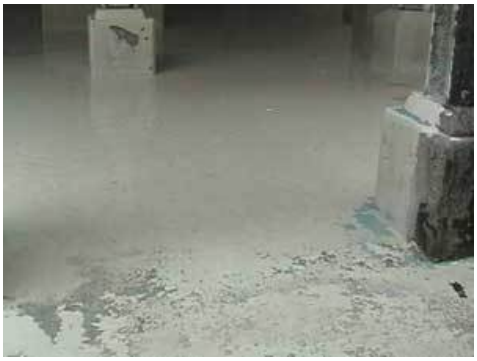
Industrial WaterWorld

An Alternative Cooling Tower Disinfectant: On-site Generated Mixed Oxidants

Favorable temperatures (80-110°F) and availability of nutrients make cooling tower systems ideal places for microbial growth. Accumulation of biofilm impedes proper heat transfer and secretes metabolic products that contribute to microbiologically influenced corrosion (MIC). The films also may propagate and release disease-causing bacteria. Control of microbial growth is traditionally achieved with biocide combinations such as bleach, sodium bromide, stabilized bromines and various non-oxidizers. Major drawbacks are costs, safety and regulatory issues associated with bulk storage and use of these chemicals. While most such biocides achieve control provided they're dosed appropriately and monitored by competent personnel, they constitute 30-70% of the chemical expense for a cooling tower system. As a result chronic underdosing to reduce costs is common. The biocides are highly corrosive and typically fed under pressurized lines that may burst or leak.



Cooling tower basin has remained algae and biofilm free since implementing the MOS program.

On-site generation of mixed oxidant solutions (MOS) from sodium chloride (salt) provides an attractive solution to concentrated biocides. Mixed oxidants are generated at the site by passing a 3-4% solution of salt through an electrolytic cell. The brine solution is converted to a powerful 0.45-0.9 % oxidant at pH 9.0 consisting of sodium hypochlorite (bleach) and minor components of other oxidants. This article documents a three-year study evaluating the cost and performance of MOS in cooling tower environments.

Study results

A district cooling tower system for a large central utility plant that cools many buildings in downtown Chicago was chosen for the initial site with the following baseline information:

- Recirculation rate = 33,000 gpm
- Delta T = 15°
- Cooling tower pH = 8.9-9.1 (uncontrolled)
- Water make-up to the system = 350,000-400,000 gpd
- Blowdown = 100,000-150,000 gpd
- Scale inhibitor = phosphonate/polymer program
- Corrosion inhibitor = azole yellow metal corrosion inhibitor
  - Corrosion rates were 0.8-1.2 mil per year (mpy) for mild steel and <0.1 mpy for copper
- Disinfection strategy: combination of slug fed sodium hypochlorite and isothiazolin
  - Sodium hypochlorite was fed two times a week (8 gallons per slug)
  - Isothiazolin was fed twice a week (6 gallons per slug)
- Consistent problem with algae and biofilm in the basin of the cooling towers
  - Bacterial counts in the bulk water averaged 10,000 cfu/ml

- Surface bacterial water counts averaged 100,000-500,000 cfu/ml.

A MIOX Corp. SAL-80 MOS on-site generator was installed and pilot tested for performance. To determine effectiveness of MOS on microbial growth, MOS dosage rates were ramped up to continuous feed of 16 lbs/day of MOS as free available chlorine (FAC). Within two weeks of achieving this level, the basin was cleared of algae and biofilm was substantially reduced. Within four weeks, all remaining detectable biofilm was removed. The oxidant concentration was routinely measured at 0.6-0.8 ppm as FAC. Even at the highest concentrations of mixed oxidant, no degradation of phosphonates, polymer or azole was measured. Further, no increase in corrosion rates occurred. Mild steel corrosion rates were measured at 0.9-1.4 mpy and yellow metal corrosion rates were <0.1 mpy.

Cost & performance

Two additional tower systems now use the MIOX units for control with similar results and a third tower system will be added this year. Payback for the units has averaged between 11 and 18 months.

MIOX unit used for study.

The MOS solution showed excellent control of microbial populations even at elevated pH typical of cooling tower waters. No negative impact on traditional scale and corrosion inhibitors was observed. Units are easy to operate and require minimal maintenance. The systems described above use 1 to 2 bags of water softener salt a day depending on water usage in the system. If properly designed, systems can result in no storage of any chemical as it can be fed directly to the cooling tower and controlled via oxidation reduction potential (ORP) readings. These units have eliminated handling of two hazardous chemicals (28,500 lbs/yr) and subsequent disposal of 51 chemical drums a year.

Conclusion

Mixed oxidant solution technology is inherently safer than use of biocides, chlorine gas or bulk bleach. It's economical and cost-efficient. And it's more effective at removing biofilm than other biocide programs. While conventional wisdom is that bromine products offer the best performance at the high pH that some cooling towers operate, these studies show MOS are equally effective.

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