PT. BIOSOLUTIONS INDONESIA

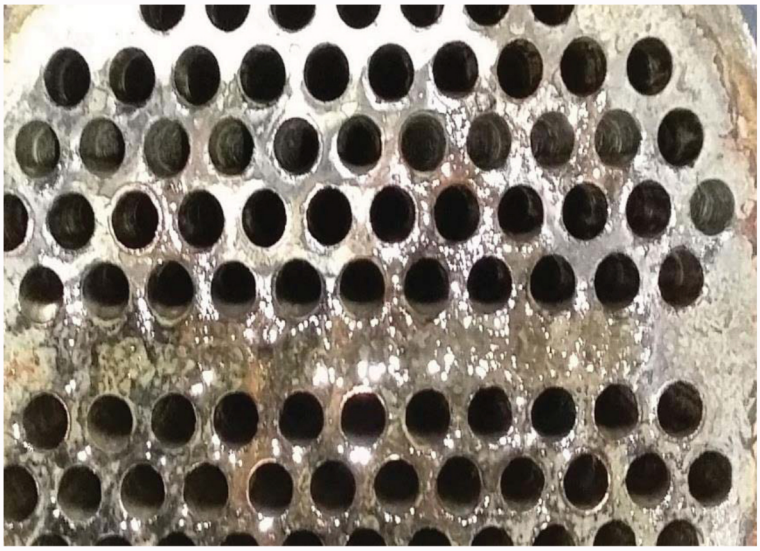
June 20, 2018

TECHNICAL REPORT

Results of a 4-Year Field Test of Electronic Cooling Tower Water Treatment at Super Mal Karawci (SMK) Jakarta, Indonesia.

Electronic Cooling Tower Water Treatment System without scale, without algae in the cooling tower, without the use of chemicals, without blow downs and without shutting down the Refrigeration Condensers for manual cleaning.

Cooling Tower inside evaporative panels are always clean



Refrigeration Condenser Heat Exchanger copper tubes are always clean

Environment friendly water treatment products

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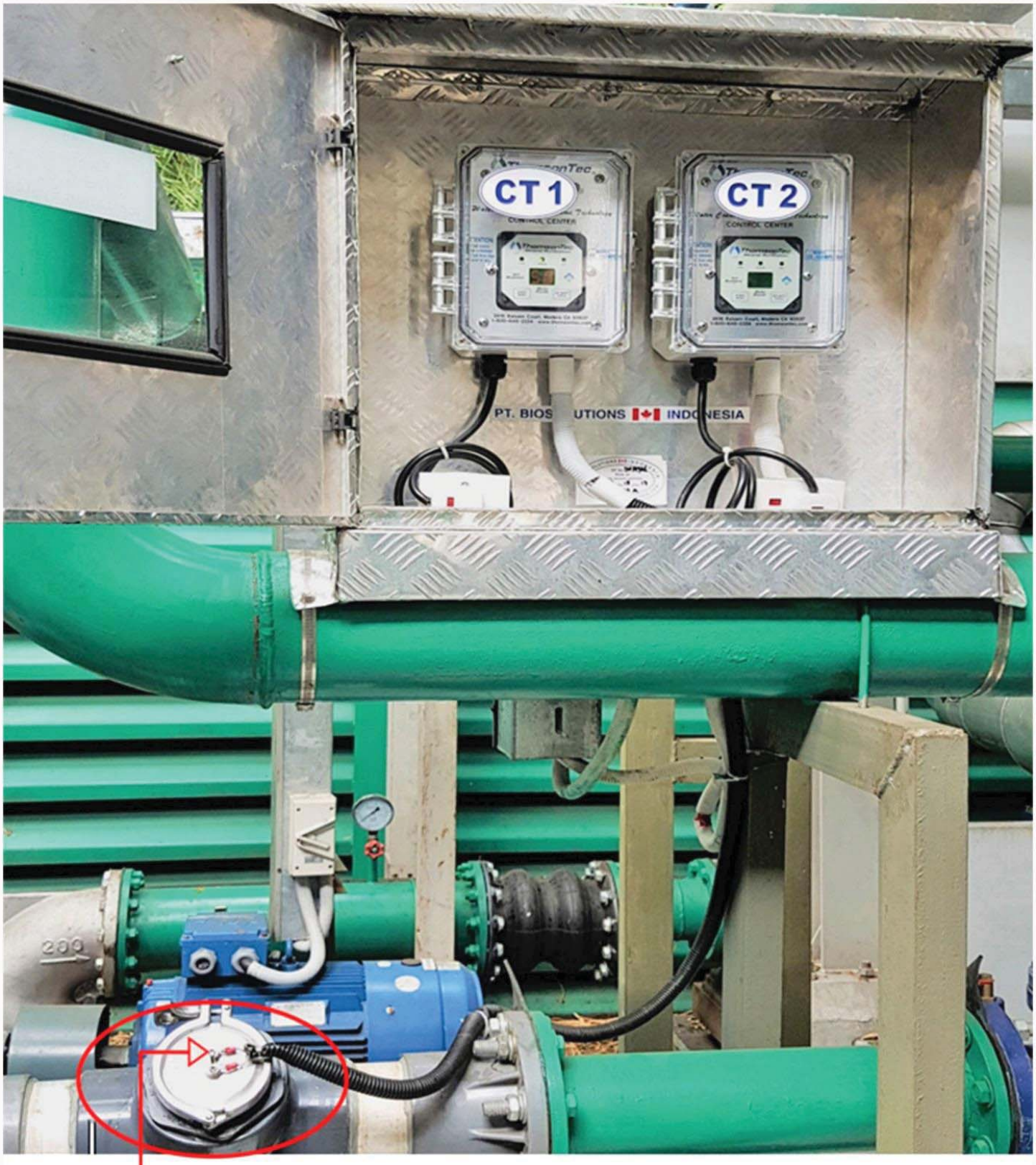


