

Japanese Car Manufacturer. Cooling Towers

2010 - 2011

A Case study of Hydropath Technology by:
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Customer : A major car manufacturer, Japan.

Installation : AquaKlear Model P200 (8 “), one unit, made in UK.

Testing term: October 22, 2010 through to February 07, 2011.

Cooling equipment :

Cooling Tower is one unit of 300RT for 3 units of compressors of equipment No. L8 of the factory.

Introduction

This report describes a field test done to determine the effectiveness of AquaKlear water conditioners on a cooling tower. Equipment was evaluated for several effects:

- Elimination of Algae
- Prevention of Scale
- Removal of Existing scale

The period of the test was about three and a half months.

The system and previous treatment

The make-up water of the cooling tower is supplied from underground wells, meaning it has a high content of silicate (50mg/L). The silicate level of the circulating water in the cooling tower should be kept below 150 mg/l (Max. Limitation is 200mg/L). Including a safety factor of 80% gives 120 mg/L.

This means $120/50 = 2.4$ condensation time is available for this cooling water, i.e. the concentration level of the water in the tower is 2.4 times that of the incoming make-up water.

Make up water parameters:

Parameter	Value	Unit
pH	7.1	pH
Calcium (as CaCO ₃)	70	mg/ l
M-Alkalinity	69	mg/ l
SiO ₂	50	mg/ l
Conductivity	27	ms/ m

Before installation, the customer was using two kinds of chemical additives:

- 1) Chemicals for inhibiting scale and corrosion.
- 2) Chemicals for killing legionella, Pneumophila and slime (biofilm).

The purpose of the test

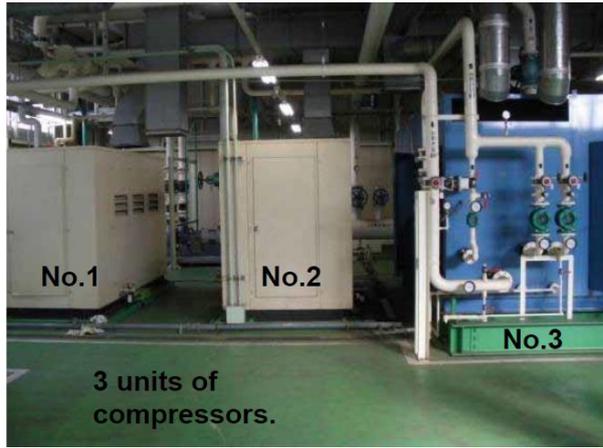
The concentration of the circulating water is only 2.4 times greater than that of the make-up water and this means that a lot of water needs to be blow down. All the make-up water is treated with chemicals so that the customer's chemical costs are very high over a year's continuous operation.

Because of the high cost of chemical treatment, the customer wanted to consider other treatment methods. The aim of the test was to study treatment of the cooling tower with Aquaklear, and to determine the most economical method of treatment – Aquaklear or chemicals.

