BEST PRACTICES – HOW TO ACHIEVE THE MOST EFFICIENT USE OF WATER IN COMMERCIAL FOOD SERVICE FACILITIES

Introduction

Water is a universal ingredient in every commercial food service operation – playing a part in cooking, cleaning, comfort, and even aesthetics. Water is also a commodity, like meats and produce that has to be purchased by the food service operator. But this commodity has been very reasonably priced for many years and most food service operators have not made water conservation a priority. Water is routinely wasted in large quantities in almost every food service operation from the smallest café to the largest institution. This oversight is beginning to change. Across the country, water and sewer rates are starting to rise. At the same time, water utilities are establishing major campaigns to educate users on water conservation and the public is putting more pressure on businesses to operate in an environmentally friendly way. The good news is that there are a multitude of cost-effective opportunities to reduce water consumption in food service facilities without reducing the quality of the food, the performance of the appliances, or the cleanliness of the kitchen.

Water consumption also has a direct effect on energy consumption. At a macro level, it takes a great deal of energy to pump water and treat wastewater; but water use and energy use are also linked together in the commercial kitchen where they impact your utility bills. In appliances, such as steamers, that utilize water as a medium for heat transfer, the energy consumption of the appliance is directly driven by the water consumption of the appliance. In appliances that use water for cooling, large amounts of water go directly down the drain, often with little or no control over the flow. Commercial food service appliances are energy intensive to begin with, but the ones that utilize water can be particularly expensive to operate.

Water Terms

Before we begin, lets discuss some of the terms used to measure water flow and how the utility might bill you for that water.

Flow Rate – The amount of water that can flow through a device is measured in gallons per minute, abbreviated as gpm. For example, a typical hand sink with aerator might be rated at 2.0 gpm. This means that the maximum rate at which water can flow through the faucet will be 2 gallons per minute. Sometimes, the gpm rating is etched into the device, as in the case of aerators. But most likely, as with pre-rinse spray valves, it is not. Since a major strategy in reducing water consumption within a food service operation is to specify fixtures that use the least amount of water while still accomplishing the task, it might be necessary for you to measure the flow rate. This is easy to do using a gallon pitcher and a stopwatch. To determine the flow rate, simply measure how many seconds it takes to fill the gallon pitcher and calculate the gpm with the following formula:

gpm = 1 gallon ÷ number of seconds you measured X 60 seconds

You might also check with your local water utility since they often have easy to use flow-rate measuring bags and cups that do the calculating for you.

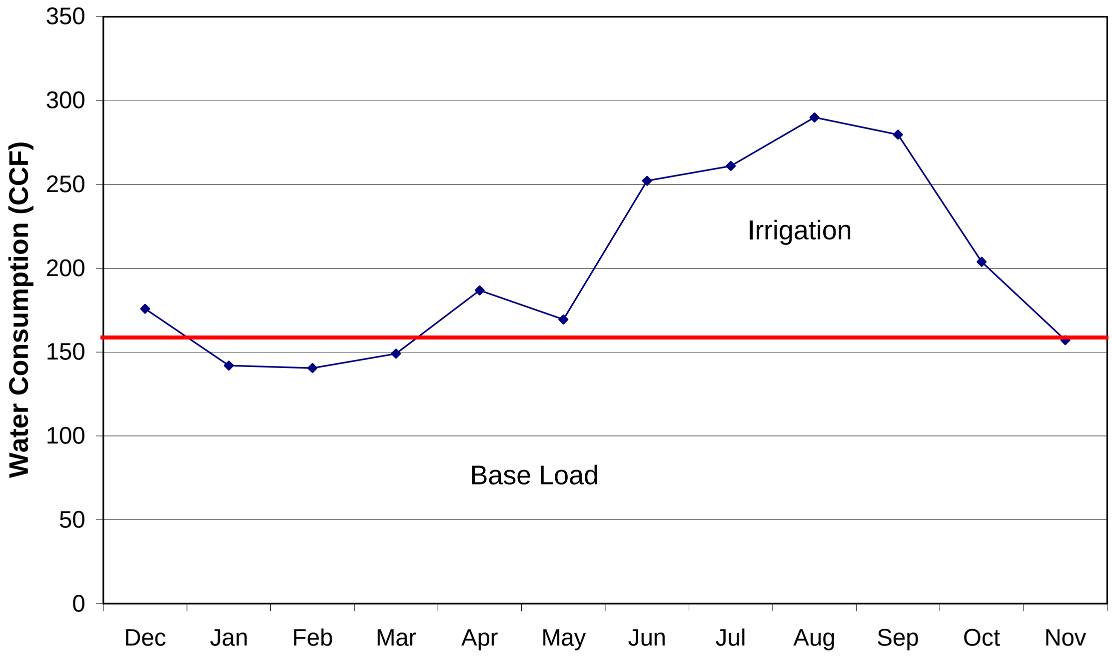
Water Accounting – Quantities of water are typically billed based on units, where one unit is equal to 100 cubic feet (ccf) or 748 gallons. Water utilities will have separate rates for the incoming fresh water, measured at the meter, and the wastewater, which is based on the fresh water meter – “water in” equals “water out”. Because wastewater requires more treatment than fresh water, you will typically be billed more for the sewer charge than for the water itself. This is important to remember because every drop wasted is billed twice! For our cost examples, we will assume a charge of $2.00 for a unit of water and $3.00 for the associated sewer charge.

