

**FIELD TEST OF ELECTRONIC COOLING TOWER (CT) WATER TREATMENT SYSTEM
CONDUCTED FOR THE PURPOSE OF ELIMINATING CHEMICALS AND BLEED OFFS.**

15 months practical investigation into the efficiency and benefits of an entirely non chemical water treatment system for Cooling Towers.

Jakarta, Indonesia, June 25, 2015



Field Test of (Electronic) Cooling Tower Water Treatment System - Eliminating Chemicals and Bleed Off.

The **Cooling Tower (CT)** used for this 15 months test is an existing Air Conditioning Water Cooled Package Plant containing 45 m³ of water volume in an open pipe system. Water circulation is 318 m³ per hour (88 l/s) through a 200 mm diameter piping system.

Location & Hours of Operation: Karawaci Supermal, Tangerang, Jakarta, Indonesia. The Karawaci Supermal Air Conditioning system operates 365 days per year, from 9.30 a.m. to 9.30 p.m.

Test Equipment: Vulcan S500 **Electronic Anti-Scale System** AND a ThomsonTec **Silver-Copper Ionization System** CS-1050 MPC for Algae and Bacteria Control.

Test Dates: March 4, 2014 to June 03, 2015.

Commissioning of both anti-scale and (Ag+Cu) ionization systems: February 26, 2014.

Product Description:

- A) **Electronic Anti - Scale System**, Vulcan Engineering, Germany. This Equipment changes the Crystalline Structure of the Calcium so it cannot bond into Scale and therefore does not need high conductivity bleed off circulating water to a waste drain.

(Photo shows the authors of this report – Graham Gething (with blue shirt) and Rudy Schouten (at Vulcan Control Module) – alongside the flat-copper wrapped CT main pipe of Electronic Anti Scale System, shortly after installation in Feb 2014).



- B) **Electronic Algae and Biocide Control System** using Silver/Copper Ionization, ThomsonTec Water Conditioning Systems Technology, USA.

(Photo shows Silver Copper Ionization System anode chamber, mounted in bypass line - between two shut off valves.



Vendor of both electronic systems: PT Biosolutions Indonesia, Jakarta, Indonesia. Contact: Rudy G. Schouten, Director. Email: birdsong@rad.net.id

Services Engineer representing owners of Karawaci Mall: Ir. Graham Gething, Jakarta, Indonesia. Email: g_gething@cbn.net.id.

CT operating criteria during test period, inspections and photographs:

No water treatment chemicals of any kind were applied to this system during the field test period, starting in January 2014 (pre-test period). The CT or sunlit louvers and PVC media plates, CT sump tanks or piping, and the water cooled package of Shell and Tube Heat Exchangers were not cleaned from early January 2014 until the end of the trial period and beyond.

In addition, no water bleed off to waste discharge of condenser water was done at any time during the trial period. In fact, conductivity was allowed to increase continually during the trial period in order to evaluate water savings achieved compared to the usual chemical water treatment for cooling towers which always requires water bleed off (to reduce conductivity reading of the water).

Both the Electronic Scale Control (A) as well as the Silver Copper Ionization Systems (B) were inspected monthly and the condenser tubes were opened and photographed on the dates shown below, in order to inspect for any extra scale formation on the inside surfaces of the Shell and Tube Condenser Copper Pipes. No extra scale was detected throughout the complete test period and beyond.

Inspections and Photographs of the Electronic Scale Growth Control System: please note that one only of the many Water Cooled Package Air Conditioners connected to this CT system was selected to be the Refrigeration Shell & Tube Type Heat Exchanger to be photographed and inspected for determining the growth or no growth of scale within the copper Heat Exchanger Tubes.



March 4, 2014



June 1, 2014

Above: showing copper tubes of AC condenser Heat Exchanger on dates indicated.



December 10, 2014



June 3, 2015

Above: showing copper tubes of AC condenser Heat Exchanger on dates indicated.

Note: The R22 Refrigerant pressure gauges were inspected during the trial period and remained relatively constant at 57 PSIG suction (+4 C) and 252 PSIG hot gas (+48 C).

