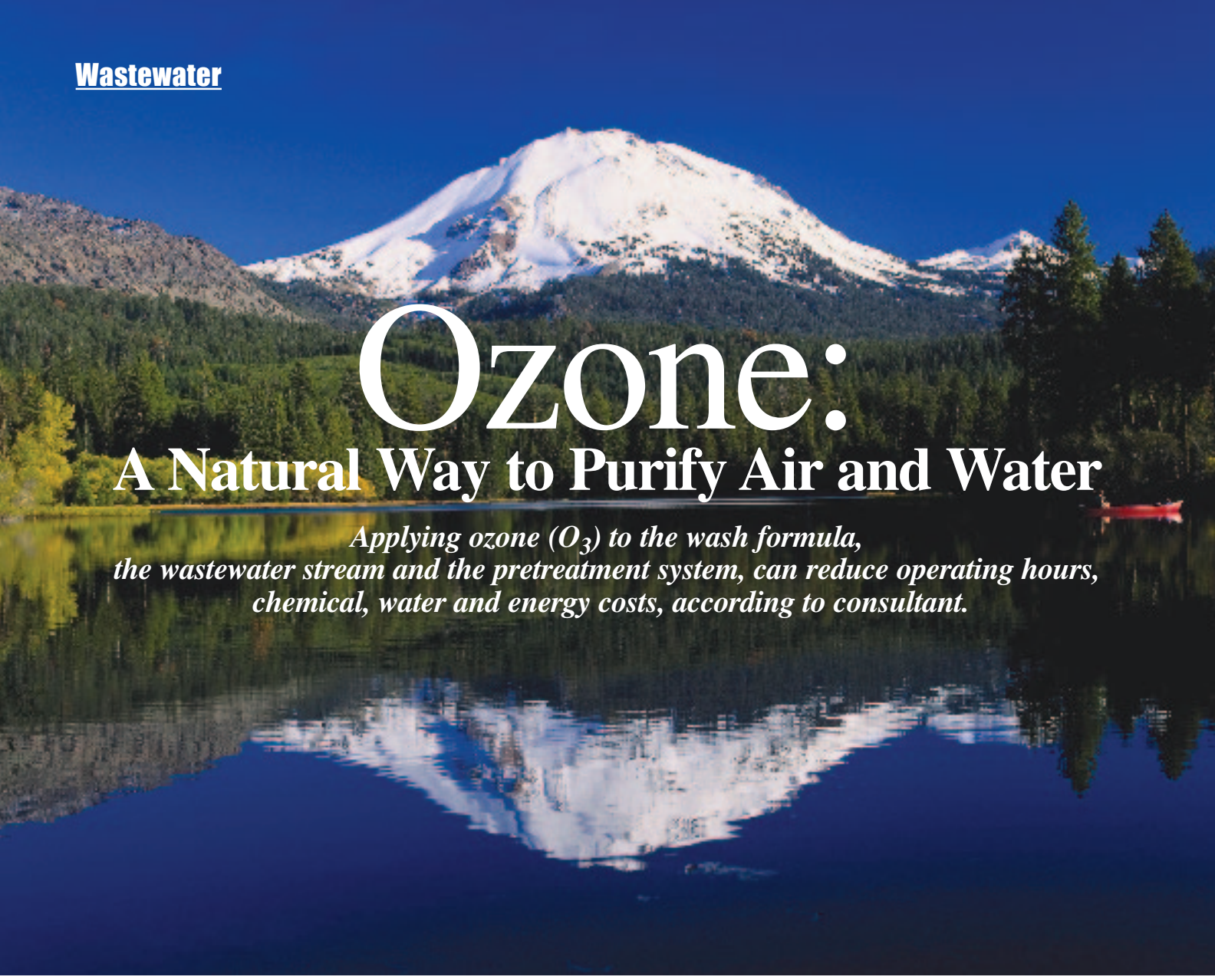

Ozone:
A Natural Way to Purify Air and Water

Applying ozone (O_3) to the wash formula, the wastewater stream and the pretreatment system, can reduce operating hours, chemical, water and energy costs, according to consultant.

By Jack J. Reiff

REDUCE, REUSE, RECYCLE, and TREAT; these have been some of the major tenets of our environmental survival plan. When looked at closely, we can see that REDUCE, REUSE AND RECYCLE (R_3), combined with the proper applications of ozone (O_3), offer a balanced formula in washroom procedures and practices. $R_3 = O_3$.

Every businessperson is interested in operating efficiently, effectively and profitably. Labor leader Samuel Gompers (1850-1924) once said, "The worst crime against working people is a company which fails to operate at a profit." What you do in a positive way to affect the bottom line will impact profitability.

We have heard many war stories about the benefits and shortcomings of ozone in treating laundry wash water. It's known and accepted that all swimming pools used for the Olympics are treated with ozone, rather than chlorine. Most of our bottled drinking water and that of major communities, like San Francisco, treat drinking water with ozone. Air conditioning systems use ozone for chemical reduction and prevention of Legionnaires' disease. Hot tubs, autoclaves and even an experimental process in Europe to stabilize AIDS (HIV) make use of ozone. Ozone *destroys* bacteria and viruses through a process called "Lysing." Bacteria is not simply weakened or dead, they are gone. Most airborne bacteria are actually destroyed, thus removing odor and improving the environment.

