

Scientific Evaluation Report "FluidTron" Nonchemical Device on Cooling Towers

Device Evaluated

"FluidTron Systems" electrostatic non-chemical device (NCD) manufactured by Electrostatic Equipment Company, Kansas City, MO, and marketed by several distributors, such as Dotson Sales in Phoenix, AZ.



Facility History

A new Phoenix, AZ, medical office building (MOB) was commissioned in March, 2010, utilizing a typical phosphonate-polymer water treatment program with stabilized bromine as the biocide. No scale, corrosion, or biological problems were reported during the one year new construction contract period. At the end of the new construction contract, the building management firm elected to discontinue the chemical treatment program and a FluidTron NCD system was installed March, 2011. We conducted an evaluation of the cooling system on March 16, 2012.

Facility Data



The cooling system consists of two BaltiBond coated BAC Model FXV 442 fluid cooler towers with galvanized steel tube bundles operated in parallel as a closed loop water source to heat pumps throughout the facility. The open water side of each cooling tower is equipped with a conductivity blowdown unit, blowdown settings of 4500 mmhos noted. A FluidTron ETI unit was observed to be wired to two exterior mounted boxes (one shown above), which were further wired to electrode units submerged in the two cooling tower basins. No corrosion coupon rack was installed and untreated makeup water was drawn from the Phoenix city water supply. Due to the recession, the MOB has never been fully utilized with current occupation estimated at 50%.

Claims Made

FluidTron sales literature and recent WEB site information (www.estatusa.com) notes that the NCD will treat cooling water for three common problems; scale, corrosion, and biological fouling. The literature also recommends supplemental filtration, flushing grids, and, when necessary, supplemental bio-control. It is interesting to compare current claims with past claims, which were much more extravagant as to the results to be obtained by NCD operation and which did not recommend any supplemental equipment.

The claimed mode of operation is that the NCD imparts a "charge" to particles and water passing through the device, as well as reducing the water surface tension.

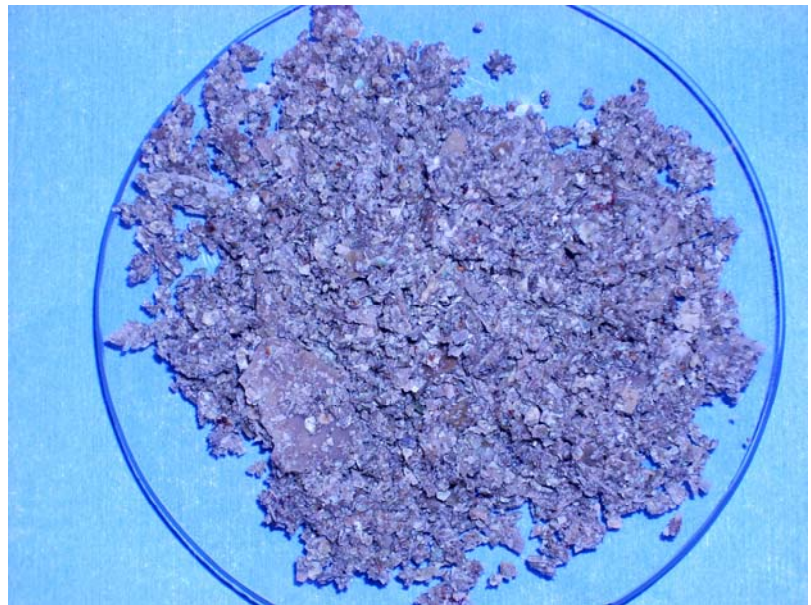
We checked for a USEPA registration number, required if the device is claimed to control biological fouling. No registration was found in the WEB site literature or at the USEPA.

