By Jeff Roseman, CWS-I, Aqua Ion Plus+ Technologies

Nonchemical Alternatives to COOLING TOWER DISINFECTION

Cooling towers are needed to dissipate heat, but the complications arising in doing so are maintenance headaches and, in some instances, disease-causing problems. Bio-slimes and algae growth can and have caused bacterial contamination in cooling systems. Legionnaires disease and pneumonia have been blamed for deaths and traced back to cooling systems. Water and air can transport many pathogens and are responsible for a host of problems related to inadequate disinfection. Chemicals are used in cooling tower systems to control scale, bio-slimes and algae growth. These chemicals flocculate iron and manganese from the influent water and contain biocides to control bacteria. Softened water is not used because the mineral deposits cause scale and reduce the effectiveness of the cooling coils, in addition to increasing maintenance and labor costs at keeping the coils clean and operating efficiently. There are alternatives on the market that when applied properly offer greater control of bacteria.

Ozone and ionization have been used for many years to combat scale and bacterial issues associated with cooling tower operation. Ozone has not been as widely adopted as chemicals because many times it is not applied or implemented correctly and the end user does not experience the intended chemical reduction and smooth operation of the cooling system. Ultraviolet (UV) light has been used to control bacteria, fungus and bio-slimes. Scaling issues and maintenance due to improper application have hindered UV from being widely accepted. By explaining some tips and tricks, maybe more water treatment dealers can understand these technologies and use them in their arsenal of treatment methods.

It is estimated that there are 500,000 to 600,000 cooling towers in the United States that use chemicals because they are accepted and proven methods of treatment. Of the half million or more towers, it is estimated only 300 to 1,000 use ozone and even less use copper ionization. Cooling towers that use ozone, copper ionization or UV light in conjunction with each other are very few and far between. Why, you may ask, if these treatment methods work so well, are they not used more often? Cost is a big factor in using ozone, copper ionization and UV. The initial start up costs are expensive, but the return on investment is rather quick when properly installed and monitored.

