing about 1.8 million pounds of laundry per year in a two-shift operation, would realize a simple payback in 4.5 years on an investment of about $130,000. With no peak-demand charge, the same two-shift operation would achieve payback in 4 years. (Tri-O-Clean states that this system was oversized and that most installations have a two-year payback.)

Other Applications of Ozone

Today ozone is used around the world for a variety of purposes, including treatment of potable water, municipal waste streams and commercial/industrial plant wastewater, cooling tower water, aquarium water, pool and spa water, as well as in medical equipment and room sterilization processes. A new application now being marketed by $Cyclo_3$pss for the food processing industry uses ozone to sanitize the water used for washing produce, fish, or meat in packing operations.

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