Appendix E

Ozone in the Laundry

The following article appeared in the April 2003 issue of *Executive Housekeeping Today*. Jack Reiff shows us how to incorporate new technologies into our operation that will conserve our resources, save us money, and help us to avoid polluting. I wish to thank Beth Risinger, CEO/Executive Director, and Andi Vance, EHT Editor/Ad Sales at the International Executive Housekeepers Association (IEHA) for allowing me to reprint this and other articles from *Executive Housekeeping Today* in this book.

Ozone Puts the Washroom On A Diet

By Jack Reiff

"Dilution is the solution to pollution," was a common saying in textile rental and other industries depending on water for processing. The statement may be true, but it is a costly solution considering the price and/or scarcity of water and the expense of sewage disposal in many areas.

Dilution does, however, play an important role in washroom chemistry that is often ignored in wash formula discussions. But a common test process, chemical titration, explains the dilution process and provides an opportunity to understand how a new ingredient—ozone—can put the entire wash process on a diet.

It Wouldn't Be Washing without Dilution

The chemical industry has developed a number of products and laundering techniques to remove soils from all types of fabrics that are safe and effective in cleansing the fabric without causing excessive fabric degradation. Current methods of chemical soil removal in the wash formula are emulsification, saponification, lubrication, flocculation, neutralization, oxidation and color alteration.

The general theory of washroom soil removal promoted by the chemical industry includes four processes—time, temperature, mechanical action and chemical action. The theory states that changing one process affects all the other processes. This is true. And taking the theory at face value should mean that increasing chemistry allows for the reduction of time, temperature and mechanical action.

This, however, isn't true because the theory ignores the process of dilution, which is necessary to rinse away soil that has been dislodged by the chemicals and to remove chemicals from the wash liquor to prepare it for the next chemical phase of the wash formula.

In a wash formula, chemicals (alkali and detergent) are added based on soil level and washwheel capacity. The resulting alkali activity establishes the parameters to bring the alkalinity of the wash liquor to specific levels for different activities: Removing soil, bleaching or removing stains, neutralizing, or adding fabric treatments.

The pH of the wash liquor, which is based on the amount of alkali added, is measured by titration. This analytical process uses amounts of acid of a known strength to neutralize and measure alkalinity of an unknown quantity. For example, if alkali added to the wash for medium soil creates a titration of 18 drops of normal acid in the wash process, the titration sequence might be as shown in Exhibit 1 (below):

Exhibit 1

Operation	Water Level	Titration
Break/Wash	Low	18 drops of normal acid
Carryover suds	Low	12 drops
Flush	High	6 drops
Flush	High	3 drops
Bleach	Low	2 drops (if water is clear)
Rinse	High	1 drop
Rinse	High	5 drops of 1/10 normal acid
Antichlor rinse	High	3 drops of 1/10 normal acid
Sour/treat	Low	pH 5.5

As the exhibit indicates, water levels (dilution) affect the titration arithmetically because of the water and chemicals retained by the fabric. High-water operations reduce the titration by about one-half from the previous step; low-level operations reduce titrations by about one-third.

If, according to the theory, more chemistry is used to remove and suspend increasingly heavier soils, then time, temperature and mechanical action should be reduced. However, the situation is just the opposite—the more chemicals used, the more water operations that are needed to reduce chemical and soil levels. And more operations require more mechanical action, which leads to more electrical use, longer operating hours and more wear and tear on equipment and textiles. This negatively affects the bottom line.

An equally unacceptable solution is to rely on chemistry to neutralize the alkalinity of the wash formula. This produces neutral salts that stay in the fabric, creating wash formula problems and user discomfort.

But by including dilution in the traditional washroom technology pie, operators can develop formulas that achieve the most efficient use of time, temperature, mechanical action and chemical action.

Employing high-level rinses allows for the greatest dilution of dissolved materials, which means more soil can be separated from the load and drained away. High-level rinses also create a higher ratio of water removed by draining water retained in the textiles, allowing for a higher percentage of materials, including alkali, to be removed at each rinse step. By progressive dilution, high-level rinses eliminate all but a very small amount of dissolved and suspended materials from the load (see *What*

You Should Know About Laundering and Textiles, by Eugene Smith, Ph.D., and Pauline Mack, Ph.D.; pp. 77–99).

How Ozone Can Improve the Process

Ozone, a new ingredient in washroom technology, also can help improve washroom efficiency. A quick and effective oxidizer, ozone is part of the chemistry added to the break/wash cycle to remove the soil that is held by the alkali and detergents. In effect, ozone cleans up the water by cleaning the detergent chemicals so that they can be reintroduced into the washwheel and continue to remove soil from the fabric.

Ozone accomplishes this by:

- replenishing oxygen in the wash water
- decomposing fats, oil and grease
- preventing redeposition of soil
- softening the wash water
- purifying the wash water
- working like an oxygen bleach
- requiring lower wash temperatures
- removing soil attached to the wash chemicals
- and deodorizing the wash liquor and vapor.

Ozone is added to all of the operations of a wash formula to continually clean the wash liquor, putting dilution on a diet.

Ozone chemistry is simple: The three oxygen atoms that bind together by an electrical input to form O_3 are unstable and have an affinity for almost any atoms other than a pair of oxygen atoms. In the washwheel, the third oxygen atom jumps ship and joins with a carbon atom to form carbon dioxide (CO_2) or with other nonorganic atoms to form oxides. This process makes wash water cleaner by reducing soil levels and making chemicals become more effective. Cleaner water allows for formulas that use:

- less chemicals
- fewer water operations
- shorter wash time
- lower water temperatures
- and peroxide instead of chlorine for bleaching.

(This enhanced oxygen technology has a synergy with peroxide; ozone and oxygen bleaches provide superior results with less color degradation than chlorine bleach.)

An added benefit is that ozone improves the quality of the wastewater going to the sewer, both because it helps reduce the concentration of wash chemicals and because it acts as a pretreatment for the wastewater.

Ozone technology still is in development but has proven to be an effective additive to the wash process. Used correctly, it can be one tool in the ROI (return on investment) arsenal for the laundry industry.

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