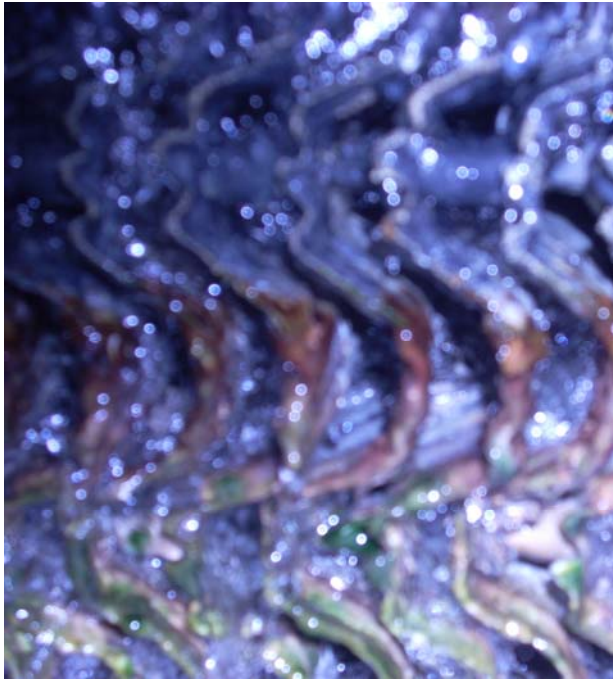
Review

Our inspection of the cooling tower found that the tube bundle was severely corroded, white rust (zinc) and red rust (iron) corrosion products are present as shown in the following photograph. A hard, gray scale was also present between the corrosion deposits.



The cooling tower basins were then examined and a substantial amount, several inches, of deposit was noted on the bottom. On removal, the deposit appeared to be flakes of scale, a greenish color was noted, and the material had an obvious bad odor. This material is shown in the photograph at right on a laboratory watch glass prior to analysis





Inspection of the fill at the water line revealed substantial algae - biological growth as shown in the photograph to the left. We also noted the presence of what appeared to be a thin scale within the fill when the sheets were spit open. Unfortunately, it was not possible to obtain a good photograph of this deposit.

Samples of makeup and cooling water, and the deposit found in the cooling tower basin, were obtained for laboratory analysis by Analytical Services, Inc., Brockway, PA, a state certified laboratory, PADEP #33-411, with the following results reported:

Analytical Results

Parameter	makeup	cooling tower 1	cooling tower 2
pH	8.0	8.4	8.5
total alkalinity, mg/l as CaCO ₃	125	195	200
conductivity, mmhos	934	8030	4850
calcium, mg/l	74	360	260
magnesium, mg/l	25.5	348	184
calcium:magnesium ratio	2.9	1.0	1.4
iron, mg/l	0.04	0.04	<0.03
copper, mg/l	0.15	0.15	0.08
zinc, mg/l	0.005	0.234	0.056
silicon, mg/l	2.7	24.4	18.7
chloride, mg/l	104	1300	750
sulfate, mg/l	250	2940	1610
total phosphate, mg/l as PO ₄	-	> 0.46	> 0.46
suspended solids, mg/l	-	12	3
total hardness, mg/l as CaCO ₃	289.8	2332	1406.9
cycles on chloride	-	12.5	7.2
ATP, rlu	-	250	733
saturation index 100 F	+0.7	+1.9	+1.9

Deposit from Cold Water Basin

Parameter	Results as % dry weight
loss on ignition	33.1
aluminum as Al ₂ O ₃	0.15
calcium as CaO	25.9
copper as CuO	0.52
iron as Fe ₂ O ₃	0.73
magnesium as MgO	0.99
silicon as SiO ₂	2.8
phosphate as PO ₄	<0.01
sulfate as SO ₄	0.95
zinc as ZnO	23.7
ATP, 1.3 gram/100 ml water, RLU	14,973

Note: Results reported as oxides, closure of 88.84%

Discussion

The makeup water as supplied was found to be scaling, saturation index (SI) of +0.7. Concentration by evaporation of this water would result in a substantial increase in scale formation potential. Running a WaterCycle computer simulation, the saturation index for cooling tower #1 would be +3.7 at the 13.6 COC found while cooling tower #2 would have been +2.9 at the 7.2 COC found. The chemical analysis reported a saturation index of +1.9 for both cooling tower waters. This difference between calculated and found saturation index values is an excellent indication of substantial calcium scale formation within the cooling towers.