Energy Accounting – If you have a hot water heater or a cooking appliance that is heating water, then you are paying for energy as well as water. The amount of energy you use will be measured and billed in kWh for electricity and therms for gas (although some gas utilities bill based on cubic feet of gas consumed). The cost of electricity varies dramatically across the country so we will assume an average rate of $0.08 for each kWh you buy. The cost of gas is more uniform from state to state and tends to average out at about $0.80 per therm so that’s the cost we’ll use for our examples. You can adjust the water and energy cost estimates presented in this document based on your own utility rates.

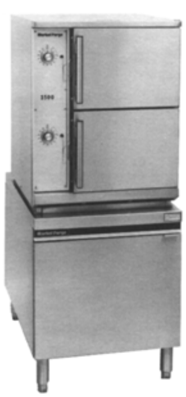
Tracking Water (and Energy) Use

Tracking the consumption and cost of utilities can be the foundation of an effective water/energy management initiative—particularly for multi-unit (i.e., chain) operations. But utility tracking is an under utilized tool in the world of food service, despite the spreadsheet literacy of this industry. Simply plotting the month-by-month consumption of water or energy use can tell an important story about a facility. The story gets even more revealing for multi-unit operators when the utility history can be compared for several restaurants in the same region. Investigating the history of water use for a facility (or facilities), one can often identify the water-cooled condenser with a stuck solenoid valve or an irrigation system with a schedule that is out of control.

Quick-Service Restaurant: 12-Month Water History



Cooking Appliances



Steamers – Steamers are water-intensive appliances. Traditional steamer designs incorporate a separate boiler or steam generator to produce steam for the cooking compartment. These types of steamers force steam from the boiler into the cooking cavity, where it circulates around the pans of food. To prevent pressure buildup inside the cooking cavity, excess steam leaves the cooking cavity through a drain, where it is condensed by a stream of cold water. This cooling water also lowers the temperature of the condensate below 160°F to meet building plumbing codes. A typical 6-pan boiler-style, pressureless steamer consumes 30 to 40 gal/h while operating, or about 175,000 gallons per year under heavy use. Newer steamer designs employ controls to limit the amount of condensate cooling water consumed by the appliance. These designs may use half as much cooling water as steamers that simply run a continuous stream of cold water.

Most steamers offer a standby setting, which maintains the boiler in a ready-to-use state while not pumping steam into the cooking cavity. The condensate cooling water is typically shut off while the steamer is in standby so the appliance consumes a minimal amount of water in this setting. Steamers that are time-controlled will automatically switch into standby at the end of the set cook time. Using a steamer in timed mode instead of continuous (manual) mode can save $1,200 a year in a heavy-duty operation.

