A GUIDE TO OZONE USE IN COOLING TOWERS

GENERAL

This Application Guide is published for the exclusive use of Simpson Environmental Dealers and customers. The Guide provides basic information pertaining to Simpson Cooling Tower Systems and their application. It will assist in the successful installation of those products. Any comments with regard to this guide or further questions regarding the subject matter should be directed to Simpson Environmental Corporation info@senvc.com.

Ozone is one of the most powerful oxidants known to man. It's capabilities have been recognized for over 100 years. It is used extensively in the purification of water throughout the world. High capital and operating costs prevented the technology from gaining general acceptance until recently. With advances in generator efficiency and declining costs the technology is now gaining wide acceptance. The cities of Paris, Los Angeles, Dallas, and Montreal ozonate their drinking water along with dozens of other cities around the world. Ozone use has grown consistently in North America throughout the 80's & 90's. There are now around 250 water treatment systems in operation on the continent. It should be noted that the power of ozone is often used to treat both drinking water and waste water in many different applications. The products in this guide are the latest innovations using ozone in Point of Entry "POE" applications that treat all or most of the water for the house.

PRODUCTS COVERED BY THIS GUIDE

The CT5, CT10 and other CT series systems designed for cooling tower water treatment.

These system include ozone generators, air preparation, control systems, recirculation pumps where needed, safety devices, and contact systems.

APPLICATION

The objective of ozone use with cooling towers is to maintain the highest purity of water with the least amount of water waste and chemical use. Chemical use in cooling towers leads to ever-increasing total dissolved solids (TDS), which must be reduced by eliminating water (blow down/bleed off) and then refilling with raw/lower TDS water. This is a vicious circle that will never end unless one of the TDS-increasing culprits (a.k.a. chemicals) is eliminated or reduced.

THE PROBLEM

Cooling tower water quality tends to be extremely poor. Cooling tower traditional treatment is based on extreme chemical use only. There are three main problems surrounding cooling towers.

- **Water quality** control is difficult due to:
  - Evaporation rate
  - Environmental contaminants, and
  - Extreme chemical use

- **Chemical dependence** is promoted by an industry that serves and maintains cooling towers. Most cooling tower manufacturers do nothing about recommending or selling treatment equipment along with the towers. In most cases, it is left up to the end users to set up the treatment method. The cost of chemicals is lower at the front end than ozone water treatment equipment, but far higher based upon the ongoing nature of the use.

- **Water Waste.** It is not uncommon, for example, to see a 3,000-gallon cooling tower constantly draining water, then constantly replenishing raw water to lower TDS. This ever-increasing TDS is caused to a great degree by the chemicals that are used for treatment.

  Not only is there an extreme amount of water being wasted on a daily basis, but the environmental impact from the chemical-laden wastewater is deplorable. This chemical-laden wastewater eventually will make its way into our lakes, streams, rivers and groundwater. This is why this wastewater is becoming the subject of more stringent regulations.

PRIMARY USES FOR OZONE IN COOLING TOWERS

Ozone is used in cooling tower treatment for:

- Bacteria/virus elimination/prevention
- Organic build-up elimination/prevention
- Blow-down reduction/elimination
- Bleed-off reduction/elimination
- Improved clarity
- Cooler running temperatures where scale is inhibited or reduced
- Reduction or elimination of chemicals needed for algae control

PRINCIPLE METHOD OF OPERATION

Ozone is generally injected into the water flow created by a separate circulation pump. This pump pulls the water from the tower's sump or basin and sends it to the ozone injector, contact tank and scale removal/filtration system. Lastly, the treated water returns back to the sump or basin. The principle is to treat the water and eliminate/reduce the following water contaminants:

- Scale-forming minerals
- Organics
- Algae
- Harmful microbes

The clean water then is used to clean the entire sump, basin, pipes and peripheral equipment.

The ozone treatment system is simple and can be broken down into three easy steps.

1. **Ozone injection**. Ozone is injected into the side-stream flow. Oxidation starts to take place immediately on microbes, organics, bacteria and viruses.

2. **Contact/Mixing**. A contact tank helps to further the ozone's ability to oxidize particles allowing them time to react prior to returning to the system. As water flows down the off-gas tank, ozonated water rises and strips any gas from the incoming water leaving only an ozone residual in the water.

3. **Filtration, scale control, particle removal**. Possibly the most important aspect of any water treatment is the removal of the particles that have been oxidized. Without this step, all you have done with the ozone is change the structure of the particles by making them larger, insoluble and/or heavier. This step is necessary for systems that require particulate removal. In addition, a separate electronic scale control device reduces or eliminates the build up of scale deposits without adding chemicals.

It is important not to construct an ozone unit too large to handle the bacteria, scale and algae. The problem encountered at that point could be corrosion. If you carry an ozone residual that is too high you stand a chance of creating a corrosive situation in the sump and its adjacent equipment. Properly sized and installed the result is a system that works without high maintenance, dangerous chemicals, extreme water waste and costly corrosion.

WATER CHEMISTRY CONTROL WITH OZONE

Ozone, by nature, is a short acting oxidant. It will spontaneously revert to Oxygen and has a half life of about 20 minutes in clean water. As a result, an adequate dose must be applied to carry through the system. In some cases where cooling loops are large, multiple injection points may be required. A correctly applied dose of ozone can keep circulating water at less than 1,000 cfu/mL and can easily get below 100 cfu/mL. Detectable slime in heat exchangers in an ozone cooling system is nonexistent. The ozone not only acts as a bactericide but also oxidizes nutrients that provide a food source for bacteria. The correct dose and application technique are critical for success.

A properly maintained water balance will be neither corrosive nor tend toward scaling. However, maintaining that balance, while somewhat easier than with chemicals, remains a requirement of a successful ozone tower. The ozone systems are characterized by low corrosion rates, low biological counts, and scale free achievement at relatively high cycles of concentration.

CORROSION CONTROL

Ozone as the sole treatment in a tower has been demonstrated very effective at controlling corrosion. Typically, corrosion rates of less than 2-3 mpy (mils/year) for mild steel and 0.2-0.3 mpy for copper can be expected in industrial applications with less in HVAC applications. Claims that ozone is highly corrosive in this application are unfounded and there is a strong base of scientific study to back up that statement. What needs to be noted is there is an extremely significant difference between the corrosion attributable to moist air saturated with ozone and the residual ozone in aqueous phase. Failure modes linked to corrosion in cooling towers are invariably linked to poor water balance being maintained, particularly where the makeup water tends toward soft.

SCALE FORMATION

One of the interesting characteristics of an ozone treatment regime is the tendency for reduced scale formation. The conventional indices used to predict calcium carbonate precipitation are not accurate predictors and a Practical Ozone Scaling Index (POSI) developed by Alan Pryor and Mark Fisher is conventionally used. This index will typically predict scaling at cycles that can be 10 times those predicted conventionally. These predictions have been supported by practical testing. In addition, Simpson Environmental enhances this capability to resist scaling with a combination treatment that includes electronic descaling. The net result can be a significant saving in blowdown water.

SYSTEM MONITORING

Ozone systems must be monitored on a regular basis to ensure that equipment failures are repaired in a timely manner. In most towers, a minimum daily check of the operating conditions is recommended. This can be supplemented with periodic measurement of ozone residuals in the basin. The conventional monitoring regime includes conductivity, ORP, Temperature, pH and pressure.

FURTHER INFORMATION
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