Environmental and Monetary Saving From Ozone in Hotel Laundry Operations

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ABSTRACT

In its role as a powerful oxidant and biocide, ozone eliminates or alleviates a variety of common laundry problems. One of the most valuable benefits of ozone to on-premise laundry operators is the near elimination of hot water consumption, since ozone can clean and disinfect better in cold water than in hot. Other cost savings result from reduced water and chemical use, reduced labor costs, shorter drying times, and longer fabric life. Non-quantitative benefits include brighter and softer fabrics, the ability to mix white and colored fabrics, and improved fabric odor. Presently, the environmental benefits that come about from ozone's use are attracting even more consumer interest than the monetary savings.

This study takes a comprehensive account of all the quantifiable savings and benefits of using ozone in a typical large hotel laundry application in the San Francisco Bay Area, relative to a baseline of chemically-based laundry operations within the same facility. Hot water consumption was reduced over 91% and total water consumption was reduced 35%. These reductions amount to annual reductions in hot water use of over 1.3 million gallons, which will result in natural gas savings of nearly $12,400 per year. Overall annual water use reductions are estimated to be 864,000 gallons—an annual water/sewer cost reduction of over $6,800. Drying times have been shortened by about 8%, resulting in equivalent natural gas consumption reductions by the dryers.

Introduction

This paper describes the results of an assessment of the environmental and energy impacts resulting from use of ozone in the on-premise laundry (OPL) facility of a 278-room mid-level hotel.

Project Impetus

While the use of ozone in laundry operations is becoming more common, most of the available data on the energy impacts its use are from the equipment manufacturers themselves, which calls into question the objectivity of the figures. The market segment and product teams at Pacific Gas & Electric (PG&E) felt that they needed data collected and analyzed by an impartial third-party to be able to objectively promote the technology among their hospitality customers.

For this project Global Energy Partners, LLC (Global) tracked the energy and water consumption of the OPL operations at the hotel before and after the installation of the ozone equipment.

On-Premise Laundry Operations

The basic equipment used in on-premise hospitality industry laundry operations is fairly standard. All hospitality facilities, except for the very largest, operate washer-extractor machines for laundering linens. (The very largest facilities will typically operate continuous batch or "tunnel" washers.) Washer-extractors are large versions of the front-loading, horizontal axis washing machines commonly found in homes. The term washer-extractor comes from the fact that besides washing the linens, the machines extract water from the linens by spinning the drum containing the linens at very high speed, rather than using a separate piece of equipment to remove the water. All OPL facilities will also have dryers. Larger facilities may also have sheet folders and irons, but the use of ozone does not impact the energy use of this equipment.

After collecting soiled linens and towels from the guest rooms, the hotel's housekeeping staff brings them to the laundry room. There they sort the soiled laundry, typically by color or type. This is necessary because different linen types are made of different fabrics and they are exposed to different soil types and require different chemicals, wash duration, and water temperature needs as a result.

Laundry personnel load the laundry into the washer-extractors by hand, select the appropriate wash program, and start the machine. The control system of the washer-extractor automatically measures and injects all chemicals into the machine in the proper amount and at the appropriate time. When the wash cycle is finished, the laundry staff manually removes the laundry from the washer-extractor and places it into the dryers. Again, laundry personnel select the appropriate drying cycle and start the dryer.

Ozone 101

What Is Ozone? Ozone is a form of oxygen found naturally in the Earth's atmosphere. In its most stable form, oxygen exists as a gaseous diatomic molecule (O_2). Ozone is a gaseous triatomic molecule (O_3) formed by the breakdown of elemental, diatomic oxygen and the recombination of a percentage of the oxygen atoms.

Although diatomic oxygen is a powerful oxidizing agent in its own right, ozone has much stronger oxidizing properties and reacts more quickly, often in fractions of a second, with a wide range of substances. In addition, ozone is one of the most effective biocides known to science, better even than chlorine, bromine, and other commonly used disinfectants. Once ozone has fully reacted with substances in water or air, excess gas decomposes quickly to normal oxygen and is reabsorbed into the atmosphere.