2017 Jakarta Installation of 2 Cooling Towers with electronic water treatment
Above: Both controllers mounted inside alumunium cover box (opened).
Bottom: Grey T-Junction with CT Nr. 1 Silver Copper
Anodes mounted in the CWR bypass line.

TECHNICAL REPORT

Results of a 4-Year Field Test of Electronic Cooling Tower Water Treatment at Super Mal Karawci (SMK) Jakarta

Results of a 4-year field test of an Electronic Cooling Tower Water Treatment System without any scale, without algae in the cooling tower, without the use of any chemicals and without contaminated water bleed off to waste.

OVERVIEW:

The field test was carried out at a large Mall in Karawaci, Tangerang, Jakarta, Indonesia. One of 7 cooling towers servicing the Mall's water cooled package air-conditioning systems was selected to test the effectiveness of the electronic descaling and bacteria/algae control systems. The CT selected is a 408TR system containing 45 m^3 water volume with a water flow rate of 38M3/Hr in an open circuit system.

One of the goals of the field test was to prove or disprove the Vulcan manufacturer's claims that there will be "no scale" forming inside the pipes or in the refrigeration air-conditioning cooling condensers. Therefore, there will be "no loss of electricity efficiency in the refrigeration system due to scale".

Location, Equipment and Operating Times:

Supermal Karawaci, Tangerang, Jakarta Indonesia. This large Super Mall operates seven days a week from 9:30 to 21:30, 365 days of the year.

Test Equipment: 1 Unit Electronic **Anti-Scale** System - combined with
1 Unit **Silver Copper Ionization** System

Field Test duration and inspection/test dates:

The field test started in early February 2014 and the first opening of the Condenser Tubes with photographs took place on March 4, 2014. Subsequently, the inspections and water analyses were repeated at 15 months, 32 months, and 3-1/2 years of continuous operation. The final inspection with photos and water testing took place on February 12, 2018, which is 4 years after the start of this field test.

Note: the final trial CT water test was validated by the Manager of Environmental Services of Intertek Laboratories of Jakarta, Indonesia.

Product Description and Notes:

Vulcan Electronic Anti-Scale System - **Model S 500** manufactured by
Christiani Wassertechnik GmbH, Berlin, Germany.

