Laundries & Dry-Cleaning Operations

Commercial laundry operations cover a range of applications from laundromats and apartment common laundry-rooms to on-premises laundries for institutions and commercial operations, such as hotels, nursing homes, hospitals, athletic facilities, and prisons. Industrial laundries offer services for the same set of users as on-premises operations, as well as uniform, diaper, and linen services. Dry-cleaning establishments often have on-premises laundry equipment, as well.

Clothes-washing equipment includes:

- top-loading (now being phased out)
- front-loading
- tunnel washers

Methods considered to replace perchloroethylene dry-cleaning operations include:

- supercritical carbon-dioxide technologies
- silicon-based compounds
- wet-cleaning methods similar to front-loading washers

Ways to reduce water consumption by conventional laundries vary from the use of more efficient equipment to water recycling and ozone systems. For dry-cleaning operations, carbon-dioxide and silicon-based technologies nearly eliminate water use as compared with the alternative of wet cleaning.

Laundry and dry cleaning operations range from neighborhood coin-operated facilities to huge industrial laundries, such as those found in hotels and hospitals. Dry cleaning operations are undergoing major changes to their processes, due to concerns about chemicals and air quality.

Description of End Use

In this section the water-use characteristics of each major laundry and dry-cleaning technology are discussed. These include water-saving technologies such as water recycling and ozone equipment.

Coin-operated and multi-family laundries have historically used clothes washers that are similar to home-laundry equipment. Top-load, soft-mount (not bolted to the floor) washers have dominated the market. With the passage of EPACT 2005, soft-mount machines with a horizontal axis and 3.5 cubic feet of volume and top-loading machines with 4.0 cubic feet of volume are regulated for the first time. They must achieve a water factor (WF) of 9.5 gallons or less per cubic foot of washer capacity and a modified energy factor (MEF) of 1.26. As of July 1, 2007, the WF is 8.0 or less, and the MEF is 1.72, according to Energy Star.

Based upon information obtained from five of the major manufacturers of laundromat equipment, it appears that most laundromats are switching to hard-mount (bolted to the floor) equipment and, increasingly, are installing multi-load-capacity washers. The capacity of multi-load washers can exceed 80 pounds per load as compared with less than 20 for conventional equipment. Standards for multi-load equipment and single-load hard-mount equipment were not included

in EPACT 2005. This multi-load equipment is basically the same as used by commercial on-premises and industrial laundries. Multi-load equipment is designed with options for many possible settings and cycles to accommodate a range of washing requirements with large variations in water use. The manufacturer or equipment provider (route operator) must preset the controls for the washing requirement prior to installation to avoid excessive water use.

Speed Queen SWFT71 Front-load Laundromat Washer

The manufacturers report that a large percentage of multi-family laundry-room equipment will continue to be of the smaller, single-load soft-mount type that is regulated.

Water use by multi-load machines depends upon how the controls are set. All multi-load washers can be set to operate at a number of cycles, including flush, wash, bleach, rinse, scour, and sizing cycles. Also, the water levels can be set differently for each cycle, so water use varies greatly depending upon the setting.

Wascomat Solid-mount W Model (above)

In a detailed study of actual operating laundromats in San Diego, California, in 2006, water use for horizontal-axis machines after a retrofit ranged from 5.2 gallons per cubic foot to as high as 12.1 gallons per cubic foot (Water Management, Inc., Western Policy Research, Koeller and Company). This illustrates the critical need to specify that washers be preset to meet the WF, which can be done by the factory or the route operator who leases the equipment. This equipment can meet a 9.5 gallons per cubic foot water factor if set properly, so it is important for the route operator to know the desired level of water use.

Horizontal-axis machines also reduce energy use, since these front-loaders reduce both hot- and cold-water use. A survey of manufacturers shows that hot water comprises only about 25 percent of water used by laundromat equipment. Switching to horizontal-axis machines does not change this ratio, but the reduction in overall water use — thus the gallons of hot water per pound of laundry — can be reduced by 19 to 29 percent (Water Management, Inc., Western Policy Research, Koeller and Company).