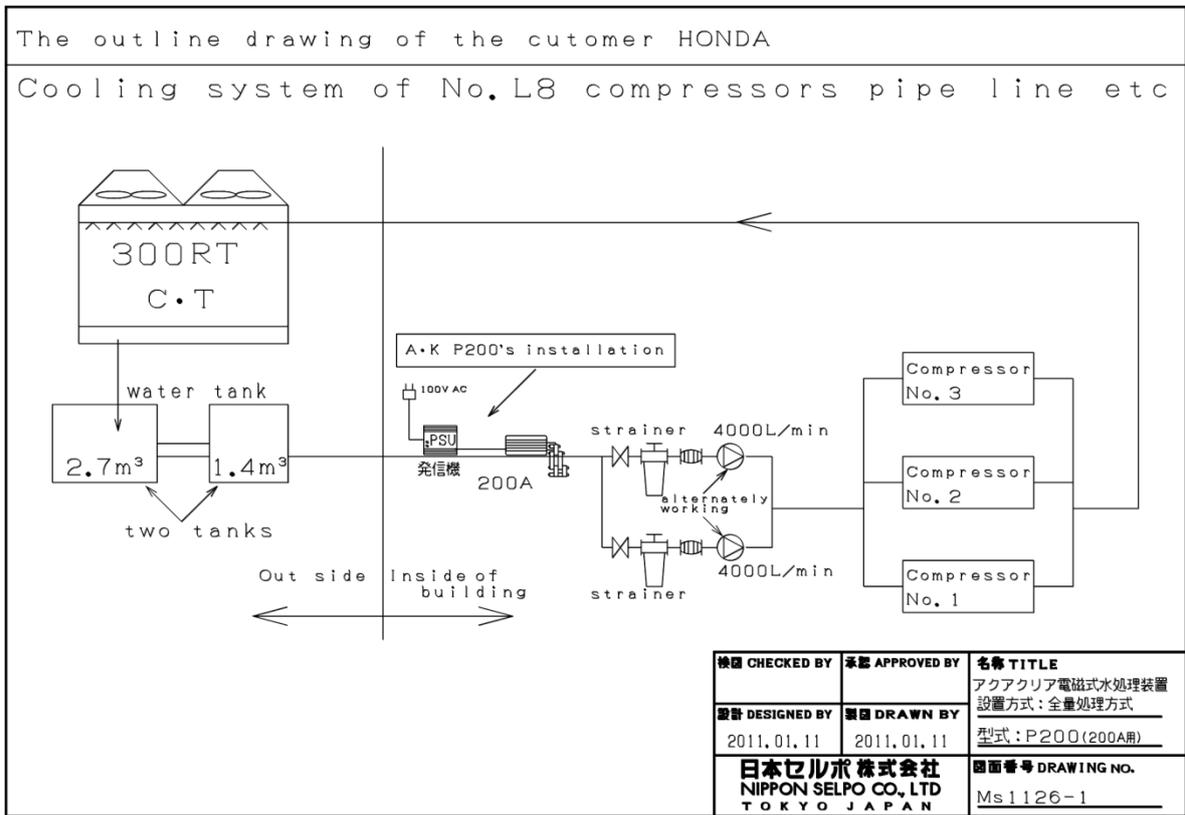
The customer's standard maintenance plan involves opening the heat exchangers every 24000 hours of operation (about every 3 years) for inspection and chemical cleaning.

The heat exchangers were scheduled for cleaning on February 7th, 2011, and the end of the AquaKlear test was chosen to coincide with this.

Test Equipment

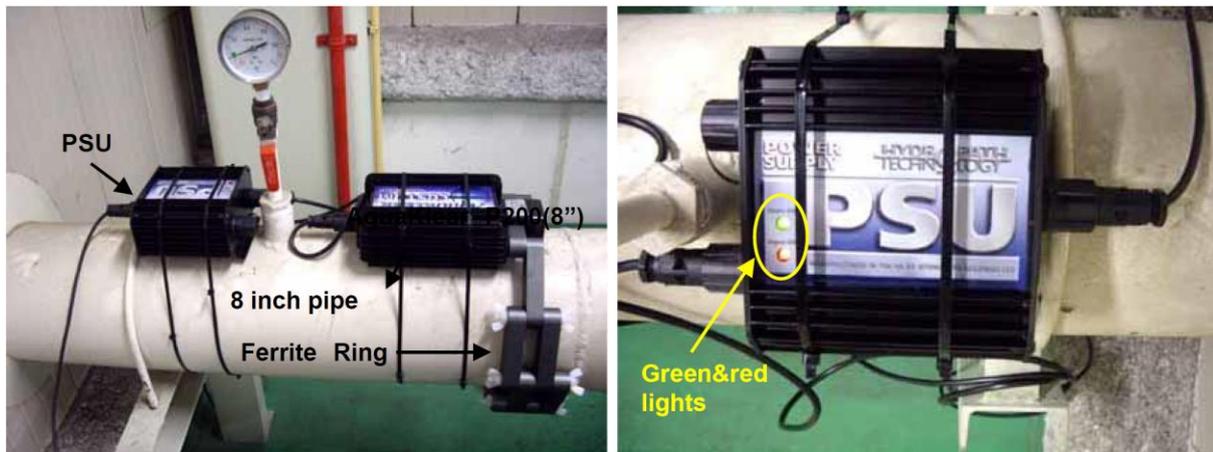


Three compressor units are cooled by a single 300RT cooling tower. The total circulating water is 3900 L/ min (240 tons/ hour) and the water temperature is 32 - 37 degrees C.



The above diagram shows an outline of the compressor cooling system, including the installation location of the Aquaklear unit.

Installation of the unit



The power supply is 50/ 60 Hz and 100 and 200V AC power are both available in Japan.

The PSU supplies appropriate power to the unit itself. The unit transfers the power to the ferrite ring around the pipe, which in turn induces an electric field which travels along the pipe.

