



**NATIONAL
ENERGY EFFICIENCY
CONFERENCE 2021**

An Initiative by:



Case study from a live manufacturing line:
**Cooling temperature consistency and energy
reduction by better managing water**

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Deston





TODAY'S CONTENT

- Cooling in manufacturing
- Case Study #1 Plastic injection molder
 - Before-After Comparison
 - Understanding the observations
- Case Study #2 Cleanroom
- Case Study #3 Commercial Building



Need for cooling is everywhere in manufacturing

Uses



Airconditioning



Direct In-Process
cooling/heating



Cooling of
equipment

These are all heat exchange processes

- All require conducting heat through some surface
- All require ejecting heat into some other medium i.e. air, oil, water



Two main types of heat ejection: Water is more effective

Air Cool VS Water Cooled

- 40% less energy
- More maintenance, but longer life
- Higher initial investment
- Bigger capacities



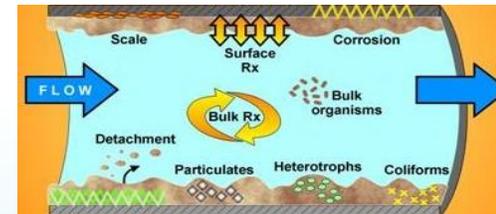
But water method need to tackle these 3 main issues:



Scale



Corrosion



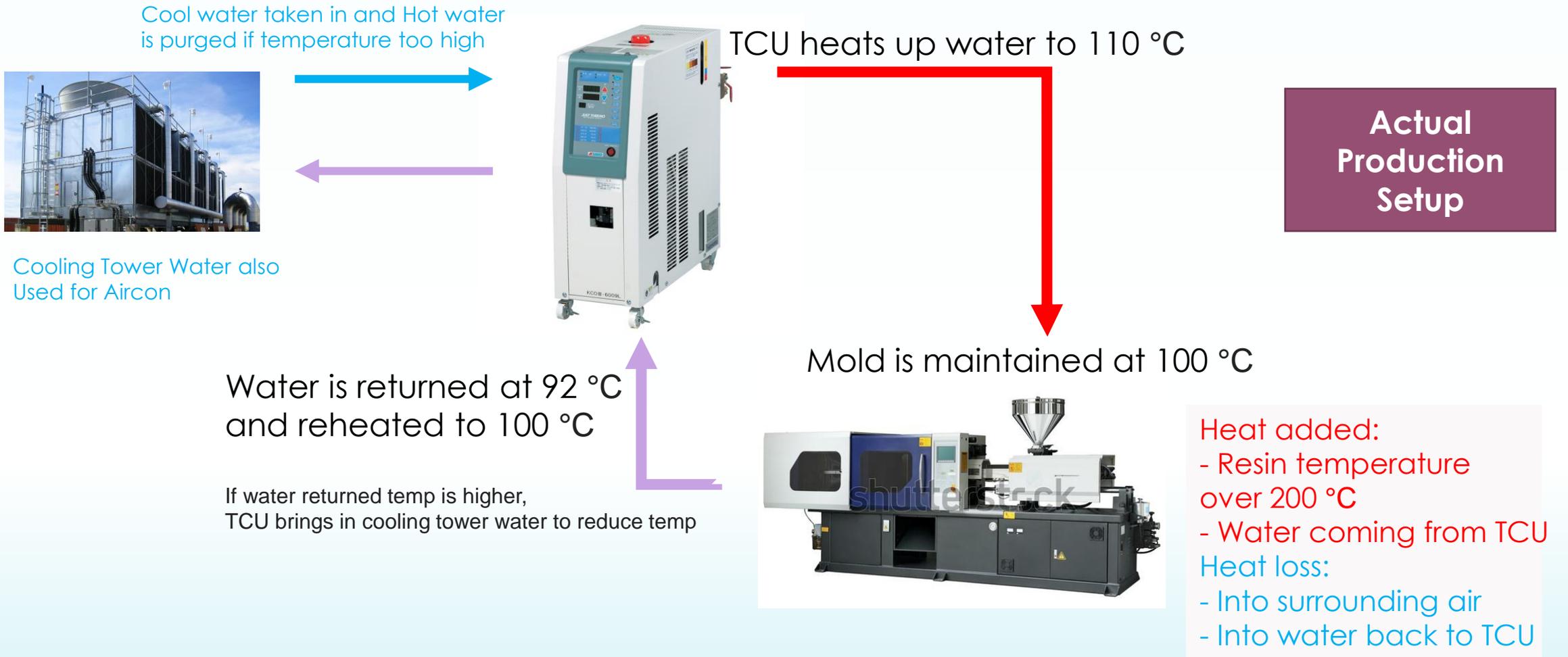
Bio-fouling

- Very good heat insulator
- Restricts flow of water



Case Study at Sanwa: Effects of scaling on plastic injection molding

- A look at Energy use and Consistency of temperature





Observations before Improvement Implementations (March 2021 baseline data)

TCU not able to hit target 110 °C, high and increasing power use



- Scaling reduced effectiveness of heating element

Mold temperature inconsistent and gradual decreasing over time



- Scaling reduced flow of hot water
- Scaling reduced heat exchange in mold cooling channels

- Lower temperature of returning water taxes TCU's reheating

Water returning is of much lower temp

Water flow is low

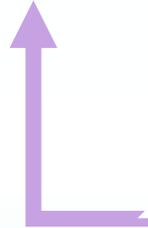


Observations after improvement implementations

- Water discharged reduced



- Returning water temperature became very consistent, and close to mold temperature



- TCU able to supply consistently at 110 °C. This was later reduced to 105 °C.
- kW usage reduced



