Green Approach to Cooling Water Management

SINGAPORE GREEN BUILDING PRODUCT
SGBC
EXCELLENT
SGBP 3116

Innovative Polymers Pte Ltd (Singapore)

By: B.K Ng

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Patent No: PCT/SG2012/000420

Agenda

1. Principles of Cooling Water Management
2. Innovation of DCI Technology
3. Successful Field Implementations and Performance
4. Site Installations
5. DCI Benefits

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1. Principles of Cooling Water Management

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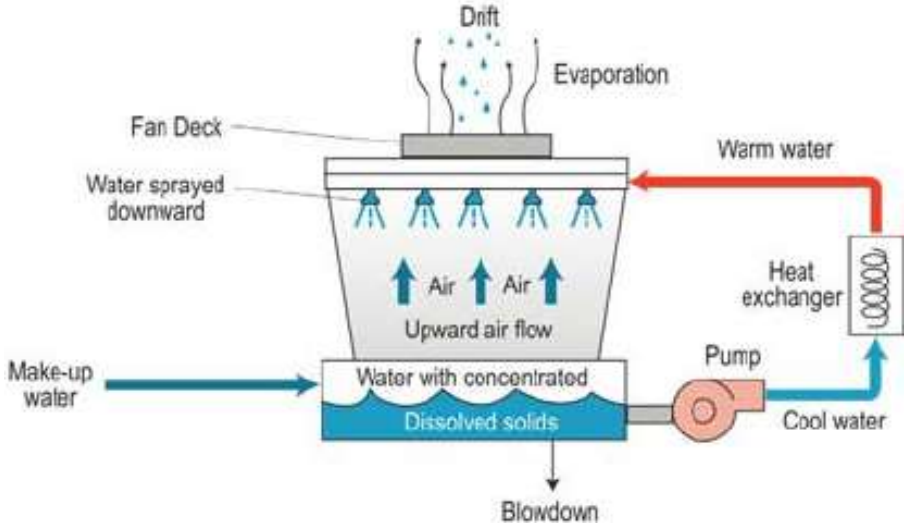
Cooling Water Management

- Evaporation cools the recirculation water
- Evaporation increases the solid concentration
- Water and air borne bacteria causes Bio-fouling



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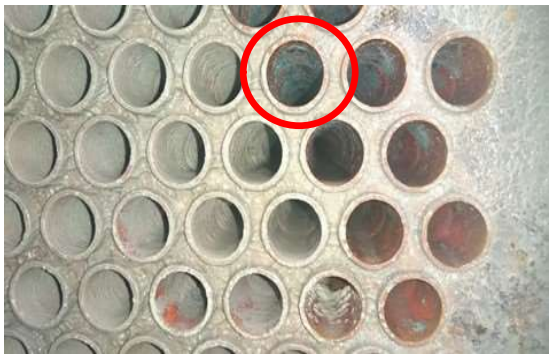
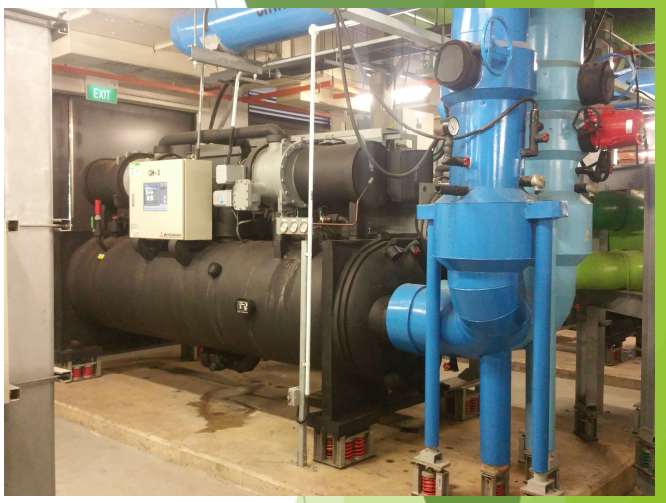
Problems Encountered

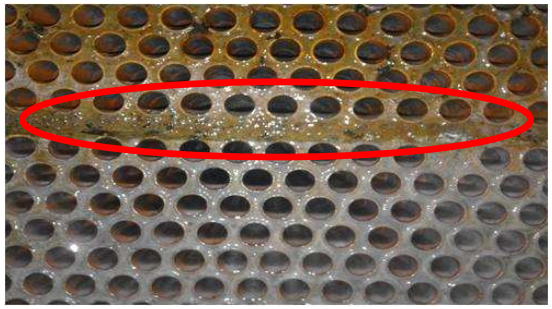


Scaling

Corrosion



Chiller System



Bacteria – Bio Fouling

- Scaling and Bio-Fouling impedes heat transfer in the chiller condenser tubes
- Due to inefficiency in heat transfer, chiller system consume more energy

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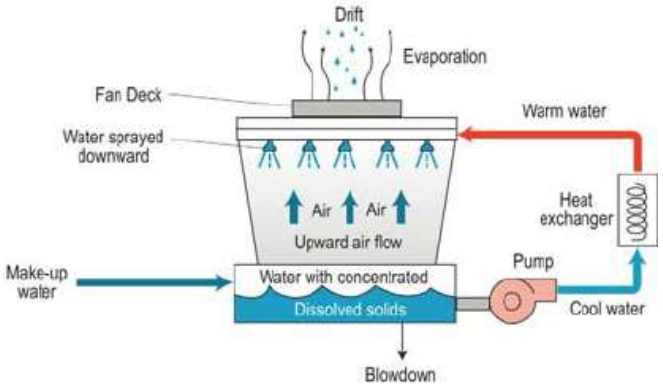
Cooling Water Treatment Methods (Conventional)