How Does Ozone Clean? Being a powerful oxidizer, ozone cleans fabrics by chemically reacting with soils. Ozone removes electrons from the soils, causing the soils to break into smaller molecules that become water soluble and are released from the linen by ordinary agitation within the washer-extractor.

When dissolved in water, ozone has a longer life in cold water than in warm or hot water. Therefore, it is a more effective laundry disinfectant in cold water. This is from where ozone's energy benefits arise as ozone can significantly reduce and even eliminate the use of hot water in laundry operations.

How Is Ozone Used? How ozone is used depends on several factors, but especially the chemical and laundry equipment vendors. Typically, ozone augments chemical laundry operations rather than replacing them completely. Most chemical vendors have laundry chemicals that work in conjunction with ozone. In addition, ozone is not applicable to all types of linens. Linens such as towels, rags, and tablecloths that are exposed to fats, oils, and grease (referred to collectively as "FOG") must still be washed in hot water with bleach as ozone will have little effect on FOG.

How Is Ozone Produced? The most common method of producing ozone for laundry applications is by corona discharge. Simply put, dry air is passed through a high voltage field. The high voltage field causes some of the oxygen molecules to split into separate oxygen atoms. Individual oxygen atoms (O) are unstable and attach to other oxygen molecules (0_2), forming ozone molecules (O_3). Ozone quickly breaks down and recombines as oxygen. Therefore, it cannot be stored, but instead is produced on-premise as needed.

Techniques for Injecting Ozone to the Laundry System

Because it cannot be stored, ozone is generated as needed and introduced into the wash water as the washer-extractor is being filled and/or while the washer-extractor is in operation. Different manufacturers of ozone equipment for laundry operations employ a variety of techniques to inject or introduce the ozone gas into the washer-extractor. Each technique has its advantages and disadvantages. Overall, ozone—regardless of how it's introduced—will provide cost savings benefits. Following are the four most common methods of applying ozone into the laundry system (Cardis et al. 2008).

Recirculation Injection. Recirculation injection (RI) systems continuously circulate wash water between the washer and the ozone system. As a result, the wash water is continuously re-oxidized and ozone-enriched. An oxidation-reduction-potential controller or an ozone parts per million (PPM) controller is highly recommended for monitoring and controlling ozone concentration in the water. Even though the RI approach can handle heavy soil and microbe loads and save water it is seldom used because it is the most complex and expensive of the four design alternatives. In addition, RI systems require constant maintenance to keep lint filters clean for proper system performance, which further reduces their appeal.

Diffusion. As with the RI approach, diffusion systems continuously inject ozone directly into the sump of the washer throughout each step of the wash cycle. However, diffusion systems omit the piping, pump, contact vessel, and filters required by RI systems. As a result, they are less complex and costly than RI systems.

Direct Water Injection. With direct water injection (DWI) equipment, ozone is injected by means of a venturi directly into the cold water supply line leading to the washer. This is a single charge system, so the wash water is ozonated only once just before it enters the washer-extractor. As a result, the ozone concentration of the wash water will decrease throughout the entire wash cycle, depending on the length of the wash cycle and the soil level of the laundry. This type of system is the simplest and, therefore, the least costly and easiest to maintain.

Charge System. A variant of the DWI approach, a charge system (CS) includes a recirculation loop from the ozone contact vessel to the ozone system. A charge system mixes ozone with cold water and then continually recycles it between a contact vessel and the ozone system to maintain a predetermined ozone level in the water. The CS approach makes it possible to achieve higher effective concentrations of ozone in the water prior to releasing it into the washer. However, like the DWI approach, the ozone-enriched water is not recharged once it enters the washer.

The Benefits of Ozone in Laundry Operations

The reported benefits of using ozone in laundry operations are so numerous as to be, at times, difficult to believe. This is one of the reasons that ozone system manufactures and distributors have had a hard time breaking into the OPL market. In addition, many of the quantifiable benefits have not been quantified by unbiased, third parties that would lend credibility to the figures. Additional qualitative benefits exist that can be very important to some facility operators.