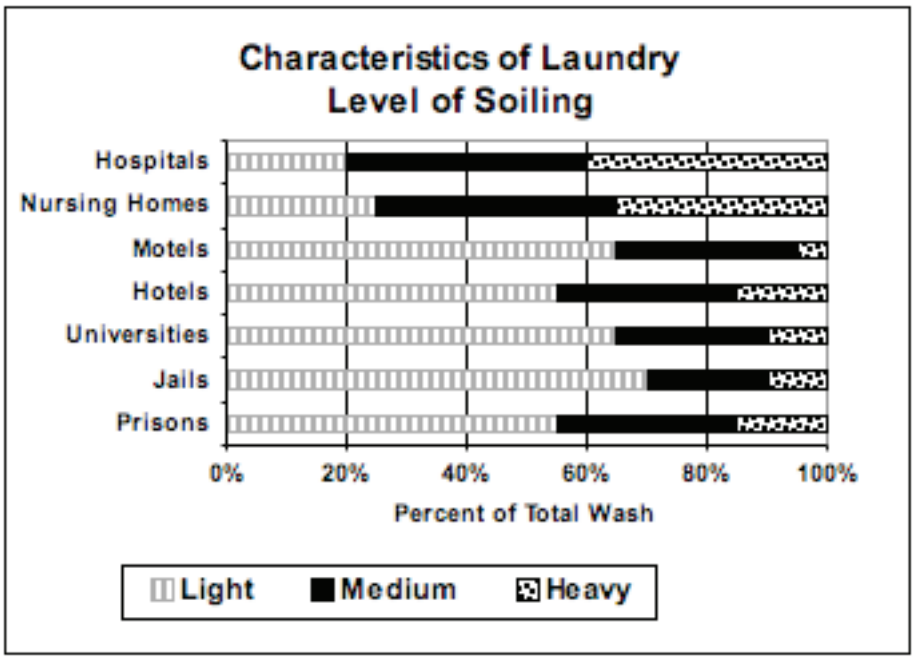
On-Premises Laundries (OPL) use washer-extractors identical to the multi-load equipment used in laundromats, except they have no coin boxes and can be much larger. Load capacities range from 30 to as much as 800 pounds. Such washer-extractors are designed to wash everything from relatively clean hotel towels and bedding to heavily soiled items from nursing homes and commercial kitchens. All equipment in this category uses the horizontal configuration and is, therefore, relatively efficient. Examples of OPL applications include prisons, hotels, hospitals, athletic facilities, food and beverage manufacturers, and uniform washing for businesses. Typical water use for washer-extractor machines ranges from 2 to 4 gallons per pound of laundry washed. Because the items being washed vary greatly, the equipment needs to be adjustable. A study done for the California Urban Water Conservation Council (Riesenberger and Koeller, 2005) illustrates these points. The tables following show the amount of laundry produced by each of the most common OPL operations and laundry characteristics based upon degree of soiling.

On-Premises Laundry Production in Common Operations

Type of Operation	Pounds/Person/Day	Pounds/Room/Day
Hospitals		25
Nursing Homes		25
Motels		23
Hotels		36
University Dorms	20	
Jails	10	
Prisons	12	

After (Riesenberger and Koeller, 2005)

The level of soiling strongly influences the amount of water required, because of the number of cycles needed to wash the items and water levels needed for each cycle. This is illustrated in the following table:



Water Demand Based upon Use of a 400-Pound Braun Washer Extractor

Soiling Level	Heavy	Medium	Light
Cycle	Bed Pads	Terry Cloth	Sheets
Flush	290	290	94
Wash	94	94	94
Wash	94		
Bleach/Rinse	134	134	134
Rinse	134	134	134
Rinse	134	134	134
Rinse	134		
Finish	114	114	114
TOTAL	1128	900	704

After (Riesenberger and Koeller, 2005)

Water Reuse/Recycling and Ozone Systems. Two technologies, water reuse/recycling and ozone, can reduce water use and wastewater volumes. These can also reduce pretreatment costs or requirements and energy use. The first are systems that recycle a portion, or all, of the water for reuse in the next wash. Many companies offer versions of this equipment, and choosing a system that fits a specific laundry requires some analysis. Some companies even offer equipment designed for laundromat operations. Recycle and reuse systems also save energy since the water from the laundry operation is already warm. In one study (*Laundry Today*, 2004) wastewater recovery was determined to be the most promising source of energy conservation in laundry operations.