Red & Green lights are indication of that water treatment is applied correctly. It is important to check this indication during operation but no other maintenance is required.

Confirming the effect - definition of a successful result

1) Algae growth.

In spite of conventional chemical additive dosing, algae growth still appeared on the Cooling Tower's fins every year. A difference in the level of algae on the cooling tower fins when AquaKlear is installed must be observed.

2) The inhibition of the scale and slime.

The customer has a maintenance plan which includes opening heat exchangers every 24000 hours (every 3 years) for inspection and chemical cleaning. One such inspection was due on February 7th, 2011 so the opportunity was taken to evaluate the effect of the AquaKlear and conclude the trial. At this point the AquaKlear would have been installed for 3.5 months.

3) The removal of existing scale

One of the functions of AquaKlear is dissolving old scale. Rather than forming on the heat exchanger surfaces, scale is caused to form in suspension and flows out with water, collecting in the bottom of cooling tower. The removal of existing scale (and its appearance in the cooling tower sump) shall be confirmed.

Results: The effect against algae on the cooling tower fins.

In spite of the chemicals which were added before AquaKlear installation, there was much algae growth observed on the fins. This is the key point to watch, in order to assess the action against algae. The algae growth should be compared before and after installation of the AquaKlear unit.

Before Installation of AquaKlear



A large amount of algae growth can be observed on the fin, due to the strong sunlight. Algae is a bed of legionella, so eliminating the algae will help reduce the presence of legionella.

14 days after installation of AquaKlear



The algae's colour is seen to be gradually changing from green to slightly brown.

25 days after installation of AquaKlear



The color of algae is changed from green to dark brown and black. Some sections of algae has detached and dropped to the bottom.

30 days after installation of AquaKlear



The algae has almost disappeared and through it the surface of plastic fins' gray color could be seen.

108 days after installation of AquaKlear



Almost all the algae on the fins were killed and removed by AK's performance so that it can be seen all the fin surfaces on the cooling tower are very clean.

In spite of this test being carried out during cold winter weather, the cooling water temperature is about 27 degree C continuously, so algae growth is a big problem for the increase of legionella pneumopfila. From the view point of this fact, AquaKlear has a very strong effect and advantage against conventional chemical water treatment because of elimination of the algae deposits..

Results: Prevention of Scale



No. 3 Compressor front view (left) and engineers disassembling the compressor (right)

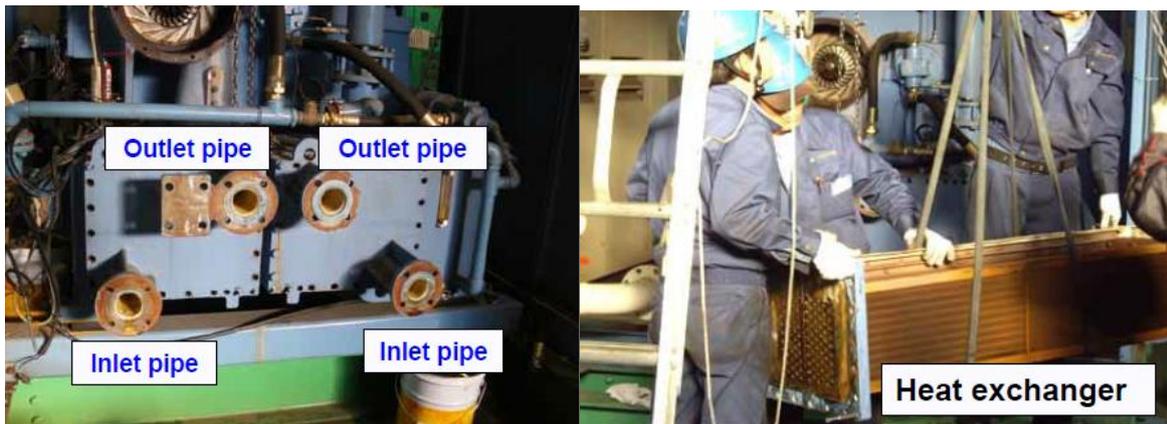
Inspection of the inside of the oil cooler



The oil cooler of the compressor (left) and the inside of the compressor (right)

When the oil cooler was opened for inspection and cleaning, it was found that there was no scale and no slime (boifouling) present in the oil cooler and it was very clean after 24000Hrs operation (3 years).

Inspection of the heat exchanger



Two heat exchangers are located inside a single casing (left). Engineers remove the heat exchanger for inspection (right).