Quantifiable Benefits. The quantifiable benefits of ozone in laundry operations are well-documented. However, there is a considerable range of benefit values and, at the same time, a dearth of unbiased, third-party values.

- Reduced water and sewer costs — Ozone aids the effectiveness of traditional laundry chemicals and requires far less rinsing. With less chemicals in the wash, fewer and shorter rinse cycles result in reduced water consumption and sewer discharge.
- Reduced hot water consumption — Ozone works best in cold water, so that sanitizing, typically using hot water, can be accomplished in cold water – saving considerable energy.
- Reduced drying time — Ozone does not change the water's pH like detergents and bleach, so less souring (alkalinity reducing) chemicals are needed. This in turn reduces the need for softener, which tends to coat the fibers and holds moisture in the fabric, extending the drying time.
- Increased linen life — Ozone shortens washing and drying times, reducing exposure to chemicals and heat, thus decreasing linen wear. Shorter cycle times and cooler water temperatures with fewer rinse steps means less wear and tear on textiles. The water softening properties of ozone and reduced exposure to chemicals also improve fabric life.
- Reduced chemical and detergent costs — Ozone is such an effective disinfectant that fewer chemicals are required in the wash cycle.
- 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.

Qualitative Benefits. There are several non-measureable benefits that have accrued to operators of ozone laundry systems, most by way of observation.

- Increased fabric softness, fluffiness, and brightness — Ozone helps prevent redeposition of soil onto the wash (one of the major causes of fabric graying), which eliminates the need for further bleaching. Ozone reduces chemical use, which causes fabrics to become rougher.
- Improved fabric smell — Ozone deodorizes by breaking molecular bonds of most organic and inorganic compounds that cause odors.
- Ability to mix white and colored linens — Ozone reduces the need for bleach in many applications. As a result, white and colored linens can be washed together, which saves labor necessary for separating.
- Improved linen availability — Many OPL facilities have observed fewer laundry items needing to be re-washed after laundering in ozone, which improves the availability of existing linens.

Project Objectives

The objectives of this project were to showcase an innovative application of an available technology that has great potential for environmental and energy savings in laundry facilities in the PG&E service area. A favorable demonstration of this technology may warrant PG&E involvement to accelerate the adoption of this technology through utility-sponsored programs.

This project took place at a hotel in the PG&E service area. However, the technology has applications in almost any commercial facility having OPL operations, such as hospitals, nursing care facilities, hotels, motels, and prisons, regardless of its location.

Project Overview

Methodology

Global designed the project methodology to establish a baseline of energy consumption prior to the installation of the ozone equipment and then compare pre-installation to post-installation energy use. The project followed a five-step process:

1. Identify a host hospitality facility within PG&E's service area that would be willing to host a demonstration of the technology. Ideally, the host facility would be part of a well-recognized hospitality chain, which would facilitate technical and information transfer to other hospitality facilities by PG&E staff. Positive project results at a facility belonging to a well-recognized chain would accomplish three objectives: 1) it would attract more attention and interest, 2) using a well-known chain would likely legitimize the results, and 3) with many similar facilities throughout the chain, replicating the results would be made easier. Complicating the identification of a host facility was the fact that PG&E could not pay for any part of the equipment or its installation due to regulatory constraints. Alternatively, the host facility would be eligible to apply for an energy efficiency rebate through PG&E.
2. After Global and PG&E had identified the host facility and prior to installation of the ozone system, a one-month baseline of water consumption was established by metering the hot and cold water supply to the washer-extractors. This provided information on both water and sewer consumption impacts as well as water heating energy impacts. Establishing dryer operating times would be used to determine dryer energy use.
3. At the end of the one-month baseline monitoring period, the ozone equipment distributor installed the ozone generator and distribution lines to each of the washer-extractors. The chemical vendor then re-programmed the washer-extractor formulas and wash cycle settings to account for the addition of ozone to the chemical array.
4. Once the ozone equipment distributor calibrated the ozone equipment, determined it was working properly, and the new formulas were producing suitable results, the post-installation monitoring period began.
5. At the end of the post-installation period, Global prepared a final report with actual energy and non-energy savings results at the host facility.