- **Chemical Treatment**
  - Not Environmental Friendly
  - Hazardous
  - Tedious Control (Due to inconsistent load)

- **Conductivity Control Blow Down**
  - Assumption control
  - Water Wastage



- **Physical Cleaning**
  - Costly
  - Down Time

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2. Innovation of DeCalon™ (DCI) Technology

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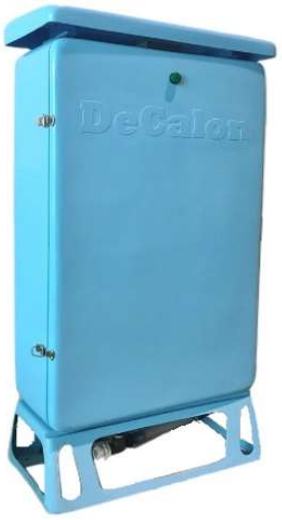
DCI Description & Objective

- DeCalon™ (DCI), is first of its' kind, patented revolutionary approach to eliminating scale, preventing corrosion and bio-fouling in cooling water systems
- The objective of DCI is to save energy, water and chemicals in cooling water management
- Changing the way we treat water!



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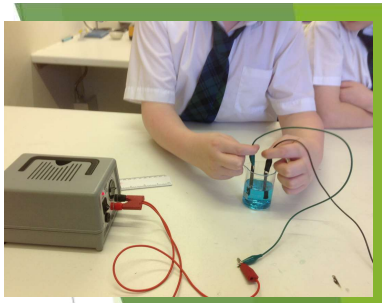
DeCalon System

- Invented in Singapore
- Patented Technology
- Started in 2014
- More Than 120 Installations World Wide

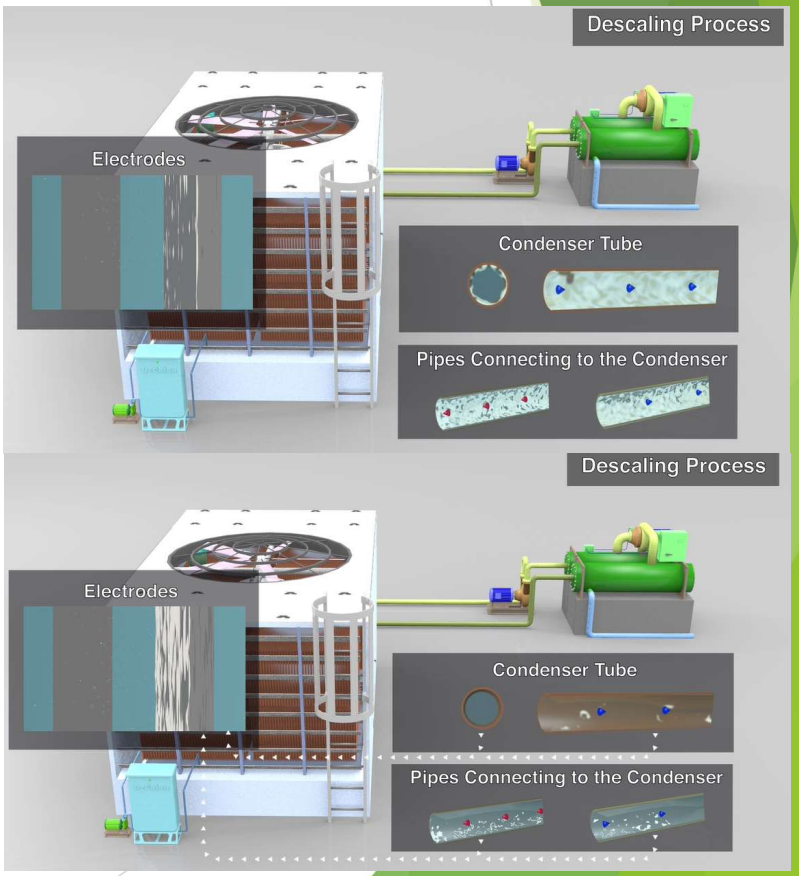
Innovation of the DCI Technology

Through Electrochemistry, CataGreen™ anti-bio technology and Software control:



- DCI dissolves the existing scales from the pipe, cooling tower and heat exchanger and prevents further scale formation due to evaporation continuously.
- DCI prevents corrosion by removing the Dissolved Oxygen (lowers ORP) and creates an alkaline environment. (pH Control)

DCI's proprietary non-chemical CataGreen™ disinfects water to prevent bio-fouling, algae, heterotrophic and Legionella bacteria.



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CataGreen™

- A proprietary non chemical device to enhance the DCI's performance
- It also disinfects the Heterotrophic and Legionella bacteria to <100,000 and <10 cfu/ml respectively.
- DCI + CataGreen = Chemical Free Approach for Cooling Water Management