Inspections of the Electronic Fungus & Biocide Control System:

Monthly inspections revealed a soft blue color buildup (approx. 3-4 mm thick) which had formed on each electrode. This buildup was easily washed away before re-installing the anode assembly. Laboratory analysis of the scum indicated that it was a mixture of copper and calcium carbonate.

Initially, the anode controller was set too low. Gradually it was raised to a 97% reading on the digital dial and at this point the expected anode erosion rate was achieved.

OBSERVATIONS:

A. Scale growth control system:

The CT was inspected frequently during the trial period but we have restricted our report to those inspections on the day photographs were taken to evaluate evidence of scale formation. During the 15 months test period, No scale formation was found on the Condenser Heat Exchanger Copper Tubes.

Detailed Inspections:



March 4, 2014

March 4, 2014: The heat exchanger tube plates were removed to reveal the inside surface of the copper tubes. Since these tubes had recently been manually cleaned, virtually no scale was present, as is obvious on this photo.



June 1, 2014

June 1, 2014: The inside surfaces of the copper tubes show zero additional scale formation after 3 months (91 days) into the test period.



December 10, 2014

December 10, 2014: The inside surfaces of the copper tubes show zero additional scale formation after 9 months (274 days) into the test period.



June 3, 2015

June 03, 2015: The inside surfaces of the copper tubes show zero additional scale formation after 15 months (456 days) into the test period.

B. Fungus, Algae and Biocide Control by Electronic Silver – Copper Ionization System:

The ionization system was installed in a 4" bypass line that was part of the CT return water pipes, as recommended by the manufacturer.



The anodes were inspected regularly and both anodes required regular monthly cleaning because of a build-up of blue scum which formed on each anode (Photo) This scum was soft and easily removed by scraping and washing with water.

With the Karawaci Supermal CT pumps operating from 9:30 a.m. to 9:30 p.m., 365 days per year, the sacrificial shedding of both anodes during the 15 months trial period amounted to approximately 75%. This indicates that anode replacement has to take place every 20 months for this 318 m³/hour (88 liters/second) circulation flow system.

C. Water Testing Results

A Cooling Tower water test was conducted on July 16, 2014, by a CT water treatment company. We show below an extract of the related test report of that day:

<u>Water Analysis Report</u>			
Company Name	:	Super Mall Karawaci	
Treatment For	:	Cooling System	
Sampling Date	:	16 / 07 / 2014	
Parameter	MU water	Cooling water	Standard Cooling water
pH	7.0	8.6	7 – 9
Conductivity, us/cm	254	1760	< 2000*
Total alkalinity, ppm	54	308	< 500
Ca-hardness, ppm	39	211	< 500*
Total hardness, ppm	51	289	< 500*
Chloride, ppm	15	94	< 400
Silica, ppm	12	45	< 120
Total iron, ppm	0.05	0.05	< 1
RSI, Ryznar Stability Index		5.2	5 - 7
Cycles, conductivity		6.93	7.87
Cycles, Ca-hardness		5.41	12.82
Cycles, Total alkalinity		5.7	9.26
Cycles, Total hardness		5.67	9.8

* We recommend letting these values drift to higher figures in the interest of saving Bleed Off Water which can now be done only once each year. The Crystalline Structure made by the Electronic Anti-Scale System makes the Conductivity and Hardness irrelevant.

D. **Legionella bacteria were not present.**

Having almost ten years of experience with Silver (Ag) and Copper (Cu) Ionization as a reliable water sanitizer & bactericide in several modern Swimming Pools in the Greater Jakarta area, the Authors were confident that no Legionella bacteria could exist (provided there are no Dead Leg pipes permitted to exist within the piping system) when an Electronic Silver – Copper Ionization system was incorporated in the CT water treatment system. Nevertheless, 2 separate Legionella laboratory tests were carried out - one by the CT owner and one by the vendor. Both lab results showed ND, i.e Legionella pneumophila bacteria were Not Detected. Furthermore, the microbiological section of a third Cooling Tower water test which was done in June, 2015 show the same findings, i.e Legionella bacteria were again shown as ND. Detailed test results can be supplied upon request.

