Sustainable Water Treatment, LLC
PO Box 5655 Asheboro, NC 27204
336-953-9552 or 651-587-7616
www.SustainableWT.com

Industrial and Commercial Water Treatment have been concerned with sustainable practices long before the social concept of Resource Conservation, LEED Certification, the Green Initiative and Save-the-Planet bumper stickers. We have been focusing on Energy Efficiency along with Water and Fuel Conservation since the genesis of our industry. As a provider of water treatment products to prevent scale, corrosion and bacterial contamination, we are part of the solution. Sustainability and Environmental Resource Conservation have always been key components of our industry, and the rest of the world is finally catching up.

HVAC systems are one of the highest energy users in most facilities. These systems have a high potential for inefficient operation, but also have great opportunity for efficiency improvements. In a typical commercial building, more than 24% of the energy is used for Heating, Ventilation and Air Conditioning (HVAC)[1]. Of this energy, more than half goes to building cooling. In manufacturing plants, chillers are often used for process cooling which will consume an even greater percentage of the overall energy used by the facility. Making your cooling systems run as efficiently as possible is important for reducing building operating costs. With the proper application of the right water treatment chemicals, chillers will run at peak efficiency with minimal water usage. Proper treatment will also extend the life of the equipment and reduce maintenance, repairs and downtime.

Energy Savings

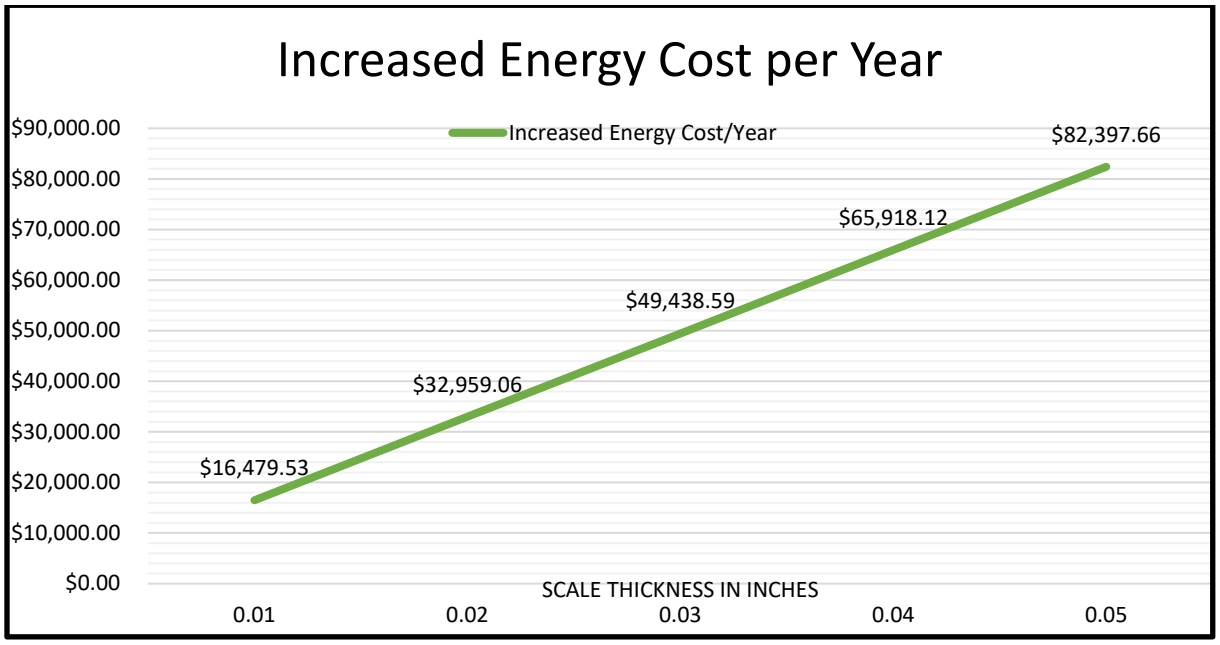
Chiller efficiency is generally expressed in terms of kilowatt per ton (kW/ton), where a kW is a kilowatt of electrical input. A ton of cooling is equivalent to the removal of 12,000 BTU per hour. Design efficiency can range from a low of 1.25 kW/ton (standard air-cooled screw compressor) to as high as 0.38 kW/ton (high efficiency water-cooled centrifugal compressor)[2].