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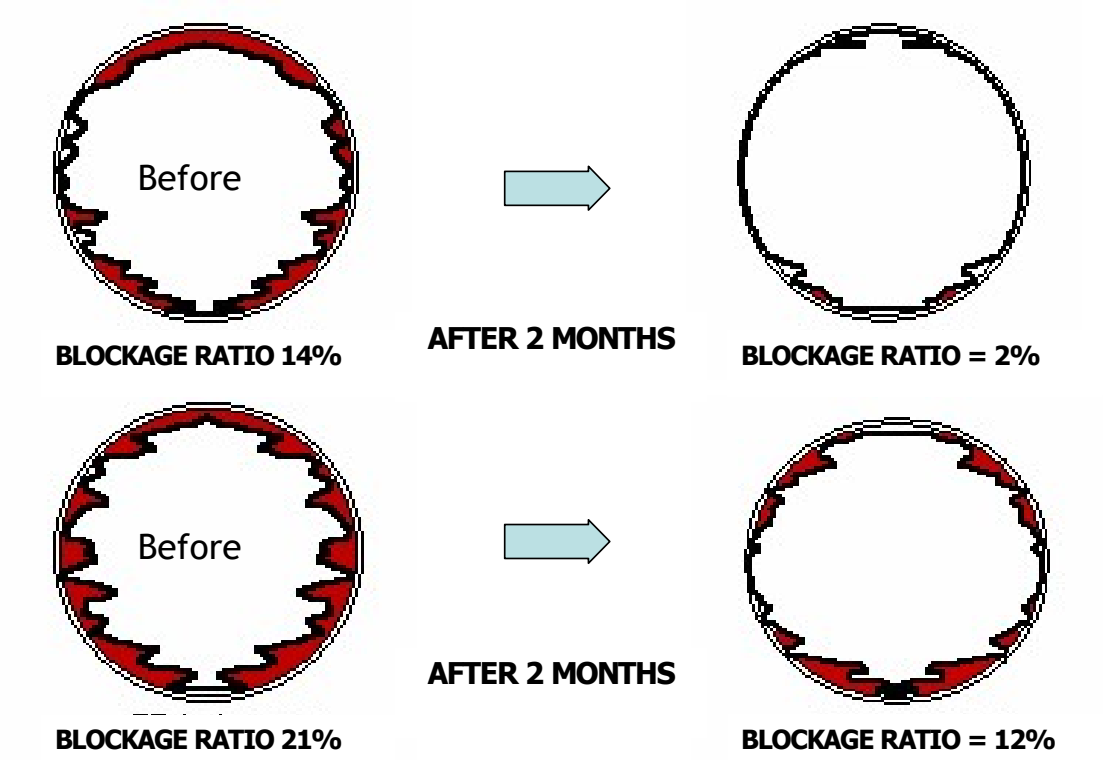
Diagrams (by Gamma Ray) indicate tube blockage and followed by reduction after 2 months of exposure to the Electrolytic Descaling Process



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Comparison

Functionality	DeCalon (DCI)	Chemical Treatment	Ball Technique System	Auto Brush System
Ability to Clean the Entire Cooling Circuitry (Condenser Loop)	✓	Prevention Only	X	X
Removal of Existing Hard Scales	✓	X	X	X
Corrosion Prevention	✓	✓	X	X
Treatment Approach	Prevent & Cure	Prevention	Cure	Cure
Ease of Operation and Maintenance	✓	X	X	X
Periodical Washing & Chemical Cleaning	Reduced	Frequent	Frequent	Frequent
Clean and Green Technology	✓	X	X	X

3. Successful Field Implementation and Performance

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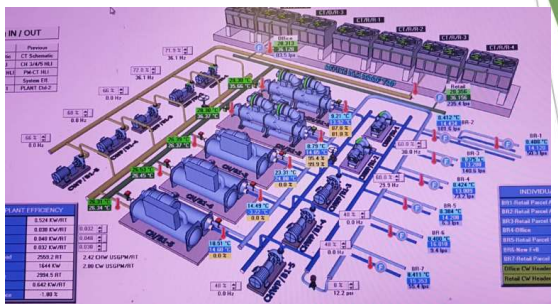
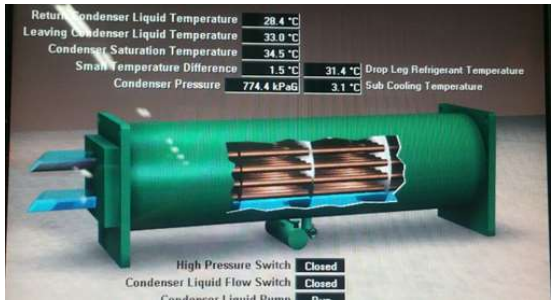
Performance Indicator

- Chiller Efficiency (kW/Ton)
- Condenser Approach Temp.
- kW usage (Power Consumption)
- C.T Blow Down Water