The Vulcan Anti-Scale system – installed on the outside of the piping - modifies the crystalline structure of calcium/magnesium in the water and other scale forming salts, so that they cannot bond to themselves or to metal surfaces inside the pipes. Vulcan claims that any scale already formed in an existing system is gradually reduced by this treated water at a speed similar to that at which it had formed.

Corrosion Control: Vulcan Engineering, the manufacturer of the anti-scale system, reports a positive side effect on iron pipes with oxygen rich water in that rust formation is reduced in the piping due to the formation of a thin protective layer of metal – carbonate.

ThomsonTec Silver-Copper Ionization System - Model CS 1050-10 MPC distributed by
ThomsonTec Water Conditioning Technology, California, USA.

This silver/copper ionization system is used to control algae and pathogenic organisms in various water treatment systems.

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

Set of Silver/copper alloy ANODES

The anodes were inspected regularly and required monthly cleaning because of a thin build-up layer of copper calcium carbonate on each anode (see photo).

This build-up was soft and easily removed by light scraping and washing with water.

During the 4-year trial period, no scale and no algae were detected on the evaporative media of the CT, except the usual biological growth on the sunlit exterior edges of the CT along with the usual dust and pollution - this was easily washed off during the scheduled external surfaces washing.

Similarly, all our CT water tests included Legionella P. bacteria. In every case the result was negative.

OBSERVATIONS:

Scale Elimination system:

During this 4 - year trial period, no scale formation was found on the Condenser Heat Exchanger copper tubes of the system.

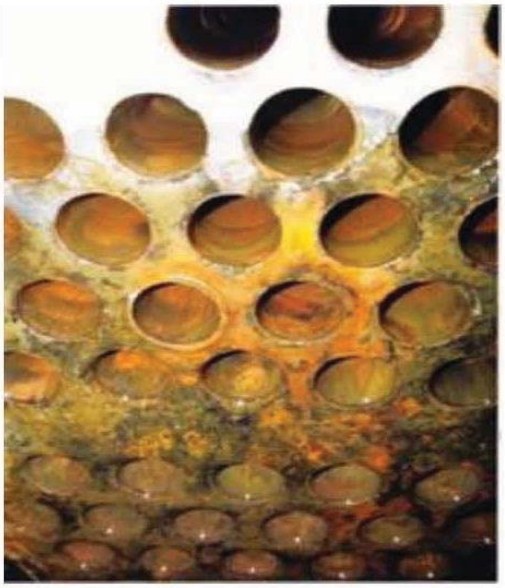
The photographs show that the Refrigeration Condenser tubes, from the beginning to the end of the trial period, were "as clean as new".

Cooling Towers: the inside surfaces of the evaporative media were very clean at all times.

Inspections, CT Water Tests and Operations :

Start-up of Electronic CT Water Treatment: early February 2014.

During the four years of this trial, both electronic systems were frequently inspected, as detailed below:



First Inspection: March 4, 2014.

At each inspection, the following procedures were followed:

1. Both Electronic systems were inspected
2. One of the Refrigeration "Shell and Tube" Condensers was opened and the tubes inspected
3. Condenser tubes were photographed
4. Cooling Tower water sample was sent to lab
5. Refrigeration hot gas pressure gauges were checked.

Last inspection: **February 12, 2018 at the end of the 4 - year trial period.**

During the four year trial period, inspections took place:

2014 - 4 times **2015 - 2 times** **2016 - 2 times** **2017 - 1 time** **2018 - 1 time**

Water Testing Results:

The final cooling tower water test was conducted by Intertek Laboratories on February 12, 2018, and test results, including remarks, are shown on page 7.

Please note that for 4 years of 365 days continuous operation, there has been:

- No chemical water treatment.
- Blow Down high EC 10,000µS/cm only twice per year.
- No cleaning of condenser tubes.
- No water treatment specialists employed.
- Very clean copper tubes in the condensers – without scale.
- No cleaning of the cooling towers inside surfaces.

With the Karawaci Supermal CT pumps operating daily, the sacrificial shedding of both copper/silver anodes during the 4 - year trial period required replacement of those two anodes after 24 months. After 48 months they are once again close to being changed. This indicates that anode replacement can be expected to take place every 24 months for this 88L/sec circulation flow system operating 13 hours per day, 365 days per year.