We can all appreciate the reluctance of many people in our industry to replace other chemistry with that of ozone. We hear about mass transfer, having the proper pH and temperature—much like enzyme applications—affecting the proper results of these products. Many of those stories may be circulated by those who benefit from not using and economical chemistry system in the washroom or in the wastewater treatment system.

The laundry industry is reluctant to use ozone in its operations. Whatever the reason, perhaps the problem is not with ozone but with the application of ozone in the washroom. It could be a case of the right tool with the wrong mechanic.

Ozone in action

Let's look at the facts about ozone. Conventional secondary waste-

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treatment methods do *not* remove all dissolved and suspended contaminants. To improve the COD (Chemical Oxygen Demand) and destroy organic contaminants, surfactants and bacteria, an oxidation purification treatment with ozone offers many advantages. Ozone's high reactivity permits oxidation in a continuous process breaking down many compounds while removing color and odor. This technique has roughly doubled the rate of reduction of COD or total organic carbon in the water medium.[1]

The high oxidation power of ozone (disinfection, control of DBP's, taste, and odor) also enhances the downstream coagulation, flocculation and filtration process. This process is sometimes referred to as micro flocculation. When this process occurs, there may be benefits in lower chemical dosage, longer filter runs, higher filtration rates and or lower filtered water turbidity.[2] This process also reduces or eliminates the VOC's in the water.

An eco-friendly chlorine alternative

Our rapid population and economic growth have placed increased demands on our water utilities. In some areas of California, people are selling off their water rights because of industries' growing demand for water. Increasing water production requirements—coupled with rigorous quality standards for the finished treated water—present more challenges. Disinfection requirements set forth in the *SurfaceWater Treatment Rule*—along with other criteria—prompted a major shift to ozone and other strong non-halogenated oxidants to replace chlorine. Ozone and like processes offer additional benefits including complete or partial oxidation of color, manganese, synthetic organic chemicals along with taste and odor-causing compounds. Enhanced flocculation, coagulation and sedimentation are some additional benefits.[3, 4]

NASA, Army success stories

The results of work accomplished at the John F. Kennedy Space Center, Cape Canaveral, FL, indicate many benefits from ozone applications as a water treatment replacing conventional chemical treatment for Cooling Towers. The results at the Jet Propulsion Laboratory in California—considered most reliable for a three-year period test—are most favorable in the use of ozone in place of conventional chemical treatment. The various sizes of the towers were 75, 250 and 350 tons. The conclusions were:

- Ozone was an effective treatment.
- Cooling Tower drift was environmentally acceptable.
- Chemicals eliminated that caused environmental contamination.
- Removed & prevented scaling deposition. Precipitated out calcium and other metallic ions as a fine sandy deposit.
- Metal surfaces were passivated to inhibit corrosion.

The ozone treatment was not considered as a dangerous poison because it could be easily detected by smell at very low concentrations.[5, 6, 7]

The U.S. Army at the Rocky Mountain Arsenal is decontaminating this 17,000-acre facility of munitions chemicals, pesticides and a variety of volatile organic compounds (VOC's), as well as di-isopropylmethylphosphonate (DIMP), an intermediate product of chemical manufacturing. This process—at a much lower cost than the usual procedures—utilizes a combination of ozone and hydrogen peroxide as a variation of advanced chemical oxidation to generate hydroxyl radicals that degrade contaminants. Iron, manganese, cyanide, and other soluble soils are either broken down to nitrogen, oxygen, carbon dioxide or other components and dissipated. Contaminants are also made insoluble for easy removal by other methods.[8, 9]

Effective wash liquor treatment

The laboratory study of ozone washing by Jack A. Turner confirmed other aspects of washing that have been professed for many years. I am a firm believer in a process of washing the fabric clean, and then treating the wash liquor as a separate entity. When ozone is used in the wash wheel, whether it is from an ozone-saturated water supply, or by injecting the ozone directly into the wash wheel to effect soil removal, you run the risk of fabric damage, equipment damage and off gassing of the ozone. Ozone in direct contact with the fabric, whether it is natural or synthetic, has a detrimental impact on the break strength of the fiber.[10] This process was used in the 1980s to get a stone washed effect on blue jeans without the use of stones.

A good wash formula using regular wash techniques of saponification, lubrication, emulsification, suspension, flocculation and bleaching will remove the soil from the fabric resulting in good stain removal. The wash chemistry, after accomplishing the above tasks, keeps the soil in suspension for removal by dilution. The ozone takes care of disinfection while assisting in the normal wash chemistry.

