Cleaning Dishes Efficiently

How to Save Water, Energy and Money in the Process

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Whether you order the steak, salad or fish at your favorite restaurant, the plate you are eating it on, the utensils you are eating it with, and the pots or pans used to prepare it were cleaned and sanitized using a commercial dishwasher. Commercial dishwashers, also known as warewashers, are available in four designs: flight type (Figure 1), rack conveyor, stationary door, and undercounter.

Door type are the most widely used commercial dishwasher; flight type and conveyor warewashers are used for high-volume applications; and undercounter models are for very low usage situations. Commercial dishwashers in each class can be further broken down into either chemical low temp machines or high temp dish machines.

Figure 1: Flight type warewashers, such as this gas model by Jackson MSC, are used for high-volume applications.

The first step in both low and high temp warewashing is to heat the water coming into the restaurant's water heater at ground temperature to 120º - 140ºF. Although chemical machines do not require additional water heating, they do require added chemicals to sanitize, which are not needed with a high temp machine, and they use more water than a high temp machine.

With high temp machines, the 140ºF water is heated to 160ºF by a heating unit in the warewasher for washing and then further heated by another heating unit to 180ºF in the final rinse tank. The rinse water from a previous load is frequently used as wash water for the next load. If the tank water cools during non-use, the tank heater will bring the wash tank temperature back up to 160ºF for washing. Both types of warewashers drain a volume of water with each rack (load) of dishes.

Water Heater Energy Savings

The first opportunity to save energy on warewashing occurs when water is heated from ground temperature to 140ºF by the restaurant's water heater. Traditional gas-fired storage tank water heaters have a thermal efficiency around 80%. The smaller the water usage, the less efficient a storage type water heater will be, but as usage increases the efficiency will approach the thermal efficiency of the water heater.

Energy can be saved by switching to one of a few high-efficiency water heating choices: standard tankless water heaters, condensing tank water heaters, and condensing tankless water heaters. The standard tankless water heater has become very popular because it does not have standby energy losses, but most standard tankless water heaters have efficiencies in the 80 - 83% range. Condensing water heaters will achieve thermal efficiencies over 90%.

The Gas Technology Institute (GTI) in 2007 conducted a study comparing a tankless water heater, a standard efficiency tank water heater and a condensing water heater with three levels of residential water usage. Once the usage was increased to 100 gallons per day the condensing tank type water heater was much more efficient than a standard tankless water heater.

Figure 2: A.O. Smith Cyclone *Figure 3: Rheem SPIDERfire*

When water usage is 100 gallons or more, natural gas condensing tank type water heaters like those pictured above are more efficient than standard tankless models.

Most restaurants with a door type warewasher will run more than 200 racks a day. At one gallon of water used per rack, the hot water usage for warewashing is over 200 gallons – and this doesn't include all of the other hot water needs of the restaurant. The most efficient choice for water heating is either a gas-heated condensing tank type water heater (Figure 2 and Figure 3) which can achieve thermal efficiency up to 96% or a natural gas condensing tankless water heater.

Energy Star Warewasher Savings

The next opportunity to save energy in commercial dishwashing is by purchasing an Energy Star rated machine. Energy Star ratings for commercial dishwashers became effective on October 11, 2007. The requirements are for a maximum water usage per rack and a maximum idle energy usage. A high temp door machine cannot use more than 0.95 gal/rack and a chemical low temp machine cannot use more than 1.18 gal/rack. Chemical machines do not need to heat up water to 180ºF, but they require additional water per rack to be heated up to 140ºF. The high temp machine has to maintain a rinse tank at 180ºF, so it will have slightly higher idle energy use. The maximum idle rate is 1.0 kW for high temp door machines and 0.6 kW for chemical low temp type machines.