A simple recycle system recovers the discharge from the final rinse in a multi-cycle operation for use in the first flush or first rinse of the next cycle. More complex systems recover more than 85 percent of the water for reuse. Simple systems rarely incorporate any type of treatment, since the final rinse water tends to be very clean. These systems are limited to a 10 to 35 percent savings (*Laundry Today*, 2005). However, to achieve consistently higher recovery rates, used wash water must be treated to some extent

before reuse. Ecolab's Aquamiser and the Aqua 360 systems are examples. Water is filtered to remove lint and dirt, then reheated and sent for reuse. More complete systems, such as Norchem and AquaRecycle, process wash water to the point that it can be recycled for use in all cycles of the washing process. In the example of the AquaRecycle System below, water is first passed through a lint shaker to remove lint and large particles, then filtered to remove particulates. Then it passes through two filters that remove oil and grease, then soaps and organics. Ozone is added to remove additional organics, and the water is passed through an ultraviolet light system for disinfection. These systems can recycle up to 90 percent of wastewater.

Ozone is gaining wider acceptance in the industry. Ozone is simply three oxygen atoms combined into one unstable molecule, O_3. Because of the short-lived nature of the gas, ozone is always produced on-site in a generator that uses the oxygen molecules in the air, which comprise two oxygen atoms — O_2. The oxygen is passed through an electric field to produce ozone. Ozone is a powerful oxidant that reacts with dirt and organic material to oxidize it. It is also an excellent disinfectant and whitener that reacts with odors, stains, and other organic material in the wash. Ozone is quickly converted back to oxygen gas in the washing process. Unlike ozone in the upper atmosphere, it lasts for only a short time in laundry applications.