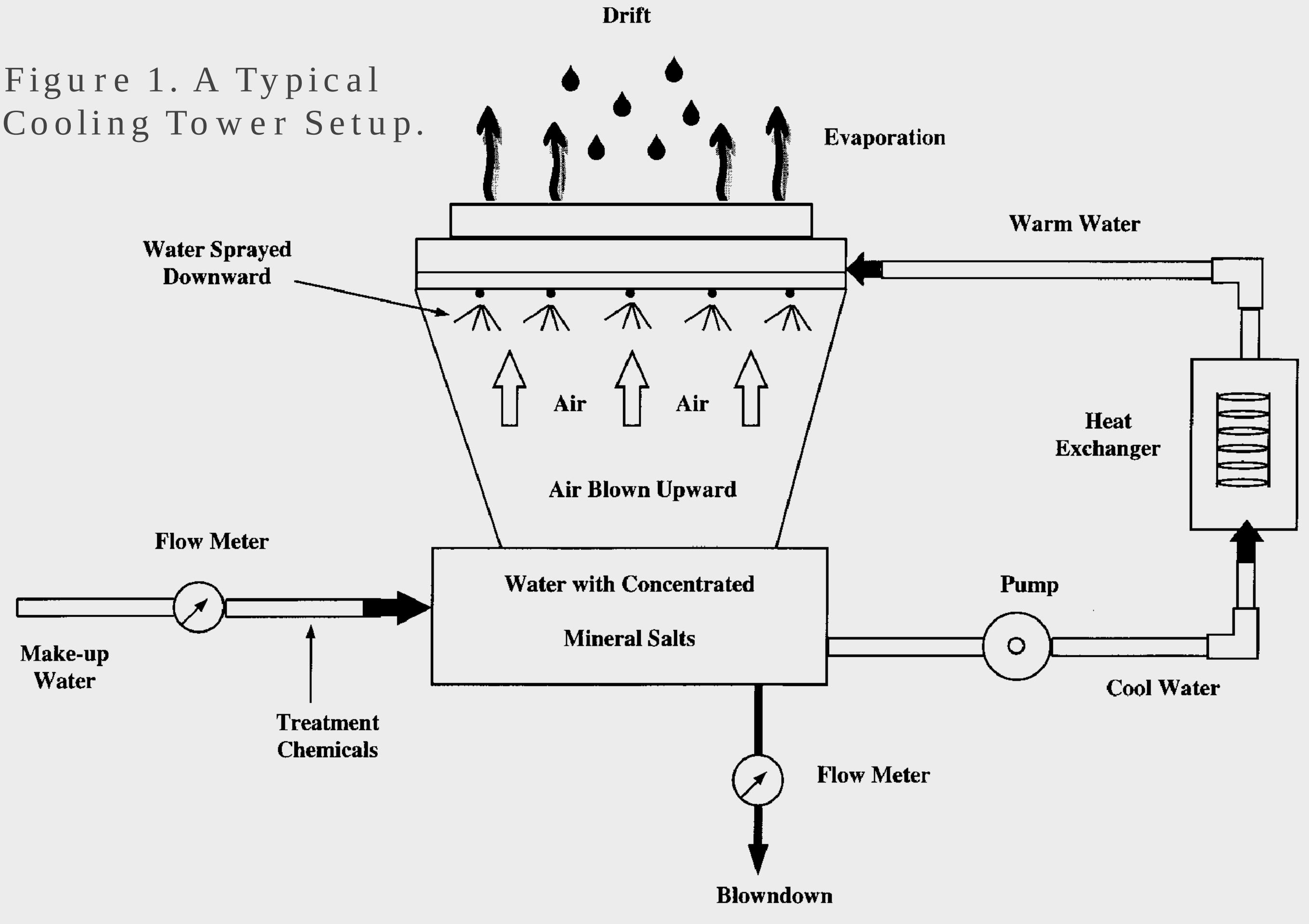
Most water treatment dealers who do not understand the technologies simply do not use them, or if they do one job and it fails, they don't find out why and they stop selling these great alternatives to chemical dosing. Whatever the case may be, these systems do work when applied correctly.

Influent Water

Every water treatment system that is employed needs to have the influent water addressed in order to effectively design proper treatment. There is more to water than total dissolved solids (TDS), hardness and iron, which many dealers test as part of a free analysis. Other contaminants such as manganese, chlorides, tannins and nitrates can change the way the designed system functions. City water or municipal water supplies are easier to work with than well water supplies, since the water is treated and contains mostly hardness minerals and chlorine. Well water, on the other hand, makes water treatment a challenge. Iron, manganese, chlorides, sulfates, nitrates and tannins can make the treatment of cooling tower water very difficult. The influent water needs to be closely analyzed so that it can be treated properly. The flow rates and equipment used also must be matched mathematically in order to function optimally.

One of the biggest mistakes made in treating cooling tower water is not pretreating the influent water. For example, without the pretreatment of water for reverse osmosis and UV light drinking water systems, these water treatment methods fail or do not work effectively. So, why not treat cooling water in the same fashion. If there is iron and manganese in the water, why treat the water after it is in the make up tank? Maybe chemicals seem to cost less than removing the iron and manganese with filtration, but after looking at labor, chemicals and blow down discharge costs, removing the contaminants with

Figure 1. A Typical Cooling Tower Setup.



About the Author

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filtration can be very cost effective. Blow down usually is done once the water reaches a set saturation or TDS level. Without the use of chemicals the TDS would not rise and there would not be a need to discharge as much water. This would reflect a cost savings on chemicals, labor and discharge fees. Pretreatment also can save money when purchasing alternative methods of treatment such as ozone, ionization and UV. With the elimination of iron and manganese, the amount of ozone needed to treat the water would be reduced, since the ozone would not have to react with the contaminants first to be effective against bacteria, algae, and bio-slimes. Since ozone is an oxidizer it reacts with other contaminants that are referred to as biological oxygen demands (BODs) and chemical oxygen demands (CODs). By reducing the demands on the ozone, the amount of ozone needed is reduced, which, in turn, decreases the cost of using ozone as a treatment method. UV light would not have as much scaling and maintenance involved. Copper ionization would work more effectively since the copper would not be binding to the iron and would reduce the copper's ability to control bacteria.