Project Host & Laundry Equipment

The facility selected to host this project is a 278-room mid-level hotel owned by a well-known worldwide chain. The hotel, located in the San Francisco Bay Area, is 13-stories high and features a full-service restaurant, lounge, pool, workout facility, and over 9,000 square feet of meeting and banquet space. Owing to these amenities, the linens used and laundered on-premise include sheets, blankets, bedspreads, towels, tablecloths, table skirts, napkins, and kitchen and cleaning rags.

The primary laundry room equipment consists of three washer-extractors and four gas-fired dryers, as detailed in Table 1.

Table 1. Laundry Room Equipment at Host Facility

Equipment	Units	Manufacturer	Model	Capacity (lbs)	Year Manufactured
Washer-Extractor	3	Pellerin Milnor	36026Q6J	95	1998
Gas Dryer	4	Pellerin Milnor	MLG130HS	120	1997

The facility typically operates its laundry equipment between 3 pm and 11 pm each day. Laundry staff manually separates the linens based on which of the six washer-extractor programs each type of linen requires. Table 2 shows the six formulas programmed into each washer-extractor.

Table 2. Washer-Extractor Formulas with Ozone at Host Facility

Formula	Water Temperature	Ozone Used?
#1 – New Linen	Cold	Yes
#2 – Whites (sheets & towels)	Cold	Yes
#3 – Bed Spreads	Cold	Yes
#4 – Table Cloths - Color	Hot	No
#5 – Table Cloths - White	Hot w/Bleach	No
#6 – Power Wash (re-wash)	Hot	No

Formula 2 is the most commonly used formula at the host facility, since sheets and towels account for 80% of the linens used each day. As an example of the differences between the traditional and ozone formulas, Table 3 compares the traditional and ozone versions of Formula 2. After the changeover to ozone, there is no need for a bleach step. Without a bleach step, the ozone formula requires fewer rinse steps and combines the sour/soft step with a final rinse.[1] As a result of the change to ozone, each load of sheets and towels takes 5-1/2 minutes less to wash than before and consumes 117 gallons less hot water and 30 gallons less water overall, in spite of consuming 87 gallons more cold water.

Two gas-fired Laars Pennant automatic circulating tank water heaters (model PNCV1750NACL2BXN) provide the hotel's hot water, including the hot water used in laundry operations. These two units are able to supply just over 2,200 gallons per hour (GPH) of 140°F water. With rated input power of 1.75 MMBtuh each, recovery efficiency of 0.85, and a water temperature increase of 80°F, the two water heaters consume 0.0078 therms (781 Btu) per gallon of water heated.

[1] The sour/soft step involves a combination of a slightly acidic chemical–the sour–that neutralizes residual alkalinity leftover from the suds (detergent) step and a softening chemical in one step.

Table 3. Comparison of Traditional (Before) and Ozone (After) Formulas #2

Laundry Step	Traditional Formula #2			Ozone Formula #2		
	Cold Water (gallons)	**Hot Water (gallons)**	**Run Time**	**Cold Water (gallons)**	**Hot Water (gallons)**	**Run Time**
1) Suds	0	47	8 mins	47	0	10 mins
2) Bleach	0	15	8 mins			
3) Rinse	0	22	2 mins	22	0	2 mins
4) Rinse	11	11	2 mins			
5) Spin	—	—	0.5 mins	—	—	2 mins
6) Rinse	22	22	2 mins	44	0	2 mins
7) Sour/Soft	15	0	4 mins	22	0	4 mins
8) Spin	—	—	4 mins	—	—	5 mins
Totals	**48 gallons**	**117 gallons**	**30.5 mins**	**135 gallons**	**0 gallons**	**25 mins**
	165 gallons			**135 gallons**		

Ozone Equipment

The host facility installed a direct water injection ozone system manufactured by Total Ozone Solutions of Bridge City, TX. Figure 1 illustrates the layout of the ozone system installed at the host facility. The system injects gaseous ozone directly into the cold water supply line that provides water to each of the three washer-extractors.