The efficiency of chillers has increased significantly over the past 50 years. The Energy Efficiency Ratio (EER) is the refrigeration capacity at full load (Watts) divided by electrical input power (Watts). Chiller efficiency has steadily increased from an EER average of 3.75 in 1970 to 7.0 in 2010.[3] Chillers dedicated to air-conditioning can consume approximately 30-40% of the overall energy used by a building during the normal business day. Energy cost per year to operate a chiller can be determined by the following calculation.

$$Chiller\ Tonnage \times Design\frac{kW}{Ton} \times Percent\ Load \times \frac{hours}{year} \times Cost\ of\ \frac{kW}{hour} = Yearly\ Energy\ Cost$$

[1] https://www.progress-energy.com/assets/www/docs/business/chiller-fact-sheet-052005.pdf
[2] https://www.progress-energy.com/assets/www/docs/business/chiller-fact-sheet-052005.pdf
[3] http://industry.gov.au/Energy/EnergyEfficiency/Documents/09_2013/hvac-fs-chiller-efficiency.pdf

In order to take advantage of the increased efficiency of this equipment it is very important to keep the heat exchange surfaces clean and free of scale, corrosion and biological contamination. One of the main causes of decreased chiller efficiency is tube fouling. And one of the most common types of fouling is Calcium Carbonate Scale. A calcium carbonate scale of 0.036 inches (about 1/32") increases cost by 30%.[4] The chart below is based on a 500 Ton Chiller operating 24/7/365 at 70% load and shows the actual cost of scale. A **Sustainable Water Treatment Program** will consist of the proper inhibitors to prevent scale from fouling the heat exchanger surfaces and keep chillers running at peak design efficiency.



Biofilm is another potential foulant described as uncontrolled microbiological growth that forms an insulating film on pipe and tube surfaces. When it occurs on heat exchange surfaces, it is 4 times more insulating than a calcium carbonate scale and will drive energy costs up to an all-time high. With the possibility of rapid accumulation, it will increase the approach temperature and can shut down the chiller due to high pressure. Approach is defined as the temperature difference of the saturated refrigerant and the leaving water. Biofilm can also cause damage to the compressor if not immediately treated.

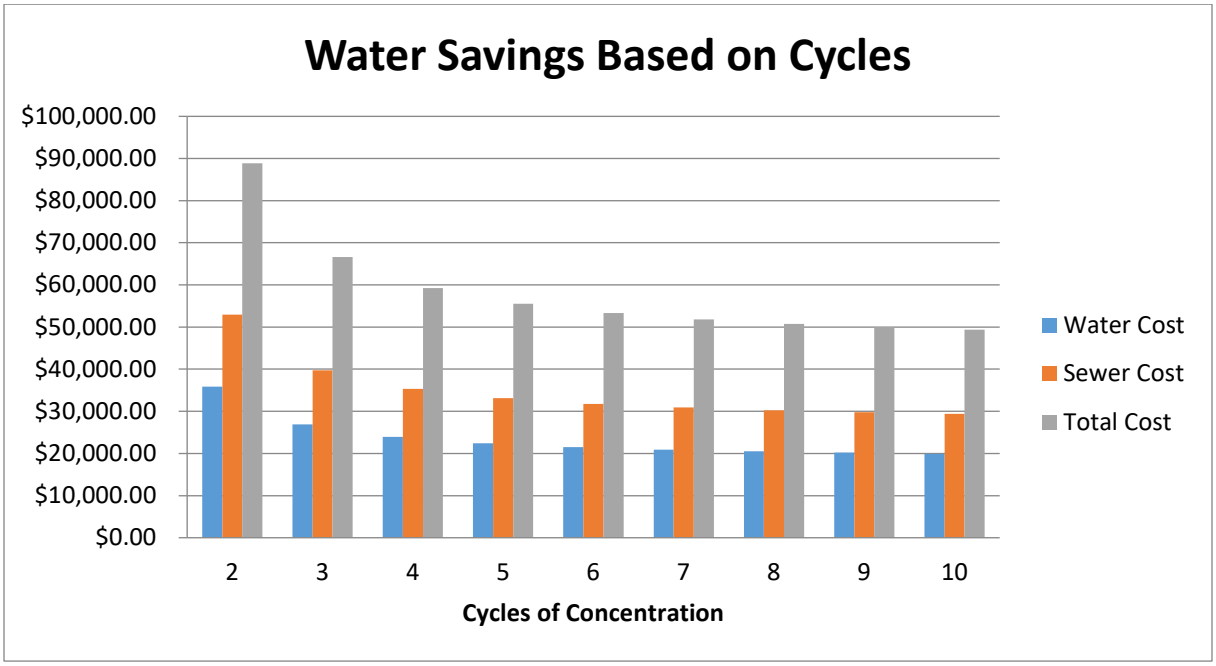
A **Sustainable Water Treatment Program** specifies alternating an oxidizing biocide with a non-oxidizing biocide or bio-dispersant in the cooling tower water on a weekly schedule to prevent the formation of biofilm. Automated controls should be used to lock-out or prevent blowdown and allow the recommended biocide contact time. Routine microbiological testing should be performed to monitor the system.