Considering the calcium mass balance, cooling tower #1 should have had calcium at 1,006 mg/l present, found 360 mg/l. Cooling tower #2 should have had a calcium level of 533 mg/l, 260 mg/l was found. The difference between expected and found calcium levels shows that substantial calcium scale formation has taken place in the cooling towers.

The laboratory calcium:magnesium ratios of the makeup and two cooling towers waters are also substantially different, confirming a large loss of calcium from the cooling waters as compared to the makeup water.

Considering the total alkalinity mass balance, we see cooling tower #1 had 195 mg/l present, based on COC a total of 1,700 mg/l should have been present. Cooling tower #2 was found to have 200 mg/l total alkalinity present; on COC it should have had a level of 900 mg/l. It is likely that the missing total alkalinity, carbonate, has precipitated with the missing calcium to form calcium carbonate scale within the cooling towers.

The cycled chloride and sulfate levels found, 1,300 and 750 mg/l for chloride and 2,940 and 1,610 mg/l for sulfate are high and severe corrosion can be expected to result without use of a well designed corrosion control program.

Found pH levels, 8.4 and 8.5 in the cooling waters, are above the 8.2 where white rust becomes a major concern and would require a well designed corrosion control program for control.

A large amount of scale was present in the cooling tower basins, with little noted on the fill and tube bundles. It is believed that this observation is due to intermittent operation of the cooling tower resulting from the low building occupancy (low thermal load). The tube bundles and fill dry out between cooling tower operation periods and any scale that has formed flakes off the tube and fill surfaces as it dries and loses water. This explains the finding of a lot of scale flakes in the cold well basin deposit with only small amounts of hard scale observed on the tube bundles and within the fill.

Chemical analysis results from the cold well deposit are surprising in that while the expected substantial amount of calcium was present, zinc was present in an almost equal amount. The deposit found in the cold well is composed almost entirely of calcium compounds from precipitation of calcium found in the cooling tower makeup water and **zinc compounds from corrosion of the galvanized tube bundle**. The loss of zinc from the tube bundle due to white rust corrosion, combined with the high level of chloride and sulfate present, and intermittent operation of the cooling towers can explain why red rust is already evident on a tube bundle that is just two years old, in spite of the water being very scaling. It is expected that the tube bundles in these cooling towers will have to be replaced in the near future due to corrosion pin holing.

Conclusions

It is apparent that the NCD is not controlling scale formation within the cooling towers based on saturation index, mass balance, Ca:Mg ratio, and deposit data. Observation confirms the presence of limited amounts of scale on both fill and tube bundles, and a large amount of calcium and zinc based deposit in the cooling tower cold water basins.

Intermittent operation and white rust corrosion, it is impossible to get a protective scale to form over white rust, has prevented formation of a hard, adherent corrosion controlling scale on the tube bundles. This effect, combined with very high levels of corrosive anions and loss of the zinc galvanize surface, results in rapid corrosion of the tube bundle and the appearance of the red rust corrosion products observed on the tube bundles. The obvious conclusion is that the NCD is ineffective for control of either white rust or ferrous metal corrosion.

While the planktonic ATP results were acceptable, sessile organism levels in the cold well deposit, as indicated by the high ATP results, were excessive. We are of the opinion that planktonic organisms are removed from the cooling water during calcium carbonate precipitation, thus they are present in the cold well basin deposit. This does present a problem in that the deposit provides a base for microbiologically induced corrosion as well as under deposit corrosion. Considering this information, there is no evidence that the NCD is providing any form of biological control.

Reporter

Timothy Keister, CWT FAIC
Chief Chemist

ProChemTech International, Inc.

“Innovation in Water Management”

Apache Junction, AZ, and Brockway, PA

814-265-0959

www.prochemtech.com