“Connectionless” steamers were initially designed and marketed as requiring less maintenance than their boiler-style counterparts. Steam is generated in a reservoir at the bottom of the cooking compartment and water is added and drained manually at the beginning and end of the day. Condensed steam simply returns to the reservoir, instead of draining outside the compartment. Since there is no continuous flow out the drain, these steamers do not require condensate cooling water. A typical 6-pan “connectionless” steamer consumes a paltry 1 to 2 gal/h while operating at peak capacity. Replacing a boiler-style steamer with an equivalent sized connectionless steamer could save 174,500 gallons per year! At $5/ccf, this translates to an operating cost savings of $1,200 per year.

Combination Ovens – Combination ovens (combis) are versatile appliances, offering multiple cooking modes, including dry heat, moist heat, and steam. The original combination ovens were literally ovens and steamers in the same box. Similar to steamers, these combination ovens incorporated a separate boiler or steam generator to maintain humidity in the cooking compartment, and required a continuous stream of cooling water to lower the temperature of water exiting the cooking cavity before it reached the drain. A typical 10-pan boiler-style combi can consume 30 to 40 gal/h while operating or about 175,000 gallons per year under heavy use.

Boilerless combis generate humidity by spraying a fine mist of water on the heat exchangers at regular intervals. The mist is quickly flashed into steam and circulated throughout the cooking cavity. This design requires less water to maintain humidity in the cooking environment and subsequently less cooling water. A 10-pan boilerless combi consumes 10 to 15 gal/h while operating at the highest humidity level, and would save 110,000 gallons per year over a boiler-style combination oven.

Water usage can be controlled by using the combi oven in convection (dry heat) mode when practical. Even if combi (moist heat) mode is required for particular menu items, the oven can be set to convection mode between cooking events or during idle periods to reduce unnecessary water consumption.

Pasta Cookers – Pasta cookers are specialized appliances designed to cook food in boiling water. These appliances frequently feature either an automatic water fill or a water tap located at the back of the appliance for filling the vat. When the cooker is set to a full rolling boil, water is continuously added to maintain the level of water in the cooking vat and replace the water lost to vaporization. Most pasta cookers have a simmer mode at 190 to 200°F, and can be returned to full boil within a few minutes. Since the pasta cooker’s thermostat cannot be satisfied during a full rolling boil, the burners or elements are energized continuously and the appliance’s energy and water consumption can

be quite high. Backing off the setting to just maintain a simmer state instead of a rolling boil will reduce the amount of water lost to vaporization and will have minimal effect on product cook times.

Chinese Ranges – Chinese, or wok, ranges frequently use a constant stream of water to cool the top of the range, due to the intense heat from the 150,000 to 250,000 Btu/h burners. These appliances typically have a manually controlled water valve, as well as additional faucets. Water consumption can be from one to six gpm, depending on the valve setting. Wok ranges with sufficient insulation do not require the additional cooling provided by the continuous water flow, thereby eliminating water consumption. A standard two well range could consume between 100 and 500 gallons of fresh water per day. This can easily be cut in half by reducing the flow without sacrificing performance.

Refrigeration

Water Cooled Condensers – Unfortunately, there are many times where water is used to remove heat from the condenser of a small refrigeration system. These water-cooled condensers require a continuous stream of cold water that is subsequently dumped down the drain (see illustration). Two typical examples include water-cooled ice machines and soft-serve ice cream machines. In both cases there are air-cooled models of these appliance and it makes good sense from a water standpoint to use the air-cooled versions. For example, a moderately sized (800-pound) water-cooled ice machine will use an additional 1,300 gallons per day of water to cool the condenser, which will cost $3,200 a year. An air-cooled machine may use slightly more electricity than the water-cooled model, but unless the condenser is in an extremely hot environment (> 100°F), the difference is insignificant (about 4 kWh per day for an 800-pound machine). What's more, in many cases, there is no difference in first cost between air-cooled and water-cooled machines!

The Dishroom

The dishroom is where the connection between water and energy use is most dramatic. Basically a room full of pumps, nozzles, and water heaters, it is a hot, humid, wet, environment. It is also where you may be able to achieve some of your greatest water and energy savings!

