



Pressurized Ozone Hospital Laundry System

Background

What is Ozone?

Ozone is a form of oxygen found naturally in the Earth's atmosphere. It is formed by the breakdown of elemental, diatomic oxygen (O₂) and the recombination of a portion of the oxygen atoms into the gaseous triatomic molecule of ozone (O₃).

Ozone is one of the most effective biocides known — even better than chlorine and other commonly used disinfectants.

Ozone's Use in Laundry

Once the ozone is generated, how it is introduced into the wash water is the primary factor in determining the efficacy of the system.

Bubbling — This method involves pumping the ozone gas directly into the wash drum during the cleaning cycle. Mixing of the ozone gas and water is minimal due to the lack of pressure within the washer drum. This method also leads to the release of a significant volume of ozone into the work environment.

Dissolving — This method uses a venturi to create a vacuum that educts (pulls) the ozone gases into the stream of cold water being sent to the washer. Dissolution of the ozone gas is facilitated by increasing the water pressure.

The Benefits of Ozone Laundry

The benefits of ozone in the laundry can be categorized as either measurable or non-measurable.

Measurable Benefits

The measurable benefits of ozone in laundry are well documented.

However, there is a considerable range of benefit values (see *Table 1*).

Reduced Labor Costs – Since ozone cleans more effectively, re-washes of heavily soiled or stained items are less frequent, reducing the labor needed to sort and re-wash items.

Table 1 – Summary of Measurable Benefits of Ozone in Hospital Laundry

Benefit	Cost Decrease	Sources of Values (Number of Values)
Reduced energy costs	20-100%	Manufacturer's claims (n=4)
	75-95%	Actual installations (n=3)
Increased linen life	15-50%	Manufacturer's claims
	60-66%	Actual installations (n=2)
Reduced drying time	10-30%	Manufacturer's claims
	13-22%	Actual installations (n=2)
Reduced chemical/detergent costs	35-70%	Manufacturer's claims
	36-92%	Actual installations (n=4)
Reduced water/sewer costs	15-75%	Manufacturer's claims
	25-35%	Actual installations (n=3)
Reduced wash cycle time (reduced labor costs)	10-45%	Manufacturer's claims
	20-46%	Actual installations (n=2)

Reduced Energy Costs – Ozone can sanitize laundry even in cold water.

Increased Linen Life — Ozone shortens washing and drying times, reducing exposure to chemicals and heat, thus decreasing linen wear.

Reduced Drying Time or Lower Dryer Temperature – Ozone in the wash water expands the fiber of the linens, which allows freer airflow through the linens during drying.

Reduced Chemical and Detergent Costs – Ozone is such an effective disinfectant that fewer chemicals are required in the wash cycle.

Reduced Water and Sewer Costs – With less chemicals in the wash, fewer rinse cycles reduce water consumption and sewer discharge.

Non-Measurable Benefits

Most of ozone's non-measurable benefits are highly subjective, but they can be significant. The following non-measurable benefits are often mentioned in testimonials by ozone laundry system owners:

- ◆ Increased fabric softness, fluffiness, and brightness
- ◆ Improved fabric smell
- ◆ Eliminated static cling
- ◆ Reduced acidity and the accompanying reduction of decubitus ulcers (bedsores)
- ◆ The ability to mix white and colored linens
- ◆ Improved linen availability ❖

Case Study: Large Rural Hospital

America's largest non-metropolitan hospital was the first to install a pressurized, dissolved ozone system on a tunnel washer in the U.S.

Players

North Mississippi Medical Center (NMMC) — This 650-bed facility in Tupelo, Mississippi, serves 22 counties in Mississippi, Alabama, and Tennessee.

Tennessee Valley Authority (TVA) — TVA is the nation's largest public power company. As a regional development agency, TVA stimulates sustainable economic development in the public interest.

City of Tupelo Water & Light — The City of Tupelo Water & Light Department provides electric, water, and wastewater services to about 15,000 customers in Tupelo.