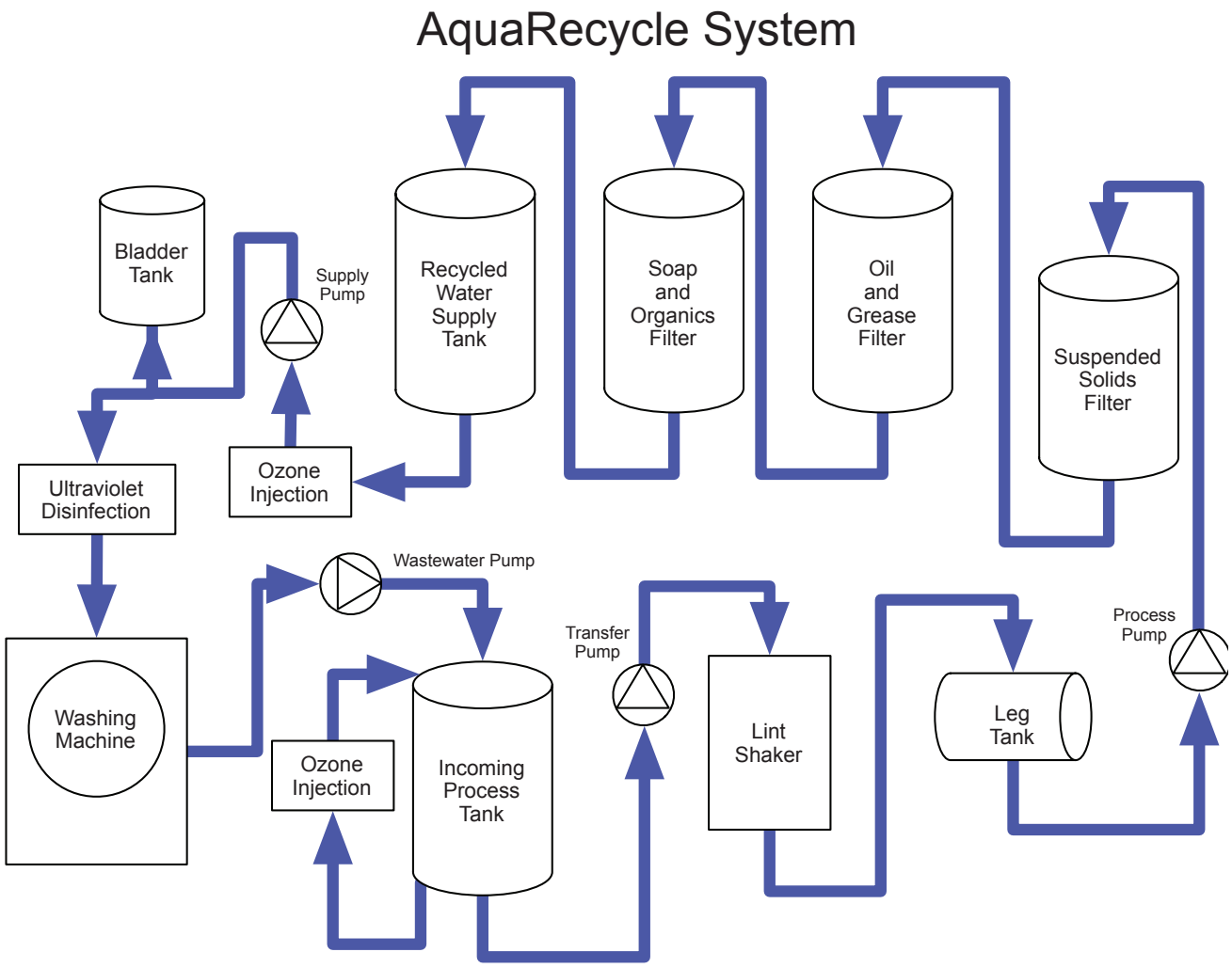
With ozone, water temperatures can be reduced, since it works best at around 80° F. This significantly reduces energy use. It also allows for reduced use of detergents and chemicals, so less rinsing is needed thus less water. Ozone systems work well on lightly soiled clothes. For heavily soiled laundry, conventional wet methods with detergent and hot water work best.

The following table presents results of actual tests conducted to evaluate three specific types of equipment for water recycling and ozone. As these results show, the Aqua 360 system saved approximately one-third of the water and energy used, while the more aggressive AquaRecycle system accomplished an 80 percent water savings and an energy savings of over 50 percent. Ozone systems fared less well on water savings, at only about 15 percent, but had a significant energy savings of about 75 percent.

Summary of Savings by Technology and Wash Classification for a 400-Pound Braun Washer

Technology	Soil Class	"Before"		Savings		"After"		Unit Savings	
		Gal/lb	Btu/lb	Water	Energy	Gal/lb	Btu/lb	Gal/lb	Btu/lb
Aqua 360	Heavy	3.22	2570	36%	34%	1.15	1695	1.15	875
Aqua 360	Medium	2.57	1990	32%	30%	0.88	1399	0.88	591
Aqua 360	Light	2.07	1798	36%	20%	0.74	1447	0.74	351
AquaRecycle	Heavy	3.22	2570	84%	50%	2.7	1292	2.7	1278
AquaRecycle	Medium	2.57	1990	70%	57%	1.97	849	1.97	1141
AquaRecycle	Light	2.02	1798	80%	51%	1.61	883	1.61	915
Ozone	Medium	2.57	1990	9%	75%	0.23	502	0.23	1488
Ozone	Light	2.02	1798	11%	76%	0.22	427	0.22	1364

(Riesenberger and Koeller, 2005)



Industrial laundries comprise a special subset of commercial laundries. These are the very large operations that typically offer services to institutional users such as hospitals and prisons and commercial enterprises such as hotels and restaurants. They often offer uniform and linen leasing, cleaning, and related functions. Industrial laundries use horizontal washer extractors identical to those used by OPL operations and also large-volume equipment called tunnel washers. Typical water-use rates range from less than one gallon per pound of laundry to around two gallons. Tunnel washers are very expensive and typically not justified unless the laundry is washing 800 pounds of laundry an hour or more (Pellerin Milnor Corp.).