Pre-Rinse Spray Valves – Prerinse spray valves are an integral part of a dishwashing station. These devices are used to knock food particles off dirty dishes before running the dishes through the dishwashing machine. Most of the valves on these sprayers are designed to spray water at anywhere from 2.5 gpm to 5.0 gpm. Over the course of the operating day, the water passing through these high-flow valves can really add up. The easiest way to save water and energy in a dishroom is to replace your high-flow pre-rinse spray valve with a low-flow unit, which is defined as 1.6 gpm or less. For instance, if your dish washer is pre-rinsing dishes for three hours a day, and you replace your 2.6 gpm valve with a 1.6 gpm valve, a 1.0 gpm flow reduction, your daily water consumption will drop from about 470 gallons/day to 290 gallons/day saving about 66,000 gallons of water a year.

1.6 gpm 2.6 gpm 4.5 gpm

A properly designed low-flow spray valve hits your dirty plate with a higher velocity than the high-flow valve so the cleaning performance can be as good or better than the high-flow units. This means that your water savings will not impact your dishroom productivity. The low-flow valves can be purchased at your local restaurant supply and are easy to install. In fact, many water utilities offer incentives if you replace your high-flow valve and some water utilities even offer free low-flow valves.

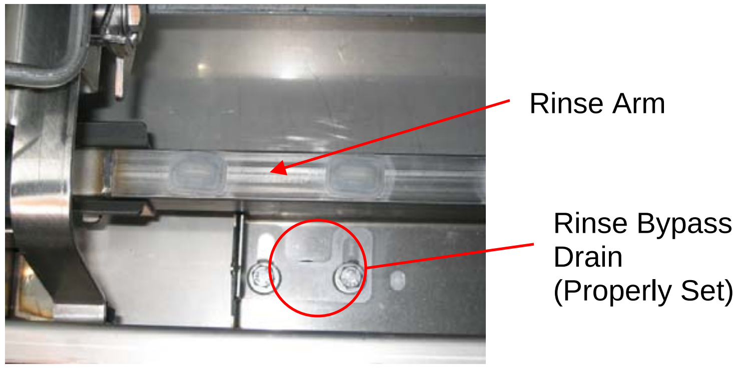
In addition to water savings, you will also save energy because you are heating the water that sprays through these valves. Depending on your type of hot water heater and utility rates, you could save as much on your energy bill as you will on your water bill. One way to calculate your energy and water savings is to use the *Pre-rinse Spray Valve Calculator*, a simple online tool created by the Food Service Technology Center and located on the FSTC website at http://www.fishnick.com/tools/watercost.

Dishwashing Machines – Dishwashing machines are complex systems that use large volumes of water during the course of operation. These appliances use either chemical agents or hot, 180+°F water for sanitation of soiled wares. Chemical-sanitizing machines are known as “low temp” machines and those using hot water for sanitizing are known as “high temp” machines. There are several categories of dishwashing machines, the most common being under-counter, door and rack conveyor types. Dishwashing machines have a wide range of water consumption, but a typical food service operation serving 300 meals/day using a door type machine could expect the appliance to consume 600 gallons/day. A larger operation, serving up to 600 meals/day and using a conveyor type dish machine, could expect the water consumption to be 1000 gallons/day. In light of their high water usage, proper selection, operation and maintenance of these appliances is crucial to minimizing water use.

Many machines are fitted with a manual fill valve. The valve needs to be completely closed after the wash tank is filled. Also, inspection of the valve needs to be a part of a regular maintenance schedule to ensure that it functions properly.

Proper calibration of the appliances will also minimize water consumption. The rinse cycle time should be set to the manufacturer's minimum recommended setting and periodically verified. The rinse pressure should be maintained at the manufacturer's specification, typically 20 psi.

Proper adjustment of the rinse bypass drain on conveyor type machines ensures that the washtank water is adequately replenished during operation. An improperly adjusted rinse bypass drain will cause excessive rinse water to drain from the system and eventually the machine will require refilling of the washtank, either manually or automatically depending on the machine's design.



Rinse nozzles should also be regularly inspected for wear. Worn rinse nozzles with larger openings will result in greater water consumption during the rinse cycle.