Dilution: new pie chart parameter

We have all seen and heard about the pie chart that refers to washroom practices. This pie chart states that "Washing is a Function of Mechanical Action, Time, Temperature and Chemistry." Chemical companies have been stating that if we increase one function we can decrease the others. When we look at the pie chart it appears to be true. We all know though, that throughout this process, there are always references to the function of dilution. Dilution is the process of diminishing the chemical strength or concentration by admixture of water.

I suggest adding the function of dilution to the pie chart. Dilution, the fifth parameter of good washroom technology, now presents a balanced approach to washing. The problem is, under standard washroom formulation practices, when the chemistry is increased it usually requires more time to dissolve in the wash liquor and more time, water and operations to dilute down for the sour or finishing baths. Therefore, another wash parameter must be added to balance out the wash formula.

When ozone is applied to the wash formula we accomplish both aspects of this process. The ozone, chemically O_3, is added to the wash liquor increasing the chemical activity of the operation. This increased chemistry activates other chemicals while oxidizing soils carried by the wash liquor. The oxidized soil is broken down to air, water, carbon dioxide and reduced solids.

Throughout the wash program, when ozone is part of the formula, the oxidation process is continually diluting the bath by flocculation and coagulation among other chemical processes. Each bath of the wash process can be injected with ozone through a closed loop side arm injection system.

This system pumps a specific amount of wash liquor out of the wash basket and through a closed loop. While the wash liquor is moving through the loop, ozone is injected into the water stream through a venturi fitting. The low pressure in the venturi is a boost to the ozone quality and enhances the ozone in its attack on the water contaminants. I liken this to a bleach operation in the wash process. If you were to attempt to bleach in a turbid bleach bath, the bleach would attack the soil in suspension rather than remove the stains on the fabric. The bleach takes the path of least resistance. To maximize stain removal the bleach bath should be clear.

Better waste water management

When ozone is applied to the wash liquor, I've found that it attacks the soil first before going after the surfactants in the wash liquor. In this process, the soil is removed, allowing the break chemistry to re-enter the wash wheel in a rejuvenated state. Newly activated wash chemicals provide for reduced wash chemistry in the formula. The same process also reduces the soil contamination so you are effecting a dilution phase during the wash cycle and all other cycles, except the bleach, throughout the total process. By cleaning up the wash water in each cycle you then can reduce the number of cycles required for the total operation. The closed loop is designed at a specific length so that the ozone is consumed outside the wash basket within the closed loop that eliminates off gassing during the wash cycle.

The enhanced oxygen from the ozone application reactivates the chemistry of the wash process making the use of high temperatures an unnecessary part of the procedure. Wash temperatures of 120ºF to 135ºF, a point at which fabric swells or softens, makes soil removal easier. These are the temperatures I normally use in critical operations of the wash. Extremely cold water is counterproductive to proper soil removal. Take for example a cut on your finger. You wouldn't think of putting it under hot water to stop the bleeding, you would put it under cold water to stop the bleeding. Body fluid (soil) flows at body temperatures (98ºF). Heavy soil, like aprons, bar mops and kitchen apparel usually require a higher temperature in any case.

Ozone, as stated above, destroys chlorine bleach through some chemical changes. This is another reason why the saturated water system is not practical. If the wash water was saturated with ozone in a supply tank and was then transferred to the wash wheel for a bleach operation, the chlorine would be made ineffective for stain removal. Bleaching with ozone during the wash cycle is easier when you control the application of ozone by cycle, time and amounts for the best wash.

The use of hydrogen peroxide bleach in conjunction with ozone can be a very effective stain removal tool when used properly as stated earlier. There is a synergy between these two chemicals, hydrogen peroxide and ozone that multiplies the individual benefits.

The benefit of ozone in the wash does not stop at the drain. Ozone can be very beneficial in the waste stream and water reuse system. The high oxidation capacity of ozone aids in the process of coagulation, flocculation and filtration. It attacks soil and decomposes much of it to air, water and carbon dioxide. Ozone bleaches out color and removes odor. It makes some soil insoluble for easy removal, drops out some metals, reduces BOD, COD, TSS and total organic carbon along with many other compounds found in the waste stream or equalization tank.

An environmentally sound, competitive edge

The mechanics of installation of an ozone system appears to be quite simple. Many people are fooled by the process. An understanding of ozone and how it works in the washroom is very important to having a successful operation. The balance of ozone volume and concentration or intensity applied properly to the wash formula is critical. The total operation and understanding of soil classification, wash formula, wash chemistry and the effects that all of this has on the wash and effluent system of the plant determines the payback and level of aid in complying with environmental regulations. The right tool in the wrong hands doesn't help the bottom line.

Ozone, though it's been around since the 1870s, is still in its infancy. A lot of research is presently going on with ozone applications in many differing fields of service.

Ozone, as one of the building blocks of a comprehensive treatment system enhances your laundry operation, provides air and drinking water purification along with other multiple benefits that do not require continuous operator monitoring.

To stay competitive in today's market, you must work within the environmental laws. You must remain flexible in your approach to meet changing demands, while providing a good quality product and reliable service from a profitable operation. Ozone, when applied properly, can serve as a helpful tool in meeting these commitments. **TR**

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