Consisting of a single self-contained, wall-mounted ozone generator (Figure 2), the installed ozone system is simpler than most ozone systems installed for laundry operations. Depending on the manufacturer and the technique used to apply the ozone, ozone laundry systems may also include an air preparation unit (sometimes called an oxygen concentrator), a recirculation pump, an ozone contact tank, an ambient ozone monitor, and an ozone destruct unit. The only utility requirement for the installed system is 110V electrical service.

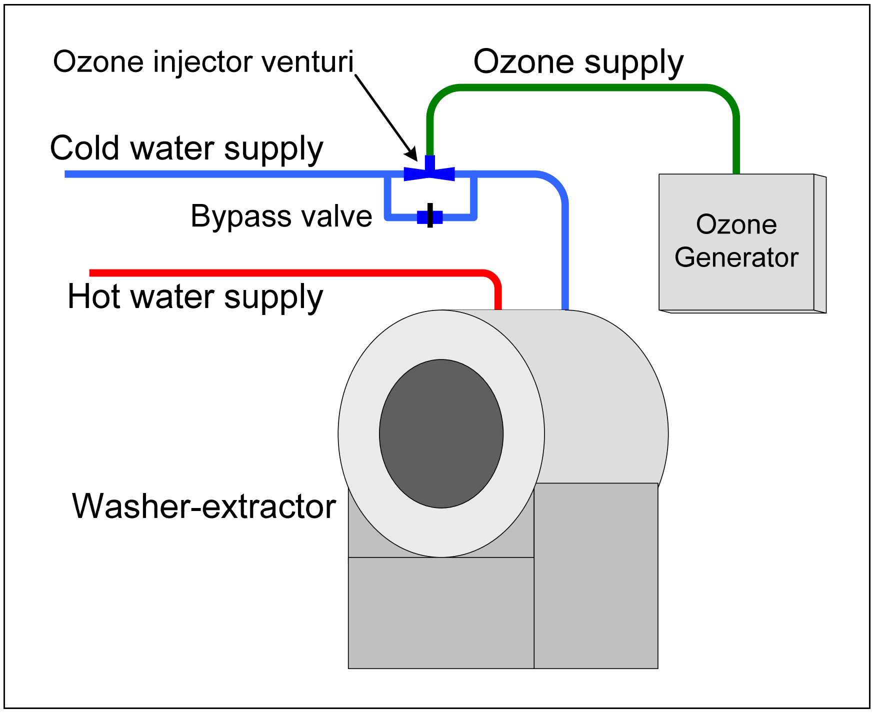

Figure 1. Plumbing of Direct Water Injection System at Host Facility

Figure 2. Ozone Generator Mounted on Wall of Laundry Room (L) and With Cover Open (R)

The installed ozone system is simple to operate, requiring only that laundry staff manually switch the ozone generator on when laundry operations begin and turn it off when they cease. The generator produces ozone only when cold water flowing through the ozone injection venturi creates a vacuum on the ozone supply line. Because the generator is vacuum controlled, there is no chance of an ozone leak. Maintenance consists only of weekly cleaning of the lint screens on the two cooling fans.

The host facility installed the ozone generator and associated plumbing at a cost of $14,000, including labor. The installation required minimal modifications to existing plumbing, which kept labor costs down. Over the next three years, natural gas and water utilities are expected to provide pro-rated rebates that will cover almost the entire project cost.

Project Results

As presented earlier, there may be many sources of cost savings and environmental benefits resulting form the use of ozone in laundry operations. This study emphasized the substantiation of the utility cost savings: water and sewer, electricity, and natural gas. The savings from utility costs alone resulted in a simple payback that, even without utility rebates or other incentives, should generate significant interest in the use of ozone for laundry operations—not only in the hospitality industry, but in any industry with OPL operations.