Operator error can have a serious impact on a dishwashing machine's water consumption. Some dishwashing machines allow operators to activate the rinse cycle manually, which can result in the rinse cycle remaining "on" continuously. If left unattended, the machine will consume water at its specified flow rate uncontrolled. Again, considering the wide range of water consumption exhibited in this appliance category, as much as 8 gallons/minute might be consumed by the machine if left in a continuous rinse cycle setting.

Staff should also be trained to minimize use of the machine. This would entail fully loading dishracks with soiled wares instead of utilizing the machine to wash racks with partial loads.

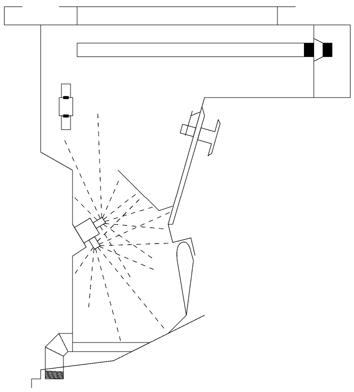
When purchasing a new dishwashing machine, end-users should specify one that uses less than 1 gallon of water per rinse cycle. For instance, a door-type dishwashing machine consuming 1.5 gallons/rinse cycle would, in a typical installation, consume 164,250 gallons/year. A machine consuming 1.0 gallons/rinse cycle, on the other hand, would consume 108,000 gallons annually – a savings of 56,250 gallons or $376. More impressive is the estimated $5600 savings that would be recognized with the operation of the 1.0 gal/rack machine over the course its 15-year lifecycle. Even a seemly small difference in rinse cycle water consumption equals significant water savings when comparing these two machines. Dishwashing machine per rack water consumption data can be found in the NSF International listings.

Waste Disposal Systems – Solid waste disposal systems use varying amounts of water depending on the subcategory. Garbage disposers typically consume between five and eight gpm during operation, while pulpers and scrap collector systems consume 2 gpm of fresh water during operation. Garbage disposers have recently undergone scrutiny in various areas due to tighter restrictions on dumping solid waste into sewer systems. Scrap collector systems accumulate solid waste in a centralized bin that can be emptied into the garbage. A typical disposer could consume anywhere between 400 and 1800 gallons per day, depending on whether it employs a flow control.

Scrappers represent a popular alternative to prerinse stations. These devices employ a high flow of recirculated hot water to rinse dishes before loading into a dish machine. These systems typically consume 7 gpm of fresh water during operation. Typical daily consumption for these units ranges between 1,600 and 2,500 gallons. Scrap collectors consume substantially less water than standard scrapper systems. A typical scrap collector would consume 500 to 700 gallons per day. This is obviously a better choice for the water-wise operator.

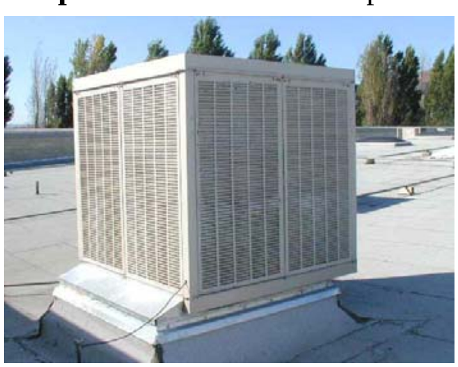
Ventilation

Water-Wash Hood Systems – Several manufacturers of commercial exhaust hoods offer hot water wash down systems as a labor saving option for cleaning fixed extractor or slot-type hood systems at the end of the day (versus manually removing baffle filters for cleaning in the dishwasher). This automatic wash down feature is more often specified for institutional kitchens, so you may not come across it in your typical restaurant. But when you do, there may be water savings hiding behind the control panel!

