U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Demonstration of Advanced Technologies for Multi-Load Washers in Hospitality and Healthcare – Wastewater Recycling Technology

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Prepared for the U.S. Department of Energy
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I. Executive Summary

The U.S. Department of Energy (DOE) Building Technologies Office seeks to develop and accelerate the integration of energy efficient technologies and solutions into new and existing buildings. An area of interest is multi-load washers used in the healthcare and hospitality industry because they are among the most energy intensive pieces of equipment used in these facilities. Multiple technologies are available on the market for significantly reducing energy and water consumption of multi-load washers. However, adoption of these advanced technologies has thus far been limited because of uncertainty about return on investment and concerns about reliability, performance, and user satisfaction, including hotel guest/healthcare patient satisfaction. Quantifying the energy and water savings potential of current market-ready systems will help promote the adoption of these technologies in the commercial sector.

The objective of this demonstration project was to evaluate market-ready retrofit technologies for reducing the energy and water use of multi-load washers in healthcare and hospitality facilities. Specifically, this project evaluated laundry wastewater recycling technology in the hospitality sector and ozone laundry technology in both the healthcare and hospitality sectors. This report documents the demonstration of a wastewater recycling system installed in the Grand Hyatt Seattle. The ozone laundry technology evaluation is documented in a separate report. [1]

In addition to quantifying the savings offered by this technology, the project also endeavored to characterize the relative satisfaction of the performance of the wastewater recycling system. Overall satisfaction was gauged based on discussions with laundry staff and engineering, including ease of integration, and operation and maintenance of the technology, as well as, consistency of the condition of the laundry and whether there was any change in customer complaints.

Laundry wastewater recycling is an add-on retrofit technology to improve energy and water efficiency in commercial laundries. In addition to the limiting factors to widespread adoption previously mentioned, space requirements and capital cost are considerations for this technology. The system works by initially cleaning the wastewater discharge from the laundry system through a series of filtration steps designed primarily for removing solids, followed by several stages of disinfection. The cleaned water is sent to a holding tank, where it is continually disinfected with oxidizing agents until it is needed for the next wash cycle, at which point it is further disinfected with ultraviolet light and sent back to the laundry system washers.

After the initial installation and startup period, systems typically require little maintenance apart from filter replacements. Wastewater recycling has little to no impact on wash quality, and can be used in all commercial facility types, regardless of the degree of laundry soiling.

AquaRecycle™, located in Marietta, Georgia, supplied the wastewater recycle system at the Grand Hyatt Seattle at an approximate installed cost of $100,000. The recycling system was already in place prior to this project,

[1] WJ Goetzler, TA Sutherland, KJ Foley, BK Boyd, GB Parker, GP Sullivan, JM Petersen, 2014. "Demonstration of Advanced Technologies for Multi-Load Washers in Hospitality and Healthcare – Ozone Laundry Systems." Prepared by Navigant Consulting, Inc. on behalf of Pacific Northwest National Laboratory for the U.S. Department of Energy, Washington, DC.

therefore, the baseline was developed by measuring the temperatures and flow rates of the recycled water returned to the washing machines. In the true baseline this water would have been supplied by make-up water, at make-up water temperatures. As such, the volumetric flow and the embodied energy of this system-return, serves as the net energy and water benefit to the installation, and thus the savings.

The results of this evaluation are based on data collected from November 2013 to February 2014. During that time the wastewater recycle system saved an average of 365 thousand gallons/month of combined water and sewer and 1,119 therms/month in hot water heating energy, while adding an electrical load of 1,922 kWh/month. In this case, the source of hot water is a heat-exchange process using distributed hot water generated by city steam with a heat exchange efficiency of 94% (according to the site). Scaling the three-month evaluation values based on average annual occupancy allows for the calculation of an extrapolated annual savings.[2] Table 1 shows the extrapolated annual results of the Grand Hyatt Seattle demonstration considering their electrical rate of $0.072/kWh, a combined water and sewer rate of $22.99/thousand gallons (kgal), and a hot water heating rate of $1.10/therm. The results show the system increases laundry electricity consumption, while providing significant water savings and reducing hot water energy requirements. Hot water heating in this case comes from steam which is provided by Seattle Steam, which generates the steam using natural gas as the fuel. In addition to the savings provided, laundry staff and facility engineering noted the technology integration went smoothly and overall customer satisfaction of the linens remains high, which is imperative given the status of the Grand Hyatt Seattle.

Table 1. Grand Hyatt Laundry Water Recycle Extrapolated Annual Evaluation Results‡

Utility Component	Utility Savings (unit/year)	Utility Rate	Net Monthly Savings ($/year)
Electricity	(27,220) kWh	$0.072/kWh	($1,960)
Water/Sewer	5,175 kgal	$22.99/kgal	$118,973
Hot Water	15,850 therms	$1.10/therm	$17,435
Total Net Savings $/year			**$134,448**
Simple Payback Period			**0.7 years**

‡ Based on 280,000 pounds of laundry/month and a wastewater recycle system cost of approximately $100,000.