[4] Mechanical Chillers, Bennett Boffardi, Ph.d, The Analyst, Volume 15, No.2

Water Savings

Water-cooled chillers use Cooling Towers designed to remove heat from the refrigeration cycle. The cooling water is pumped to the top of a cooling tower where it is distributed using spray nozzles and then flows by gravity down through the tower fill. A fan is used to pull air across the flow while evaporation cools the water before it is sent back to the chiller to remove heat from the refrigeration cycle as the cooling cycle begins again.

Water can be reused or conserved in a cooling tower by increasing the operational Cycles of Concentration. Maximum cycles of concentration are determined by a saturation index where total dissolved solids, calcium, alkalinity, pH, and temperature are all variables. Scale inhibitors are applied based on water quality and blowdown quantity. A **Sustainable Water Treatment Program** is designed to run maximum cycles of concentration before blowing down a percent of the water. The chart below is based on a 500 Ton Chiller operating 24/7/365 at 70% load. It shows that increasing cycles of concentration from 3 to 7 will save nearly 25% on water and sewer expenditures.



Equipment Savings

The cost of a centrifugal chiller over 400 tons varies from $80,000-$200,000 depending on the brand and design.[5] Cooling tower cost will vary from an estimated $20,000-$50,000 depending upon the materials of construction. Your water treatment professional should be contacted prior to purchase and installation to recommend appropriate automated chemical feed controls, cleaning products and start-up passivation procedures. A **Sustainable Water Treatment** program will consist of proper start-up recommendations and the addition of scale and corrosion inhibitors designed to protect and extend the life of the entire cooling system.

[5] https://www.fpl.com/business/pdf/water-cooled-chillers-primer.pdf

Green Chemicals

Extending cycles of concentration in the cooling towers and using reclaim water to reduce dependence on fresh water requires the addition of water treatment products. Our industry works hard to provide chemistries that have less impact on the wastewater treatment plants and the environment.

New technologies with inhibitors designed with no heavy metals, reduced phosphates, organic tracing additives, all-organic programs and biocides with shorter half-lives are environmentally friendly and are used in successful water treatment programs. A **Sustainable Water Treatment Program** will consist of the most advanced products to provide protection for cooling systems and minimize environmental impact.

Conclusion

The Water Treatment Industry is an industry that helps people and businesses conserve water, save energy and maintain the infrastructure at their facilities. By providing this service we are helping the environment and by choosing the correct products, we are keeping the water clean and preventing pollution. We are also on the leading edge of using reclaimed or recycled water in cooling towers. Visit www.SustainableWT.com to see how we can we can propose a **Sustainable Water Treatment Program** for you.

A Sustainable Water Treatment Program Checklist

- ✓ A water analysis of the make-up water and the cooling tower water
  - o Testing should include conductivity, pH, calcium and alkalinity in the make-up water
  - o Inhibitors are tested and comparisons are made to determine if system is currently protected
  - o Look for signs of scaling. Low calcium and alkalinity cycles could indicate a $CaCO_3$ scale
- ✓ Microbiological testing performed on-site to detect biofilm formation on heat exchanger surfaces
- ✓ Calculate cycles of concentration to make sure maximum cycles are being maintained
- ✓ Make-up and blow down water meter readings should be recorded to document reduced water usage
- ✓ Corrosion monitoring using online sensors or corrosion coupons to log corrosion rates of metallurgy
  - o Verify compliance with ASHRAE recommendations
- ✓ Chiller approach temperatures should be logged and trended
  - o Verify heat exchanger surfaces are transferring heat at peak efficiency
- ✓ The chemical feed system maintenance is critical in a **Sustainable Water Treatment Program**
  - o Something as simple as a dirty sensor or in-line strainer could cause excessive water usage or even shut down the feed system and cause fouling in the chiller