The R22 Refrigerant pressure gauges were regularly inspected during the trial period and remained at constant hot gas head pressure because there is no scale in the condensers. Therefore each AC unit is always operating at "as new" electricity usage and thus optimising running costs.

CONCLUSION:

Both the Services Engineer of the CT system at Karawaci Supermal, as well as the Vendor of the Electronic Scale and Electronic Algae and Legionella P 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 water treatment systems.

In addition, water usage will only be required for cooling evaporation plus a Blow Down twice per year because there are no chemicals used. Vulcan has set a maximum EC (Electronic Conductivity) reading of 10,000µS/cm for their system. The usual EC for chemical treatment of Cooling Towers is 1,200µS/cm - needing almost daily Blow Down of chemically contaminated water to maintain the appropriate EC readings.

Since scale buildup inside the refrigeration condensers has been eliminated, periodic descaling of condensers is never required.

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

Note: if the circulating water Ph is outside the normal range, then attention needs to be given to maintaining Ph 7 to Ph 8, regardless of which water treatment system is used.

This 4 - year field test shows that both Electronic systems can be relied upon to perform as per manufacturers' claims, that efficiency and safety of the CT system is maintained, overall equipment durability is enhanced, and that significant savings on water consumption, electricity 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 meet the Leeds and Green Mark Building Criteria required for “Green Building” designation anywhere in the world.

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June 20, 2018

For more information, please visit www.biosolutions.co.id

For previous reports:

15 months report:
https://drive.google https e.com/open?id=1UZtKLNE4269Vrg6KKozqBHSnPtiCrdBn

32 months report:
https://drive.google.com/open?id=1Ywjz3FTSH1GNzeBN4Xyq6_q2RKJh2mtX

Report on 3-1/2 years of continuous operation:
https://drive.google.com/open?id=1IjG4FSM72iOUK31flrHkt98oX5uLSuDp

Job Number : EV180437

Customer : PT. Biosolutions Indonesia

Project Name : Cooling Tower

Customer Ref : 4291.r1/IUS-EV/X/2016

Laboratory Sample I.D :				EV180437-1
Customer Sample I.D :				SMK Cooling Tower
Date Sampled :				12-Feb-18
Sample Matrix :				Water-1
No.	**Test Description**	**Units**	**Regulatory Limit**	**Results**
	Physical Tests			
1	Carbonate Hardness	mg/L	1000	143
2	Conductivity	µS/cm	1200	1680
3	pH	S.U.	7.0 - 8.3	8.27
4	Total Dissolved Solids, TDS	mg/L	2000	1160
5	Total Hardness as $CaCO_3$	mg/L	500	345
6	Total Suspended Solids, TSS	mg/L	50	<1
	Anions			
1	Alkalinity Bicarbonate as $CaCO_3$	mg/L	80 to 400	143
2	Alkalinity Carbonate as $CaCO_3$	mg/L	80 to 400	<1
3	Alkalinity Total as $CaCO_3$	mg/L	80 to 400	143
4	Chloride, Cl^-	mg/L	300	224
5	Sulphate, SO_4^{2-}	mg/L	500	268
	Nutrients			
1	Nitrite, NO_2-N	mg/L	200 to 700	0.009
	Total Metals			
1	Copper, Cu	mg/L	-	0.021
2	Iron, Fe	mg/L	0.3	0.168
3	Silver, Ag	mg/L	-	<0.001
	Microbiology			
1	Legionella pneumophila***	CFU/100ml	N.A	ND

Note: Refer to QA/QC – Accuracy page for list of analytical methods used
Regulation Limit based on Superchill Australia


CS Series
Mineral Purification Technology
Fewer Chemicals
Easier Maintenance
More Enjoyment
COPPER
EXCLUSIVE TRUTEC FEATURES
ThomsonTec
WATER CONDITIONING SYSTEMS TECHNOLOGY


Vulcan
The electronic anti-scale system
Your green alternative to water softeners
Vulcan S500 gegen KALK gegen ROST
No Salt
No Chemicals
No Maintenance
German Technology
Absolutely Magnetism-Free
MADE IN GERMANY