E. Corrosion Control:

Vulcan Engineering, the manufacturer of the Anti-scale system reports an “amazing” side effect of the product on iron pipes with oxygen rich water is that rust is no longer formed; it will disappear and be replaced by a very thin black protecting layer, called Magnetite.

In order for us to substantiate/confirm this statement, we are installing in the existing piping 2 easily removable sections in the existing pipe. With one of these sections, we will remove all scale to simulate the effect in a new piping system. In the other section, we will leave the scale in place to simulate the effect in an old piping system.

These sections will be inspected every 4 months to observe any tendency to rust and the results will be recorded by the Karawaci Supermal Engineering Department as part of their scheduled maintenance inspections.

CONCLUSION:

Both the Services Engineer of the CT system at Karawaci Supermal, as well as the Vendor of the Electronic Scale & Electronic Algae and Bacteria control systems are satisfied that an open pumping system for Cooling Towers can be treated without chemical water treatment products if fitted with these two electronic systems. In addition, wasted water usage will be reduced to what is required for a bleed down only once per year and there will be no scale formation in the systems' Heat Exchangers.

Since scale buildup inside the refrigeration condensers has been eliminated, periodic descaling of condensers is also eliminated.

Refrigeration compressors operate at peak efficiency because there is no scale buildup inside the condenser water tubes and ideal heat transfer is produced.

Please note that if the makeup water is Ph unstable, then attention needs to be given to maintaining Ph 7 to Ph 9 within the circulating water.

This field test shows that both systems can be relied upon to perform as per the manufacturer's claims; that efficiency of the CT is increased, overall equipment durability is enhanced, that closed systems do not have to be incorporated to control Scale formation within the refrigeration heat exchangers and that significant savings on water consumption and chemical costs can be realized.

The complete elimination of chemicals in this CT operation during the field test of the combined electronic systems supports the fact that both are “Eco friendly” and would add significantly to the criteria required for “green” building designation anywhere in the world.

Rudy G. Schouten and Graham Gething.
Jakarta, Indonesia, June 25, 2015.

Attachments:

1. Anti Scale system pamphlet of Vulcan Engineering of Germany
2. Silver Copper Ionization system pamphlet of ThomsonTec Water Conditioning Systems Technology, USA



The electronic anti-scale system

Your green alternative to water softeners



No Salt
No Chemicals
No Maintenance

German Technology
Absolutely Magnetism-Free



CS Series

Mineral Purification Technology

Fewer Chemicals

Easier Maintenance

More Enjoyment



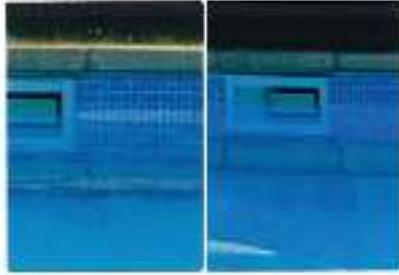
**EXCLUSIVE
TRUTECH
FEATURES**

ThomsonTec™
WATER CONDITIONING SYSTEMS TECHNOLOGY

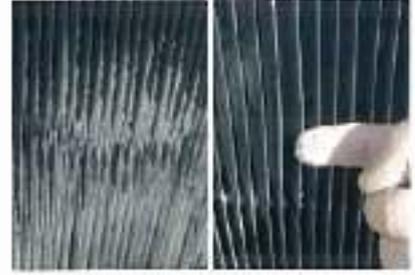
The Vulcan treatment effects – before and after



Grill plate in a professional kitchen



Swimming pool water line



Cooling tower grid



Pool chlorinator



Toilet bowl



Grease trap



Greenhouse plants



Piping system



Commercial Line – Vulcan 5100

Benefits



- ✓ Maximum working life of commercial machinery and equipment
- ✓ Reduction of harmful bacteria and biofilm
- ✓ Less time and effort spent on cleaning
- ✓ Reduction of maintenance on irrigation systems and water tapping
- ✓ Food and beverages keep their natural taste
- ✓ More reliable water supply within sanitary facilities
- ✓ Savings due to more efficient use of energy for heating water