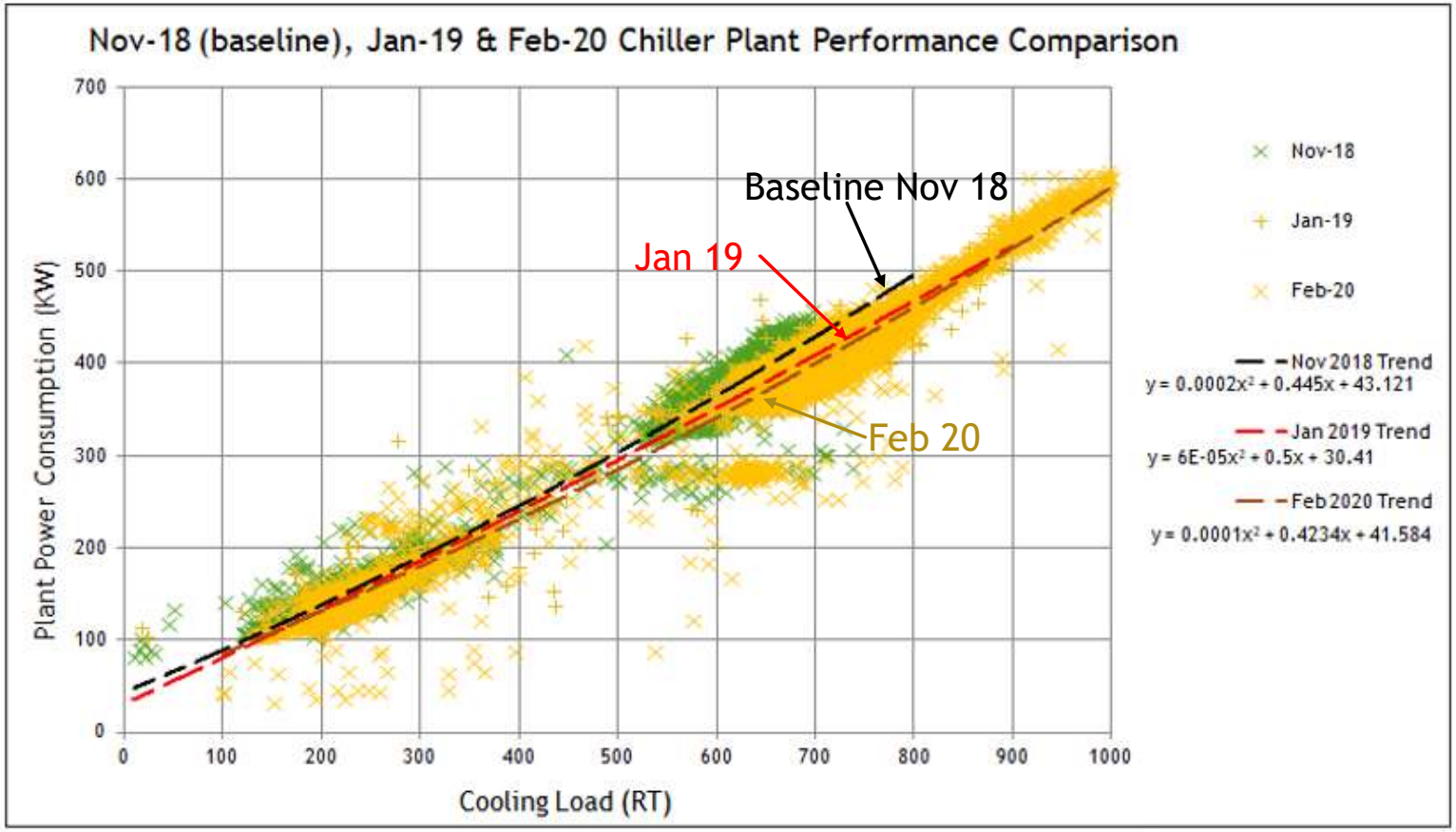




DCI in Keppel Bay Tower, Singapore

Toward Super Low Energy Building (SLEB) Status

Chiller Performance @Keppel Bay Tower



Data Analytics by IPMVP Standards

KBT's Main Findings

Based on International Performance Measurement & Verification Protocol (IPMVP Vol 1),

KBT's Chiller Plant Performance (different from Chiller Performance) in Nov-18, Jan-19 & Feb-20 @ 784RT (70% load) is as follows:

▶Nov-18 (Baseline-No DCI) @ 70% load	▶0.619 kW/RT (Baseline)
▶Jan-19 @ 70% load after 2 months	▶0.584 kW/RT, Power Saving = 5.65%
▶Feb-20 @ 70% load after 14 months	▶0.575 kW/RT, Power Saving = 7.10%

Bacteria Control @Keppel Bay Tower Singapore

Keppel Bay Tower

Cooling Tower	CT1		CT2		CT3		CT4		CT4A	
Bacteria	HB	LB	HB	LB	HB	LB	HB	LB	HB	LB
1/11/2018,baseline	2900									
Dec-18	170	ND								
Jan-19	68	ND	83	ND	63	ND	16	ND	6	ND
Feb-19	330	ND	200	ND	190	ND	450	ND	220	ND
Mar-19	810	NT	3400	NT	770	NT	1900	NT	340	NT
Apr-19	110	NT	280	NT	250	NT	400	NT	170	NT
May-19	310	ND	340	ND	320	ND	38	ND	17	ND
Jun-19	130	ND	130	ND	110	ND	1400	ND	870	ND

HB = Heterotrophic Bacteria Count, Control limit < 100,000 CFU/ml
LB = Legionella Bacteria Count Control limit < 10 CFU/ml

ND = Not Detectable
NT = Not Tested

Corrosion Control @Keppel Bay Tower Singapore

Date Started : 18 Jan 2019

Date Completed : 18 Jul 2019

Test Duration : 6 months

Test Report : By an accredited lab

CDA122 Copper

C1010 Mild Steel

Coupon Metallurgy	Coupon Part No.	Serial No.	Weight New (gram)	Weight After (gram)	Weight Difference (gram)
C1010 Mild Steel	CO1733750104100	121	9.7553	9.5765	0.1788
CDA122 Copper	CO17342101104100	011	11.0287	11.0230	0.0057

Mild steel corrosion rate = 1.18 MPY
Copper corrosion rate = 0.03 MPY

Std ind mild steel spec < 3.0 MPY
Std ind copper spec < 1.0 MPY

MPY = Mil Per Year

3M Singapore 2019

Industry
Production Factory

Chiller Capacity
2000RT

Cooling Purpose
Air Conditioning

Key Performance
- 5% Energy savings
- 50% Blow down water saved
- Zero chemical discharge