IndustrOzone/Alliance Commercial Equipment — IndustrOzone Technologies, LC of Raleigh, North Carolina is a leading producer and provider of ozone laundry systems. Alliance Commercial Equipment of Salt Lake City, Utah specializes in tunnel washers. Due to the complexity of tunnel washers, IndustrOzone and Alliance work in tandem on all tunnel applications to assure systems meet the customers' needs and deliver long-term results.

Goals and Purpose

TVA and its distributors actively work to demonstrate electrotechnologies that bring added value to the operations of large commercial and industrial customers. Although ozonation had been used successfully in commercial conventional washing machines, its use in tunnel washers had not been demonstrated in TVA's service region.

Approach

NMMC's laundry facility consists of three washer/extractors and one tunnel washer. The facility operates nine-hours-per-day, seven-days-per-week and handles laundry from 58 healthcare facilities in northern Mississippi and northwest Alabama. These 58 facilities house 1,162 patient beds and produce 18,350 lbs of laundry per day, or 6.7 million lbs per year.

Tunnel washers – like NMMC's Lavatec Lavatrac shown in Figure 1 – are used by institutions and commercial laundries that process large amounts of laundry on a relatively continuous basis. Fundamentally, a tunnel washer is a continuous batch washer – or CBW – since it washes several loads of laundry simultaneously.

Figure 1 – Side (L) and Loading Chute (R) of Lavatec Lavatrac Continuous Batch Washer at NMMC



Ozonation of wash water makes it possible to clean and sterilize materials using lower temperature water and fewer chemicals.

However, in the case of NMMC, energy savings were not possible, since wash water was not heated using boilers, as is the typical method in large laundry operations. Historically, wash water at NMMC was heated using waste heat from an innovative 83-ton heat exchange system utilizing closed-loop, water-cooled heat pumps that cooled the laundry room. However, since ozone works better in cool water, NMMC needed another way to discharge half the waste heat from the laundry room. This was accomplished by installing a 42-ton cooling tower at a cost of \$42,000. Now, the system produces sufficient



Tunnel washers use large amounts of hot water and chemicals. As such, there are several opportunities to make this process more efficient, enhance customer value, and enhance sales for an electric utility.

Two major measurable benefits of ozone in laundry systems are water heating and chemicals use.

hot water for NMMC's three washer/extractors, while the remainder is discharged via the cooling tower.

In February 2004, Alliance installed three corona discharge ozone generators manufactured by IndustrOzone – one of which is shown in Figure 2. Alliance used dissolved ozone systems with

Figure 2 – Alliance/IndustrOzone Ozone System (L) and Corona Discharge Tubes (R)



pressurized water, making the tunnel washer at NMMC the first hospital tunnel washer with a pressurized, dissolved ozone system in the U.S. After some initial tuning and balancing of the system to accommodate the continued use of reduced amounts of oxygen bleach, the ozone system has been operating flawlessly.

With the ozone generators costing \$84,900, the total cost of the ozone system was \$126,900, including the \$42,000 cooling tower (but not considering the \$50,000 contribution by TVA and the City of Tupelo Water & Light Department).

Results

The three major benefits from the operation of the ozone system at NMMC were reduced chemical and detergent costs, reduced labor costs, and reduced linen replacement costs.

Reduced Chemical and Detergent Costs

Chemical costs were reduced, but not eliminated entirely at NMMC, because of the desire to retain some oxygen bleach use while the ozone system is being calibrated and the staff is getting used to the ozone system’s operation.

Reduced Labor Costs — Labor costs for overtime

were reduced ten percent because the volume of laundry items needing re-washing due to inadequate removal of stains, odors, or soils had decreased 93 percent, from 600 lbs to 43 lbs per day.

Reduced Linen Replacement Costs

— The cost of replacement linen was estimated to be the largest cost savings for NMMC, comprising just over one-half the operating cost savings.

Table 2 shows the estimated annual impacts on operating costs at NMMC, based on the savings documented during the first few months of operations. Overall, costs decreased by about 13 percent. This figure is especially remarkable considering that there were no energy savings at NMMC.