The inside of the heat exchanger (left) and a magnified view of the pipes (right).

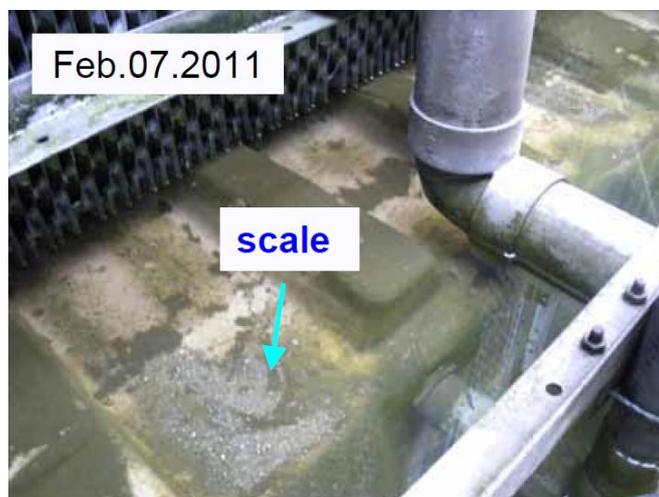
As the exchangers were only opened every three years, no direct comparison could be made with the chemical treatment. However, there is not any scale or slime in this heat exchanger after the installation of AquaKlear.

However, the customer would normally expect to see both scale and biofilm build-up upon inspection, and therefore the fact that neither could be seen was due to AquaKlear.

The removal of existing scale



There was some alga growth in the bottom of cooling tower, before the installation of AquaKlear.



The powder-like scale precipitate formed by AquaKlear could be observed in the sump pool at the bottom of the cooling tower.

Water analysis

A water analysis is given below. The crucial matter to note is the high content of silicate (50 mg/L) in the make-up water. With chemical treatment, this was kept lower than 120 mg which means 2.4 time of condensation of the cooling water. The AquaKlear test had to be carried out under the same condition.



Automatic blow-down controls the conductivity of the water to between 55 and 65 ms/ m, as with the previous chemical treatment.

In addition, the calculation of the Langelier index shows the saturation degree of calcium. A positive value indicates water prone to scaling (hard) and a negative value indicates water prone to corrosion (soft).

HEAD		mak up water	circulating water	
Date of water sampling			Chemical treatment	AquaKlear 14 days later
date.month.year.		08.07.2010	08.07.2010	05.11.2010
pH(25°C)		7.1	8.5	8.4
Ca +Mg hardness	mg/L	107	240	260
Calcium Hardness	mg/L	70	150	160
CL ⁻ ion	mg/L	15	31	23
SO ₄ ²⁻ ion	mg/L	-	20	13
Silicate, SiO ₂	mg/L	50	100	120
Fe ²⁺ ion	mg/L	-	-	0.03
HCO ₃ ⁻ ion	mg/L	69	160	170
Conductivity	ms/m	27	60	63
Color	degree	-	-	2.5
Turbidity	degree	-	-	0.2
Langelier index		-1.2	+1.2	+1.1
		Strong corrosive	Seriously scaling	Seriously scaling

The index is positive in the circulating water both before and after treatment with AquaKlear, indicating that the water is, chemically speaking, “prone to scaling”. However, the test clearly shows that AquaKlear prevents hard scale from forming on the heat exchangers, and instead causes it to form as powder in suspension in the water. AquaKlear does not alter the chemical composition of the water, but changes the location at which the crystals form by physically treating the water.

12. Conclusion.

1) The effect against algae growth.

Chemical treatment had no effect against inhibition of algae growth which is very important in acting against legionella pneumophila.

On the other hand, AquaKlear treatment has had an excellent effect on this matter and it can be solve the problem of algae in cooling towers .

2) The effect of scale inhibition.

After stopping the chemical additive, AquaKlear gave an excellent result - which meant the confirmation of zero scaling in the heat exchanger after 108 days use.

The circulation water showed a very strong scaling according to the Langelier index . The indications are +1.1 through + 1.2. (very serious scaling) but nevertheless AquaKlear prevented the formation of scale.

3) The effect against old scale.

The old scale on the cooling tower fins was removed. Some scale looking like a powder was precipitated in the bottom of basin of the cooling tower.

The customer concluded following this test that AquaKlear is a better treatment method than chemicals, considering also that there is no chemical pollution.

4) Rental business.

The customer decided to operate AquaKlear on a rental basis and they pay less than the cost of chemical treatment each month.