3M Singapore 2019

Chiller Tube Scope

Chiller 1 – Chiller Tubes after 10 months operating with DCI system

Malaysia, Johor F&B Factory - 2015

PROCESS COOLING

Industry
Food and Beverages

Cooling Tower Capacity
100RT

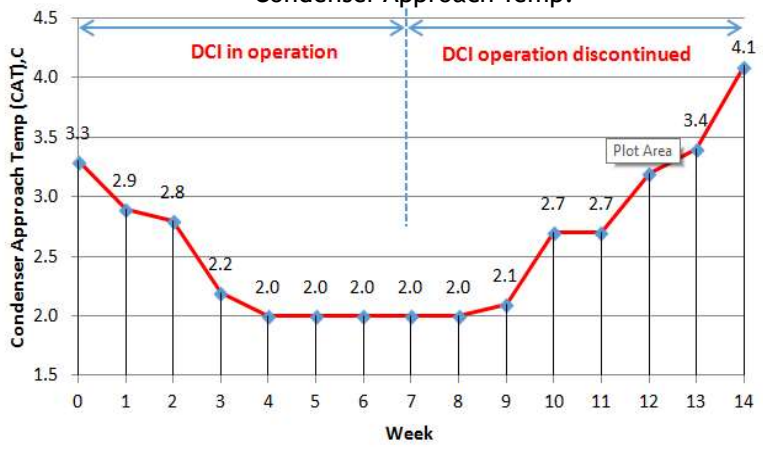
Chiller Capacity
80RT

Cooling Purpose
Chilled water is supplied to production machines for process cooling

Key Performance

- Estimated energy savings : 77,760 kWh/year
- Percent Power Savings : 16.9%
- Water Savings : 88%
- Production Process Improved

Condenser Approach Temp.



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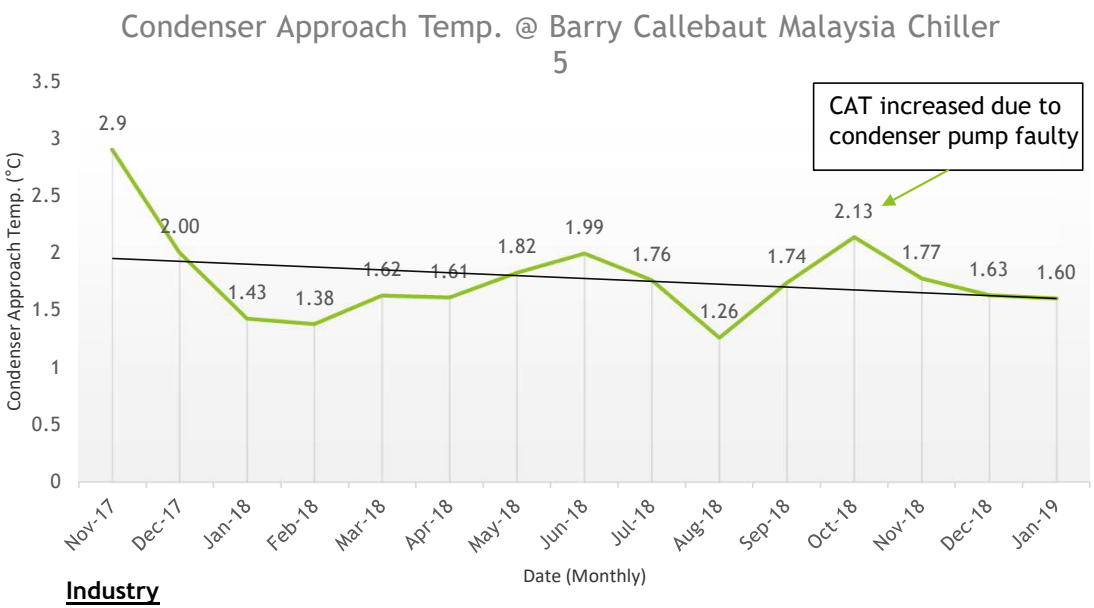
Barry Callebaut Malaysia 2017



Industry
Food and Beverages
Cooling Tower Capacity
500RT
Chiller Capacity
300RT
Cooling Purpose
Chilled water is supplied to production machines for process cooling
Key Performance
Estimated energy savings : 150,000 kWh/year
Percent Power Savings : 15.2%
Water Savings : 50%
Chemical Savings : 100%

Philippines, Semi-Conductor Factory -2016

HVAC System

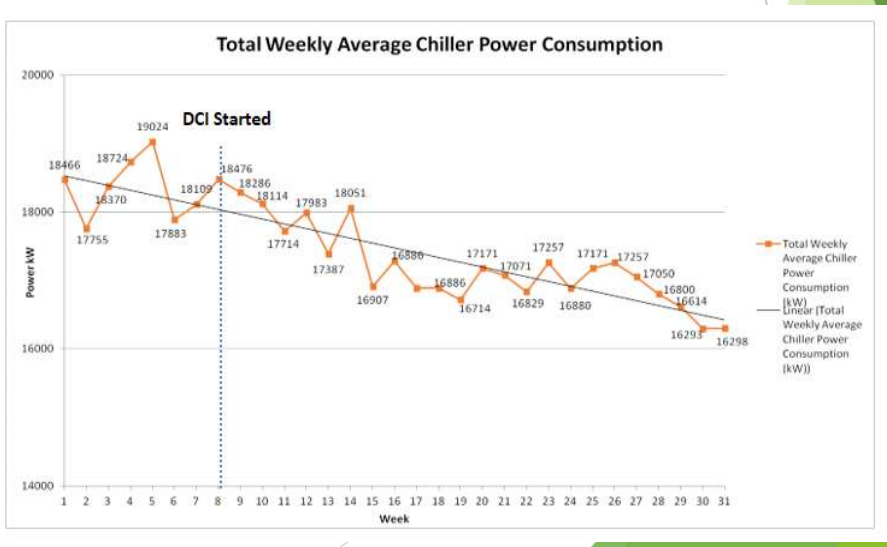
Industry
Semi Conductor

Cooling Tower Capacity
5000RT

Chiller Capacity
2000RT

Cooling Purpose
Air Conditioning

Key Performance
Estimated energy savings : 740,260 kWh/year
Percent Power Savings : 11.2%
Water Savings : 27%
Chemical Savings : 100%