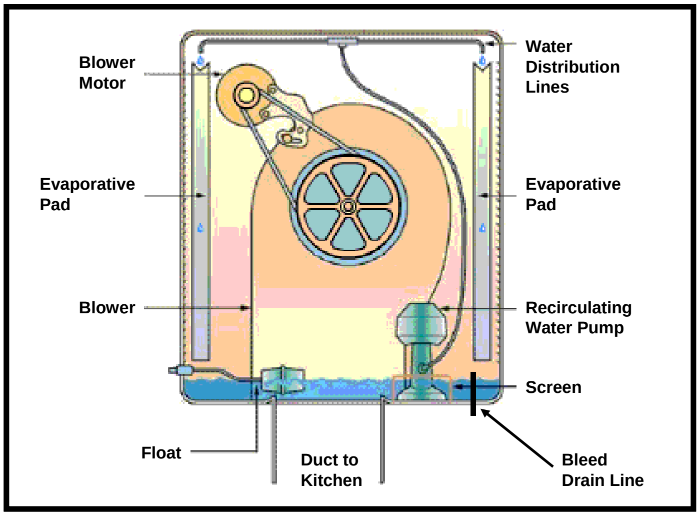


The system functions by spraying hot soapy water over the grease extractors during a timed cycle conducted at the end of the day when the exhaust system is turned off. The flow of hot water may range from ½ to 1 gpm per linear foot of hood for the duration of the cleaning cycle—which can be set in the field between 3 minutes and 10 minutes (3 – 4 minutes for light duty, 5-6 minutes for medium duty and 7-10 minutes for heavy and extra heavy duty appliances). The duration of the wash cycle is dependent on the duty class of appliances under the hood, hours of equipment operation, type and quantity of detergent used, water pressure and water temperature. Depending on these site-specific factors, the hot water consumption for a 16-foot hood could range from 24 to 160 gallons per day. At our representative water and sewer rates, this translates to an annual cost from $60 to $400. Adding the cost of gas to heat the hot water, the total utility cost for this wash down system would range from $120 to $770. The obvious conservation strategy would be minimizing the quantity of hot water used during the wash down cycle while still providing adequate cleaning performance. Unfortunately it becomes the responsibility of the food service operator to establish, on a trial-and-error basis, the option settings for soap quantity and wash cycle time based on appliance usage and associated hood cleaning requirements. Remember, the installing contractor has nothing to lose by setting the wash cycle at its maximum.

Evaporative Coolers – Evaporative coolers are commonly used in dry climates for



cooling makeup air in commercial kitchens. Sometimes called "swamp coolers", these systems provide inexpensive cooling by pulling outside air through damp pads. Evaporative coolers are much less expensive to operate than air conditioners, but they require regular maintenance. Failing to commission or maintain evaporative coolers can end up costing a lot in water and sewer charges. For example, most evaporative cooler designs use a sump with an overflow drain. If the incoming water valve is set too high, the sump will continuously overflow and water will be wasted down the drain. Another common problem involves the "once-through" type of evaporative coolers. These units do not have a sump and are generally easier to maintain but they need to be carefully commissioned or they will waste many thousands of gallons of water. A properly commissioned evaporative cooler has pads that are wet, but not soaking, and little or no water should be dripping off the bottom of the pads (particularly for once-through systems). The pads themselves should be in good shape – not torn or overly caked with mineral deposits, and the fan motor, blades and belt should be in good condition or the cool air will never make it to the kitchen. Finally, remember to turn off the water to your evaporative cooler in the winter so the lines won't freeze and rupture and then remember to turn them back on again in the spring!



Cleaning

Water Hose – The hose is aggressively used in a food service facility to clean floors, mats, sidewalks, parking lots, and sometimes even walls. A heavy-duty hose will deliver anywhere from 9 to 20 gpm, so judicious use of the hose is a wise practice. Every hose should be outfitted with a high-pressure nozzle which will make the hose a much more effective cleaning tool while also dramatically reducing the amount of water that is used. If the hose is hooked up to a hot water line, then you should be especially careful not to overuse the hose or leave it turned on when it's not being used.

Water Brooms – Water brooms are a water efficient alternative to the hose-and-nozzle for cleaning floors, sidewalks, and parking lots. These devices use a high-pressure spray to effectively clean a surface area but consume about half the water of a hose with a nozzle. Because the water exits the broom at a high velocity, the cleaned surfaces dry quickly and there is no run-off. Based on an average use of 1 hour per day, a water broom would consume 200 to 250 gallons of water compared to 400 to 450 gallons for a hose with a nozzle. That would save you about $800 a year in water and energy charges!

Sinks

Hand Sink – Most kitchens include a hand sink designed for hand washing and other light duty cleaning. A typical flow rate for a hand sink with an aerator is about 2 gpm.