An Energy Star machine not only saves water it also reduces the amount of energy needed to heat the water. The Energy Star's website (www.energystar.gov) has a tool to compare the water and energy usage of a standard warewasher to an Energy Star warewasher. It estimates that a standard door type machine will generally run 280 racks a day in a restaurant. With a high temp machine that amounts to 49,392 gallons of hot water saved per year by using an Energy Star unit. (See Figure 4)

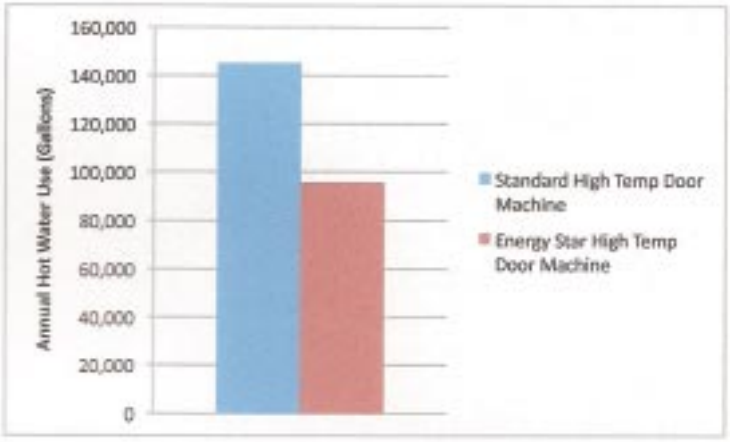

Figure 4: Energy Star Water Savings

Gas Booster Warewashing Savings

Booster heaters are one of the primary ways to achieve the 180º water needed for the final sanitizing rinse. There are currently several gas-fired booster heaters available for high temp warewashing. Using natural gas instead of electric for boosting the rinse water temperature to 180ºF will significantly reduce the carbon footprint of your warewasher. The Energy Star life cycle cost estimate tool assumes a carbon emission factor of 1.54 lbs. CO2 per kWh for electric, which translates to 451 lbs. CO2 per MMBTU. The natural gas carbon emission factor is given as 117 lbs. CO2 per MMBTU. Even with an assumption of 80% efficiency for the natural gas booster there is still more than three times less in carbon dioxide emissions.

In addition to the reduction of carbon dioxide emissions, a natural gas-fired booster heater will save money on energy costs when compared to an electric booster heater. The Energy Star life cycle cost tool shows annual savings of $476 when you use a gas booster heater instead of an electric booster with door type high temp dish machines. The tool assumes $0.103/kWh for electric and $1.33/therm for gas. The total savings will of course vary with usage.

Using a natural gas booster water heater, such as this one by Precision Temp, instead of an electric booster, will save money and reduce your carbon footprint.

Putting It To The Test

GTI submetered a restaurant in EL Segundo, CA that had an electric high temp door machine. The data showed usage around 215 racks a day and monitored the energy usage for both the wash and rinse tanks.

Table 1 below provides the estimated cost for a natural gas-fired unit compared to the electric unit with the measured 1500 cycle per week usage at El Segundo. GTI used a rough estimate of $1/therm for gas and 10¢/kWh. It also assumes the gas unit is 30% less efficient than the electric unit. Annual savings over $630 are possible. If usage were to increase to 280 racks or more a day, the savings would increase even further.

The potential to use gas not only for a rinse boost but also for the wash tank would provide additional cost savings and carbon footprint reduction. Today, there are very few gas warewashers available, however, GTI is currently working with a manufacturer to produce a high temp warewasher that uses natural gas for both the wash and rinse tanks in a standard footprint stationary door type warewasher.

To summarize, there is potential for a great deal of energy savings and carbon footprint reduction when it comes to commercial foodservice warewashing. First, use a more energy-efficient gas water heater, second, purchase an Energy Star rated warewasher, and third, use a gas-fired booster water heater.

To learn more about how to clean your dishes more efficiently and reduce your carbon emissions, visit www.gfen.com. A helpful booster water heater payback tool can also be viewed at www.gfen.com/Calculator/calculatorweb.html

El Sugundo, CA Restaurant Submetering Project

	Energy Usage	Cost per Week	Annual Cost
Electric Warewasher (Measured)	250 KWh/ week	$25/week	$1,300
Gas Fired Warewasher (Estimated)	12.2 Therms/week	$12.20/week	$634

Table 1: El Segundo, CA Site Potential Cost Savings