Singapore, SIMTech A*Star Research Lab - 2015

HVAC System

Industry
Research Laboratory

Cooling Tower Capacity
250RT

Chiller Capacity
164RT

Cooling Purpose

Chilled water is supplied to AHU for clean room air conditioning

Key Performance

- Estimated energy savings : 80,680kWh/year
- Percent Power Savings : 17.5%

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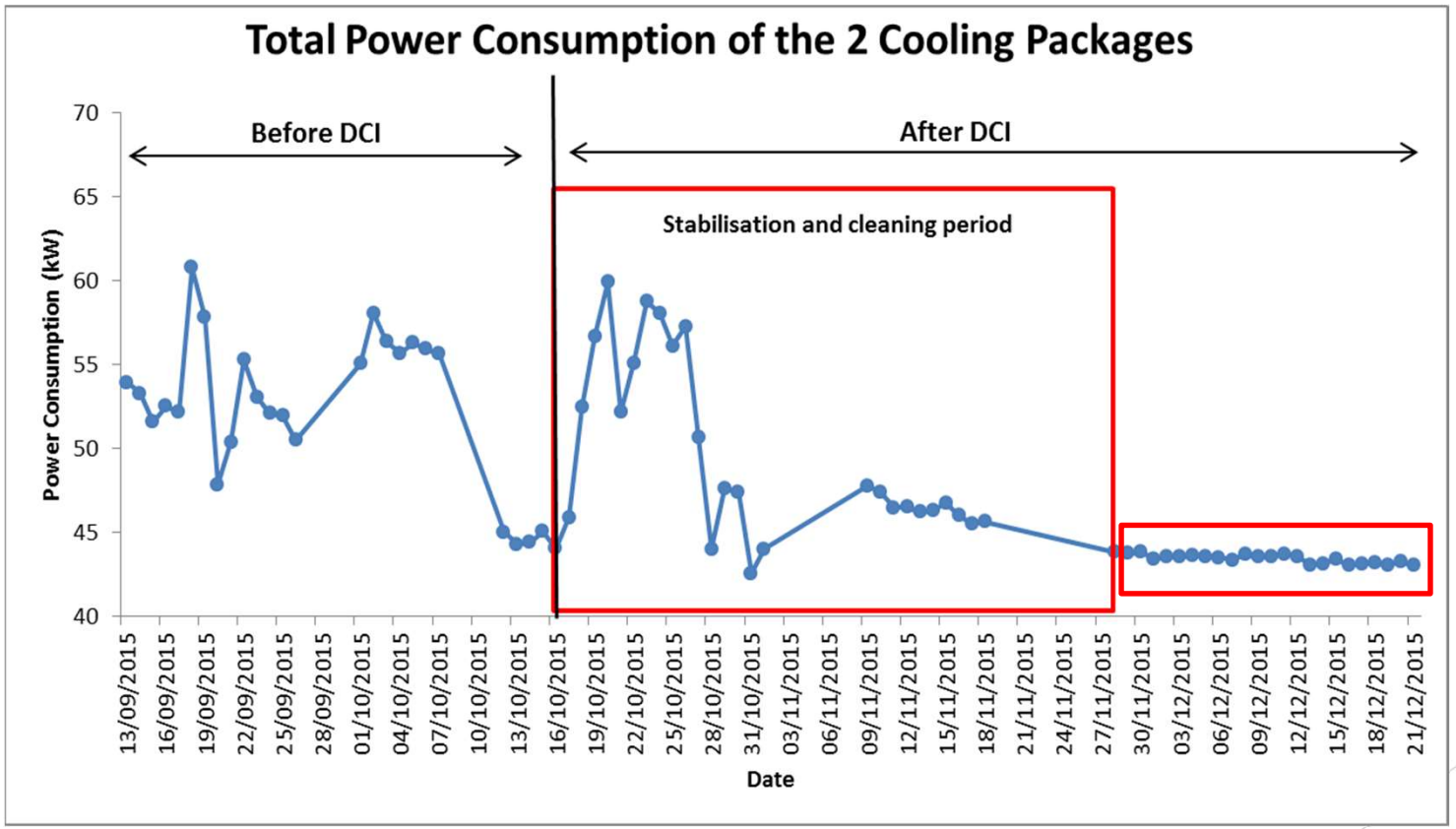
Singapore, SIMTech A*Star - 2015