Conclusions

The Grand Hyatt Seattle is characterized as having relatively high utility rates—especially water and wastewater rates. The wastewater recycle system projects to save 5,175 kgal of water/sewer and 15,850 therms of hot water heating energy annually while adding an electrical load of 27,220 kWh to operate the system. The result is significant net utility cost savings and a simple payback period of less than 1 year for the Grand Hyatt Seattle. The evaluation shows this technology could be financially attractive for hotels with similar laundry volume and similar utility characteristics. It also shows the system can be integrated at a high-end hospitality facility without negatively impacting the operation of the central laundry or the quality of the linens being laundered.

[2] Typical occupancy is 82.2% of capacity and the occupancy rate during the evaluation averaged 69.6% of capacity. Therefore the annual numbers were scaled by multiplying the utility consumption by 1.18 (82.2/69.6) to accurately project true annual consumption/savings.

Figure 2. AquaRecycle System (Photo: PNNL)

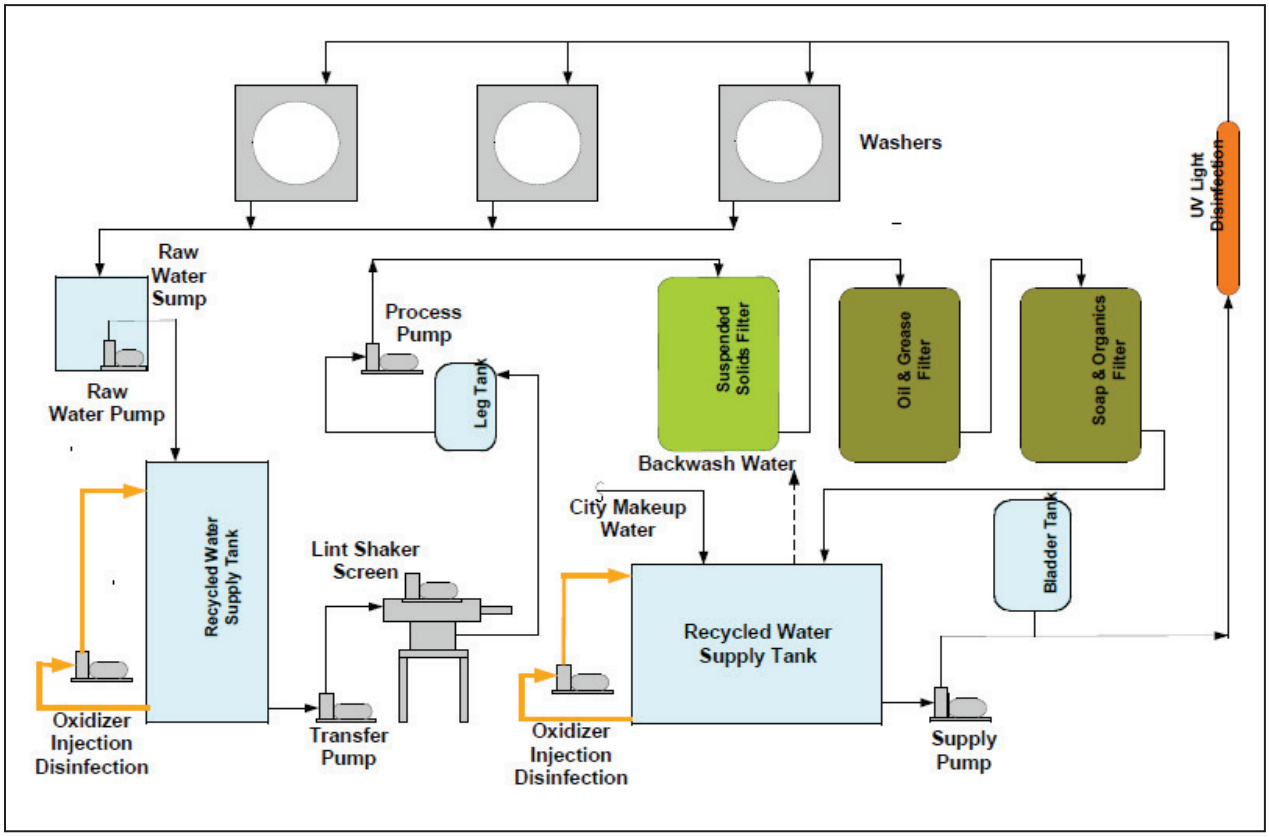

Figure 3. Schematic of AquaRecycle System