Water & Sewer Savings

Property managers at the host facility monitored the flow of hot and cold water into each of the three washer-extractors for 30 days prior to installation of the ozone system and for 30 days after installation. Table 4 compares daily hot and cold water consumption for laundry operations during those two periods. The use of ozone in the laundry operations reduced hot water consumption by over 91%. Cold water use increased by over 41%, because the use of ozone calls for cold water instead of hot. Overall, however, water consumption for laundry operations decreased by an average of 2,432 gallons per day or over 35%. This is equivalent to over 863,000 gallons per year. During the 60-day monitoring period, occupancy at the hotel was stable at about 75%. Therefore, a change in the number of guests accounts for little, if any, of the variation in water consumption for laundry operations.

Table 4. Comparison of Average Daily Water Consumption by Washer-Extractors, Pre- and Post-Installation

Monitoring Period	Cold Water – Average Daily Use (gallons)	Hot Water – Average Daily Use (gallons)	All Water – Average Daily Use (gallons)
30-Day Pre-Installation	2,902.9	3,990.1	6,893.0
30-Day Post-Installation	4,112.7	348.0	4,460.7
Difference	1,209.8 (41.7%)	-3,642.1 (-91.3%)	-2,432.3 (-35.3%)
Annualized Difference (gallons per year)	452,867	-1,316,420	-863,553
Annualized Difference (hundred cubic feet)	605.4	-1,759.9	-1,154.5

A decrease in water consumption also means a decrease in water sent down the sewer. The host hotel's combined costs for water and sewer costs are $5.92 per hundred cubic feet (ccf).[2] Based on reductions over the 60-day monitoring period, the hotel will realize water and sewer cost reductions of $18.72 per day or $6,835 per year.

Energy Savings

Because ozone works best at ambient water temperatures, most types of linens can be washed in unheated water, which reduces water heating costs. Electricity is not a big part of overall laundry energy use at the host facility, since the water is heated using natural gas and the dryers are natural gas-fired. As a result, the most significant energy savings at the host facility resulted from reduced natural gas consumption for water heating and clothes dryer operation.

Electricity Savings. Electricity savings resulted from shorter washer-extractor operating cycles and shorter drying times, which shortened the operating times of the motors within that equipment.

Each of the two washer-extractors contains a single 10 hp motor that spins the cylinder and operates the water pump. The motor operates nearly continuously during washer-extractor operation, with only short pauses between laundry steps. With the changes in Formula #2, washer-extractor motor run-times decreased 16%, resulting in electricity savings of approximately 0.5 kWh per load. Typical laundry operations result in about 40 washer-extractor loads per day, corresponding to savings of 20.5 kWh per day or 7,488 kWh per year. Analyzing the hourly energy charges for the periods during which the host facility operates its laundry facility, Global established that the average energy cost to the host facility is $0.09 per kWh. Therefore, the value of the washer-extractor motor savings is $674 per year.

Each of the four dryers has two motor: a 1 hp basket motor drive and a 3 hp blower motor. Both operate continuously while the unit is in operation. Establishing a change in dryer run-times due to the use of ozone proved to be quite difficult. Metering the electricity usage was not feasible because of the number of dryers. Metering only one dryer would not provide sufficient data to establish consumption because which dryer laundry staff uses to dry any given load is random, since the four dryers are the same.

To establish dryer run-times, Global staff observed the dryers in operation and noted the run-time–which the control panel displays–when the dryer stopped tumbling. The weighted average drying time before ozone was 26 minutes and the post-ozone weighted average was just under 24 minutes. The resulting reduction was smaller than anticipated and results in a savings of 0.08 kWh per load. Based on 40 dryer loads per day, daily savings are 3.2 kWh or 1,163 kWh per year. At a cost of $0.09 per kWh, the value of the dryer motor savings is $105 per year.

It is possible that the smaller than expected decrease in drying time was due to the retention of the sour/soft step in the ozone formula. Frequently, ozone formulas eliminate the sour/soft step, which results in shorter drying times.

The total annual electricity savings due to the ozone system is 8,651 kWh, with a value of $779 to the host facility. As expected, electricity savings accounted for a small share (3.5%) of the overall energy savings.

Natural Gas Savings. A majority of the natural gas savings resulted from the reduction in hot water consumption in the washer-extractor, with a small portion of the savings resulting from shorter dryer run-times.