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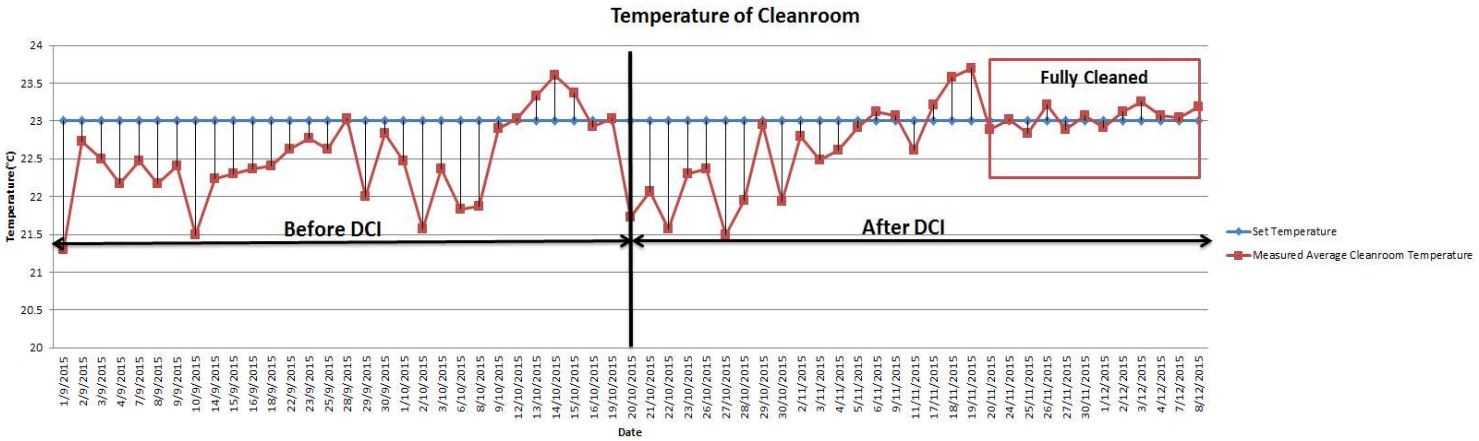
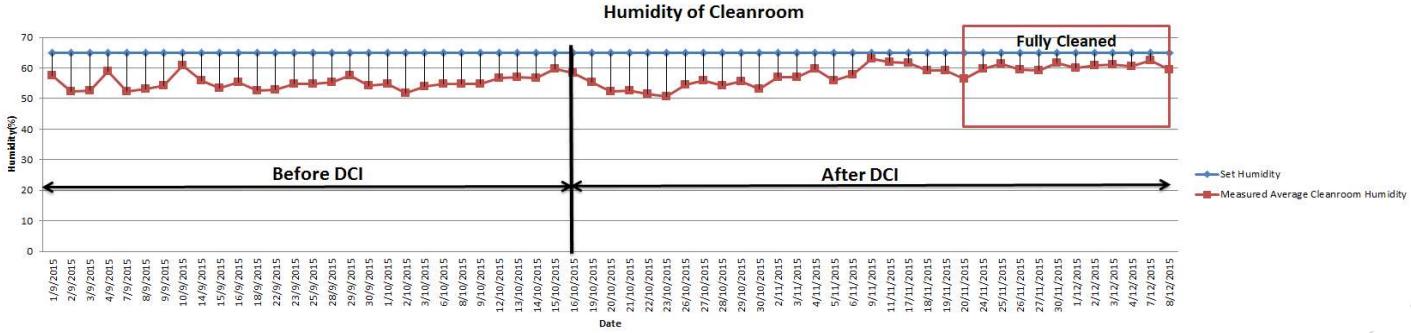
Singapore, SIMTech A*Star - 2015



Average temp difference from set point = 0.04 ^{0}C



Average RH difference from set point = 4.84%

New Zealand, Hospital - 2015

HVAC System

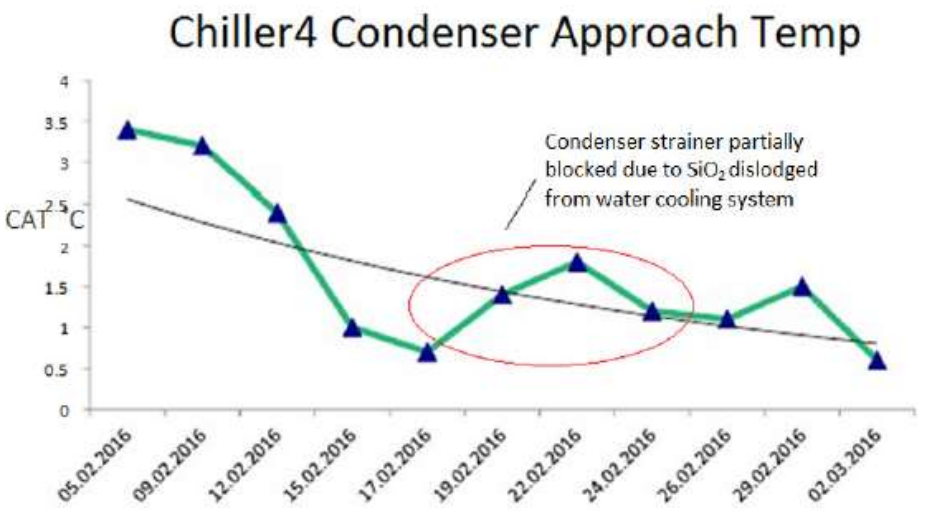
Industry
Hospital

Cooling Tower Capacity
200RT

Chiller Capacity
160RT

Cooling Purpose
Air Conditioning

Key Performance
Percent Power Savings : 17%
Water Savings : 41%
Chemical Savings : 100%



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Other Sites

Our Customers

Our Distribution Network

- Singapore (HQ)
- Malaysia
- Thailand
- Indonesia
- Europe
- USA
- New Zealand
- Australia
- India
- Vietnam
- Taiwan

Our Credentials

SINGAPORE GREEN BUILDING PRODUCT
SGBC
EXCELLENT
SGBP 3116

ISOQAR REGISTERED
UKAS MANAGEMENT SYSTEM
0026
Certificate Number: 9565-Q15-001
ISO 9001:2015

TÜVRheinland
C US

CE
CE No. AK 50394764 0001

4. Site Installation

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Single DCI

(Average 350 to 400RT Chiller Capacity)