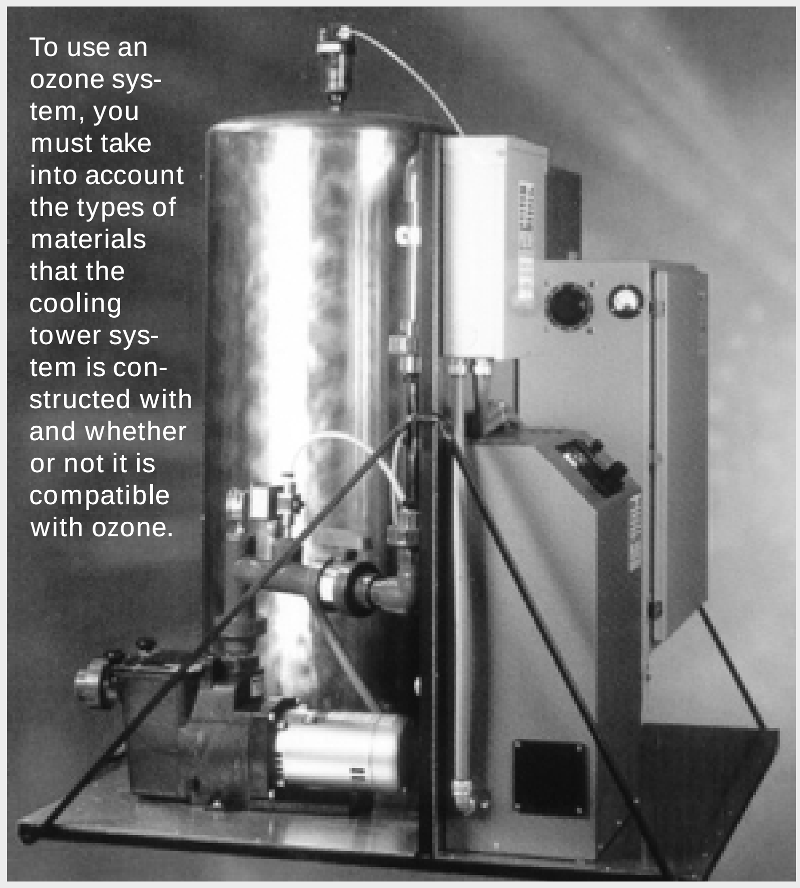
Descaling Methods

Now that the water is free from iron and manganese or other contaminants that are removed by pretreatment, what do we do with hardness minerals since softened water is not used? Some companies have used magnets to combat this problem and have been very successful. However, the magnet controversy within the water industry still prevails. Again, if matched mathematically with flow rates and contaminant levels then this could be an alternative.

An even bigger benefit would be using copper ionization. Due to its electrical charge, this type of treatment has good scale reducing properties, and the small amount of copper in the water reduces bacteria and algae. Copper ionization's benefits are two-fold. Hardness minerals from municipal and well water supplies can be controlled with ionization and, if UV were installed, ionization would help keep the quartz sleeves or coiled tubes that protect the bulb from scaling. In some applications, ozone may not be as effective at controlling scale.

Sizing Equipment

Sizing equipment can be time consuming, and this is another reason many water dealers have not pursued this market arena. There is nothing more disconcerting than spending valuable time designing a system and proposing a bid and not getting the sale. What is even worse is getting the job and having the equipment not function properly and ending up with a discontented customer because his capital investment will see no return. One missed variable in the calculation can cause a multitude of problems in the future. Not understanding how the technologies perform are other factors that contribute in design flaws of using chemical alternatives. The influent water analysis, the amount of water and the flow rates are three of the most important parameters in treating any water supply, but the compatibility of the application and technologies used play a significant role.