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[2] One hundred cubic feet (ccf) is equivalent to 748 gallons.

As stated previously, hot water consumption fell 91%, or 3,642 gallons per day, as a result of the ozone system. On an annual basis, this is almost 1.32 million gallons. The natural gas savings resulting from this decrease is 28.4 therms per day or 10,383 therms per year. The 12-month weighted average cost of natural gas for the facility is $1.19 per therm. Thus, the value to the host facility of the natural gas savings due to reduced hot water consumption alone is $12,397, or nearly 89% of the cost to install the ozone system.

Each dryer contains a control system that determines the length of run-times. The operator loads the dryer, then starts the drying cycle by selecting cycle "B" (sheets, pillowcases, and towels) or cycle "C" (tablecloths & bedspreads) on the dryer's control panel. The dryer's control system then monitors the temperature of the exhaust air to determine the proper length for the drying cycle. At the beginning of the cycle, the exhaust air is comparatively cool due to the high moisture content of the linens. As the linens dry, the temperature of the exhaust air increases until there is insufficient moisture in the linens to cool the exhaust air further. At this point, the controller shuts off the burner, but continues to tumble the linens for a short "cool down" period. Due to various factors, each drying cycle tends to differ in length. In addition, laundry staff can manually add drying time if they feel the linen is still too damp.

The reduction in natural gas use due to the shorter dryer run-times was 0.133 therms per load. Based on 40 dryer loads per day, daily savings are 5.34 therms or 1,948 therms per year. With a natural gas cost of $1.19 per therm, the value to the host facility of the dryer natural gas savings is $2,326 per year.

The total annual natural gas savings due to the ozone system are 12,331 therms, having a value of $14,723 to the host facility. Thus, natural gas represents two-thirds of the savings resulting from the ozone system.

Summary of Savings

Table 5 summarizes the savings due to the installed ozone system at the host facility. As expected, the value of the natural gas saved due to the replacement of hot water with cold was the leading component of total savings. The value of the electricity savings were minor, also as expected. The value of the water and sewer savings were large than expected, which is significant since the ozone system vendor did not include that value in the pre-installation savings estimates upon which the host facility operator based their decision to install the ozone system.

Considering all the quantifiable savings resulting from the installation of the ozone system, the ozone system has a simple payback of 7.5 months. With available rebates and incentives, the payback would likely be significantly shorter.

Table 5. Summary of Savings Resulting from Ozone in Laundry Operations

Cost Point	Value of Each Unit Saved	Units Saved per Year	Value of Savings per Year	Percent of Total Savings
Water & Sewer	$5.92/ccf	1,154.5 ccf	$6,835	30.6%
Electricity (washer-extractors)	$0.0900/kWh	7,488 kWh	$674	3.0%
Electricity (dryers)	$0.0900/kWh	1.163 kWh	$105	0.5%
Natural gas (hot water)	$1.1940/therm	10,383 therms	$12,397	55.5%
Natural gas (dryer)	$1.1940/therm	1,948 therms	$2,326	10.4%
Total Quantifiable Savings	—	—	**$22,337**	—

Environmental Impacts

In addition to the energy and utility savings due to the ozone system, there are environmental benefits as well. Besides the greenhouse gas benefits from reduced power plant emissions and reduced direct combustion of natural gas from the decreases in the use of electricity and natural gas, respectively, there are other environmental benefits. The significant reduction in water consumption opens the saved water to other uses and end-users. In addition, less water down the sewer reduces strain on wastewater treatment systems–especially considering the chemical load associated with laundry water.

Conclusions

The value of the hot water savings at the host facility were about as expected. However, the value of the water and sewer savings was significantly greater than expected. The overall the value of the savings due to the ozone system were higher than anticipated, resulting in a payback short enough to remove almost any doubt that an OPL operator might have regarding the technology.

Ozone systems for use with OPL operations are now available on the market, although the number of vendors is still relatively small. With more studies such as this one, there will soon be adequate information available regarding the costs and benefits of ozone laundry system to further remove barriers to their widespread penetration of the OPL market.

References

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