Multiple DCIs

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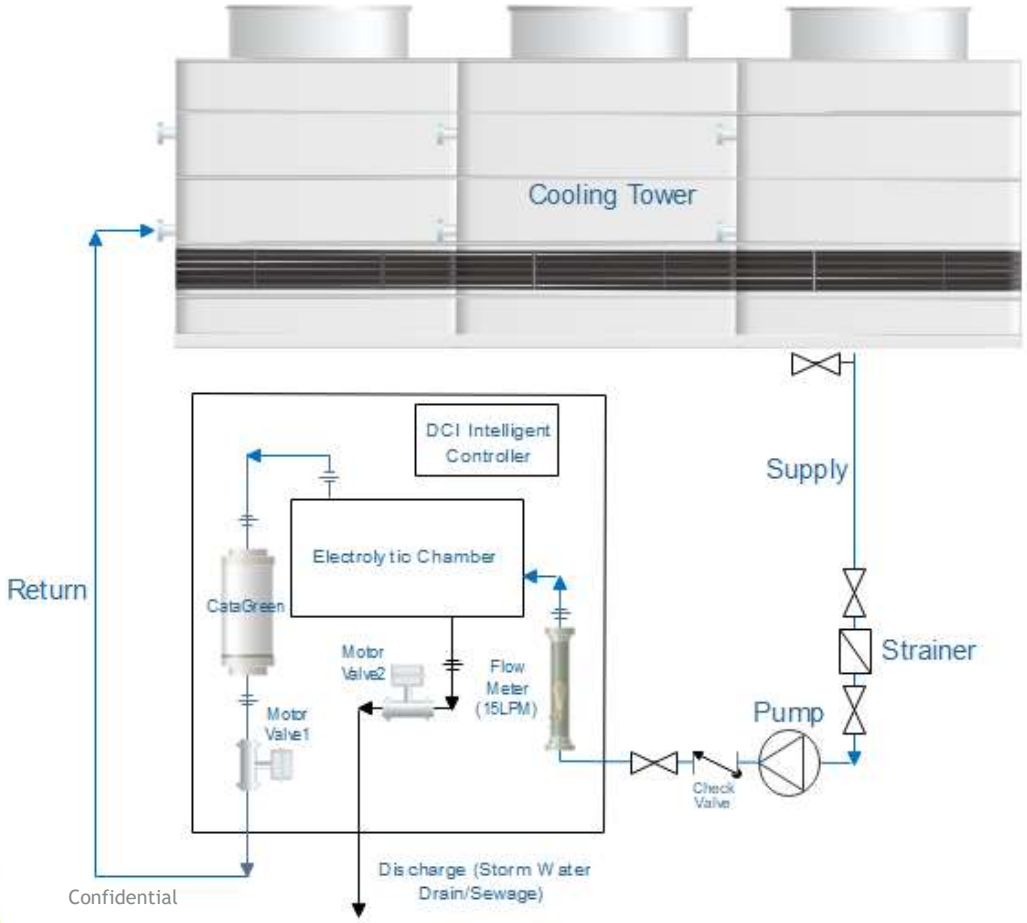
DCI System Flow Schematic



- Stand alone system
- No shut down required during installation
- Does not interfere with clients' system
- Conductivity control blow-down no longer required (water saving)

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5. DCI Benefits

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DCI Benefits

- **Energy savings between 5% to 25%**

  Optimal performance of water-cooled chillers at **all time**

- **Water savings > 50%**

  Cycle of concentration (COC) will increase due to Minimal Blow-Down

- **Chemical savings 100%**

  No hazardous chemicals required

- **Higher Product Yield & Improved quality**

  More efficient cooling

- **Increases Productivity**

  Reduced downtime

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Excellent Technology

- Reduction in CO_2 Emission/ Footprint
- **True CLEAN AND GREEN**

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Our Questionnaire

DeCaIon Questionnaire for Aircon Application

Date : Confidential Company :

1 Chiller operating hours

Chiller operating hours		h/d
Chiller operating days		d /year

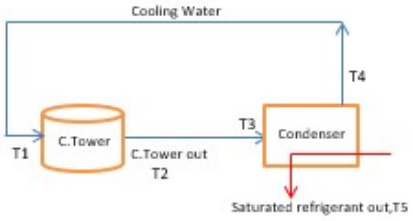
2 Chiller/Cooling system configuration

	WCPU	Chiller	C.Tower	
Unit capacity on duty				RT/unit
Quantity on duty in parallel				Units
Standby quantity				Units
% average operating load				%

3 Chiller data

	Now	When New	
Chiller efficiency @ 100% load			kW/RT
Chiller Age			Years
Chiller type (1= Centrifugal,2=Helical/Screw,3=Reciprocating,4=others)		1	Centrifugal

4 Temperature data @ above % chiller operating load



	Location	Now Temp °C	New Temp °C
T1	C.Tower -in		
T2	C.Tower -out		
T3	Condenser-in		
T4	Condenser-out		
T5	Sat Rfgt -out		

CAT	Now	When New
T5-T4		

°C = (F-32) x 5/9
CAT = Condenser Approach Temp

5 Cooling Tower

	US gpm ÷ 4.4 = m³/h		
Cooling Tower water flowrate (recirculation)			m³/h
Cycle Of Concentration (COC)			Cycles
Cooling Water blow-down			m³/mth
Cooling tower make-up			m³/h

6 Water analysis (ppm as $CaCO_3$ where applicable)

	Make up H_2O	Cooling H_2O
pH		
Ca^{2+}		
Mg^{2+}		
Cl^-		
T.Alkalinity		
$SO_4^{=}$		
SiO_2 as SiO_2		
Conductivity,uS/cm		

7 Present treatment chemicals used (if any) State currency Local currency / mth

8 Heat exchanger/condenser tube yearly cleaning + maintenance cost Local currency / year

9 Electricity cost (average) Local currency/kWh

10 Water cost Local currency/m^3

11 Chiller/Cooling Tower and configuration flow schematic
Pse attach a sketch with this Questionnaire

Q&A

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Thank You!

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www.decaion.com.sg