To use an ozone system, you must take into account the types of materials that the cooling tower system is constructed with and whether or not it is compatible with ozone.

Unfortunately there are no easily understood "cut-and-dried" formulas for sizing equipment. There are some existing formulas, but they are ambiguous and not pertinent to every application. Parameters that must be considered are the size of the cooling tower, which is measured in tons; the amount of water that is in the makeup tank; the amount of water that is in the distribution system; the amount of evaporation that will take place; the climate to which the cooling tower is exposed; the amount of blow down; the amount of influent water needed to replace evaporation on hot or cooler days; the types of materials of which the system is constructed that are compatible with ozone; where the unit will be placed; the injection points of the ozone, UV light or copper for proper dispersion; and off gassing of the ozone. As we can see, there are many variables in figuring the proper treatment, and one missed variable can render the system ineffective.

Ozone does not leave a residual. If there are areas too far from the injection point, the amount of ozone at these areas might not be effective enough to kill the bacteria, thus bio-slimes can form. UV light does not add anything to the water so if there are microorganisms that are not destroyed they, too, can cause growth within the system. Copper ionization will help in this control, but improper copper levels also can lead to problems. Ozone needs to be monitored and controlled with ORP meters or redox controllers to be the most effective. A little bit of ozone goes a long way, and by controlling the levels of ozone, such problems as corrosion or the destroying of pumps and gaskets can be minimal. Trying to determine water usage can be tricky and must be carefully calculated. Measuring the tank and piping can give good approximations of how much water is in the system, but evaporation will vary greatly depending on climate and weather conditions to which the cooling tower is subjected. The amount of blow down will be reduced since chemicals are reduced and TDS levels will not increase as rapidly.

Consider the Option

Filtration, ozonation, copper ionization and UV light may not be an option on some water supplies or applications, but their usefulness and alternatives to chemical dosing should be considered as an option. Water supplies with contaminants, which are hard to remove might be treatable only with chemicals, although when these technological advancements are understood, there are ways to use the positive benefits synergistically. There is not one water treatment method on the market that is a cure for all water problems or uses, but when employed with each other, these methods can be extraordinarily advantageous for the application and customer's needs.

Knowledge Is Power

There are many ozone, copper ionization, filtration and UV manufacturers in the marketplace that have used their products in cooling tower applications. Each has his own idea on how his equipment performs, but when used in conjunction with other technologies he sometimes can be misinformed or not educated enough on the capabilities of how his equipment can benefit, when used in conjunction with other technologies. Jumping on the bandwagon to treat cooling towers would be a mistake for many water dealers that are going to try and make a fast dollar. This process is time consuming and educationally taxing. Many types of water are not going to be favorable to this type of treatment and the cost factors are going to keep companies from using the technology unless a return on investment can be established. The impact that chemical alternatives will have on the environment is huge and very positive worldwide. With persistence and determination, many water treatment professionals will be successful.

Studying articles and books (some listed at the end of this article) would be wise, and doing research with pilot testing is recommended. A good background in chemistry, physics and microbiology is very beneficial in deploying a good system design that will give a return on investment for the consumer. Understanding how bio-films form and how the technologies work will help avoid the pitfalls of disinfection with chemical alternatives. Unfortunately, this column does not provide enough space for a full explanation of using these types of systems on cooling towers. Consultation with experienced professionals and manufacturers is recommended. **WQP**

Suggested Reading

1 Nathanson, Roger. "The O-Zone—Today's Lesson: Well, Ozone Again," *Water Quality Products*, December 2002.

2 Water Quality Association Task Force. *Ozone: A Reference Manual*, Water Quality Association, Copyright 2002.

Additional reading may be found at www.waterinfocenter.com.