Dry cleaning is undergoing major restructuring as the use of perchloroethylene as a dry-cleaning agent is phased out due to air-quality concerns. The three replacement technologies are wet cleaning, basically a laundry operation that uses water as the cleaning agent just like a washer; silicon-based technology, which can be used in some existing dry-cleaning equipment that currently uses perchloroethylene; and supercritical carbon dioxide, a new, innovative method of cleaning. The latter two technologies consume no water, so long as air cooling is used in the process-fluid operations.

Water-Savings Potential

EPACT 2005 set the standard for single-load commercial washers that are soft mounted, therefore, states and cities are preempted from setting more stringent standards for this class of machines. However, there are more efficient single-load washers on the market, and a water factor of 8.5 or less could be promoted, though not required.

Since there is no federal standard for single-load washers that are hard mounted or any of the multi-load washers, states and cities can set local standards. A minimum standard WF would be 9.5, but there are enough single-load hard-mount models available to support a local WF standard of between 8 and 8.5.

Multi-load machines can use as much as 12 gallons per cubic foot and range in size from 4 to 12 cubic feet. Water savings of 5 to 20 gallons a load can be achieved by having a local standard of 9.5 gallons per cubic foot.

Tunnel washers can cut water use per pound of laundry by 30 to 60 percent.

Water-recycling equipment can recycle from 10 to 90 percent of the wash water, depending upon the level of treatment provided, and conserves energy by recycling warm water. Ozone equipment reduces water use by 10 to 25 percent, but can also significantly reduce energy and chemical use.

Among the replacements for conventional dry cleaning, the wet-cleaning method uses washer equipment almost identical to normal horizontal washers and uses water in the process. Volumes per cubic foot are lower that those for conventional washer operations, but water is still used. The silicon-based and carbon-dioxide systems do not use water.

Cost-Effectiveness Analysis

Cost analysis considers many variables. Hard-mount equipment is slightly less costly than soft-mount equipment of the same capacity, because it does not need the suspension equipment to allow for high gravity-forced spin speeds. Hard-mount systems can also take advantage of gravity dumping of wash water. These cost differences are small in comparison to overall costs.

Tunnel washers cost hundreds of thousands of dollars, but are designed for efficient washing of large volumes of laundry with lower energy and half the water use. To be cost-effective, most manufacturers recommend that the throughput be in excess of 800 pounds an hour.

To make recycling systems economically viable, the combined water and wastewater costs generally have to be greater than $4 per thousand gallons.

The AquaRecycle system costs about $100,000 for a system capable of recycling 15 gpm and more than $330,000 for a system capable of recycling 250 gpm. This equals about $12 per nominal pound of capacity. The AquaTex 360 costs slightly less, about $9.50 per nominal pound of capacity. Ozone systems cost from $10,000 to $45,000 per unit, depending upon size.

Recommendations

Proven Practices for Superior Performance

- Require all single-load hard-mount laundromat or other coin- and card-operated machines to have a WF of 8.0 or less.
- Require all multi-load coin- and card-operated machines to have a WF of 9.5 or less and be installed with proper settings to achieve the required WF.

Additional Practices That Achieve Significant Savings

- Promote a WF of 8.0 or less for single-load soft-mount washers.
- Encourage the use of recycle/reuse or ozone equipment when feasible.
- Encourage the use of tunnel washers wherever laundry volume is sufficient.
- Encourage the use of non-wet dry-cleaning.

References

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