Therefore, even without any energy savings, the ozone system should pay for itself in about eight months (not

including the \$50,000 contribution from TVA and the City of Tupelo Water & Light Department).

In addition to NMMC management’s positive response the measurable cost savings, the response to the ozone system by NMMC staff has been overwhelmingly positive as well. Robert Watson, the Director of Laundry Services at NMMC, states that even after just a short operating period, several other benefits have been realized due to the ozone system, including:

- ◆ Complaints by nursing staff about fabric roughness have been eliminated
- ◆ Complaints by nursing and housekeeping staffs about poor fabric odor have been eliminated
- ◆ Complaints by laundry staff about static cling have been eliminated
- ◆ Many have remarked that the white linens – especially sheets – were noticeably whiter
- ◆ Bacteriostatic test results have shown no decrease in laundry cleanliness due to the use of ozone
- ◆ The operation of the ozone system is simple, requiring only that the system be turned on in the morning, off at night, and that the system be told what type of laundry each load contained for the proper ozone settings to be carried out automatically
- ◆ NMMC’s maintenance supervisor concluded that the ozone system is less labor intensive than the balance of NMMC’s laundry system, in terms of required maintenance. ❖

Table 2 – Estimated Annual Operating Cost Impacts of Ozone Laundry System at NMMC

Estimated Annual Operating Costs				
Operating Costs	Before Ozone	After Ozone	Change	Percent Change
Chemicals	\$72,000	\$61,200	- \$10,800	- 15%
Labor	725,000	652,500	- 72,500	- 10%
Replacement linens	700,000	595,000	- 105,000	- 15%
Totals	\$1,497,000	\$1,308,700	- \$188,300	- 13%

Case Study: Nursing Home

An application of ozone sponsored by TVA at a skilled nursing facility in Murfreesboro, Tennessee.

Players

Community Care of Rutherford County is a county-owned nursing home in Murfreesboro, Tennessee, which is located about 35 miles southeast of Nashville. This 131-bed skilled nursing and rehabilitation facility has a laundry staff of 5 to 6 persons who operate two Unimac 60 lb capacity washer/extractors, as pictured in Figure 3. Laundry water at the facility is heated electrically.

Figure 3 - Community Care of Rutherford County's Two Unimac 60 lb Capacity Washer/Extractors



Approach

Community Care installed an IndustrOzone KA32 ozone system in January 2002 at a cost of \$18,000. The KA32 system, pictured in Figure 4, is designed for light to medium soil conditions and can accommodate up to 250 lbs of washer capacity and instantly deliver in excess of one part per million of dissolved ozone with little or no

ozone residual odor. These models also feature the Clear-View™ piping system that allows operators to see the ozone gas as it enters through the patented ozone injection system, and watch as the ozone gas completely dissolves in to the water before it enters the washer/extractors.

Results

Table 3 shows that the annual impacts on operating costs at Community Care of Rutherford County have been significant and quickly achieved, as is the case in most ozone laundry installations. Since the

installed cost of the system was \$18,000, the simple payback, based on the figures in Table 3, was just over six months. Unlike most ozone laundry systems, however, Community Care of Rutherford County has not realized any water savings due to the very short wash cycles used prior to installation of the

ozone system.

Non-financial impacts have also been very favorable at Community Care of Rutherford County. There has never been a history of bedsores at the facility, but there has been a dramatic decrease in sheer burns (a type of burn most often associated with the rubbing of skin across linens as when transferring a patient from a bed to a chair or vice-versa —

analogous to a “rug burn”). Community Care of Rutherford County has also reported tremendous improvements in linen odor, improved linen softness, and decreased volume of re-wash items. ❖

Figure 4 - IndustrOzone KA32 Ozone System with Capacity of up to 250 lbs



Table 3 - Annual Operating Cost Impacts of Ozone Laundry System at Community Care of Rutherford County

Operating Costs	Annual Savings
Energy	\$13,200
Replacement linens	21,600
Totals	\$34,800 / Year

Additional Information

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