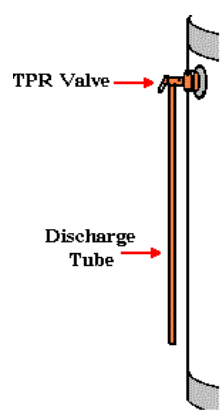
Without an aerator installed, the flow rate could be as high as 10 gpm. From both a sanitation standpoint and a water conservation standpoint, it makes sense to install hands-off controls on this sink so that sanitary hand washing is more effective and also so that these sinks don't get accidentally left on or used for other non-intended purposes like heavy cleaning or defrosting. One typical hands-off control system uses an infrared (IR) sensor to detect hands and operates the valve when needed. Another system uses a spring-loaded foot pedal control. Hands-off IR controls also make sense in customer restrooms, where the sinks might be over-used or left on by patrons.

Defrosting – Food items should ideally be defrosted by moving them from the freezer to the refrigerator a day before they are needed, but this kind of advance planning is not always practical in a busy kitchen. So, the food code allows for defrosting frozen food in cold running water. It is important to make sure that you don't defrost your food in hot running water since that encourages bacterial growth and violates the food code. It is also a good idea to limit the flow of cold water as you defrost. A sink that is running full on at 2.0 gpm defrosting food for two hours a day will use over 87,000 gallons a year, costing you about $600.

Dipper wells – Dipper wells are used as utensil rinse-and-holding stations on the front line. Most have a single spigot and valve and they may use either cold or hot water. Typically, the dipper well valve is turned to full flow and never turned off during serving hours. Because dipper wells are small, many operators don't think they have much impact but that small stream, running continuously, will add up to a surprising amount of water. For example, at a typical flow rate of 0.5 gpm, and a 16-hour operating day, a dipper well will use 175,000 gallons a year and cost over $1,000 in water and sewer charges. If the dipper well is flowing hot water, then you will pay another $1,000 for the energy to heat that water. That's over $2,000 a year for one little spigot!

The dipper well is an obvious candidate for some water conservation measures. Certainly, turning them off when they are not needed is important, but turning them down during the operating day or completely replacing the valve with one rated at a lower flow are two easy ways to save.

Leaks



Leaks are a frequent occurrence in the hot water heating system. Pipes and fitting should be regularly inspected for leaks. Temperature Pressure Relief (TPR) valves are a common source of leaks. These valves are present on the hot water heater supplying the system, whether the dishwashing machine is “low” or “high” temperature. A TPR valve is also present on the booster heater supplying hot sanitizing rinse water to “high temp” machines. TPR valves have a limited service life and will eventually fail.

Water leaks are also commonly found throughout the restaurant. The small amount of water that is dribbling out of a leaky faucet, spray valve, or hose valve may seem insignificant, but that water is leaking all day, every day and the gallons start to add up. For example, a small cold water leak of just under 0.2 gpm, which is about 10 gallons an hour, will add up to 100,000 gallons by years end, costing you $700 in water alone. If this is a hot water leak, then you can count on spending an additional $500 to $1000 on the energy needed to heat the water. Repairing a water leak is usually as simple as replacing a washer. The bottom line is that water leaks are a drain on your profits and should be a priority maintenance item in any facility.

Restrooms

Toilets – The toilets in a busy restaurant can consume a lot of water, so it’s important to install low-flow units. Once again, many water utilities offer very good advice and incentives to help you choose and install the right model. You might also consider installing waterless urinals. The waterless urinals can save a significant amount of water and provide for better hygiene in restroom settings, but they do require regular and proper maintenance and some applications have shown negative payback because improper maintenance caused the urinals to fail. Only consider this option if you can guarantee that the maintenance staff will be appropriately trained in waterless urinal maintenance.

In Conclusion

Water is essential to human life and while two-thirds of our planet is covered with water, the supply of fresh, potable, water is very limited. It is crucial that water-use be as efficient as possible so that there is an adequate supply of this vital resource. It is hoped that these best practices offer practical guidance on ways you can be more water and energy efficient throughout your food service operation.