- No more scaling in TCU even after 6 months of running



Mold temperature inconsistent and gradual decreasing over time

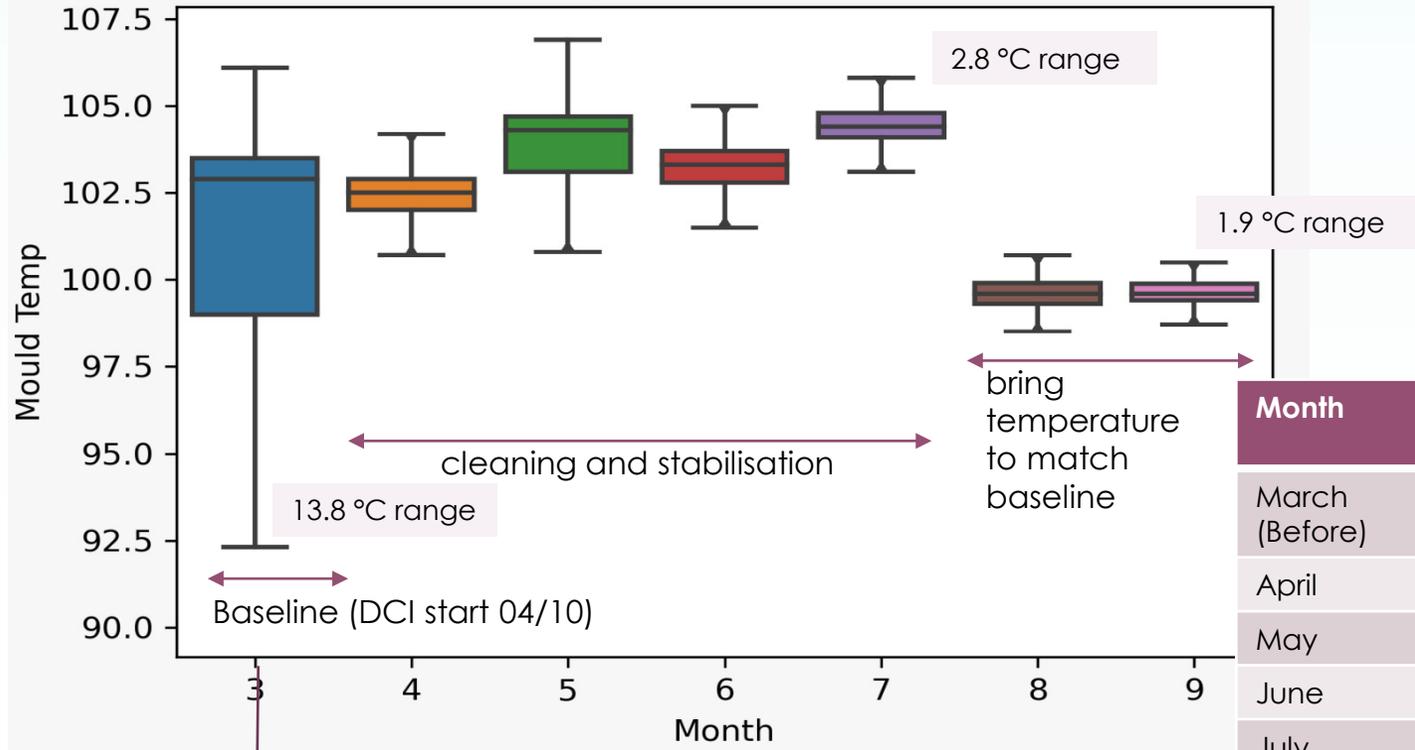


- Mold temperature became very consistent
- No more scaling in mold even after 6 months of running



Case Study at Sanwa:

From highly inconsistent processing temp to very consistent



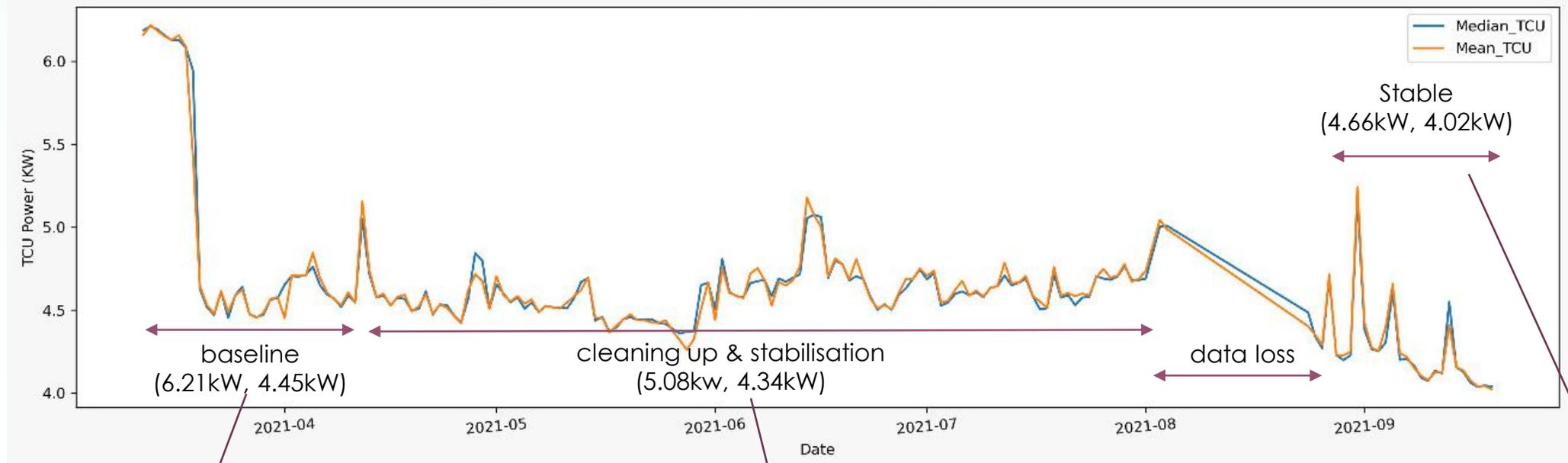
Month	Median (°C)	Max (°C)	Min (°C)	Max-Min range (°C)	75%-25% Range(°C)
March (Before)	102.9	106.1	92.3	13.8	4.50
April	102.5	104.3	100.6	3.6	0.90
May	104.3	106.9	100.7	6.2	1.60
June	103.3	105.0	101.5	3.6	0.90
July	104.4	105.9	103.0	2.8	0.70
Aug*	99.6	100.8	98.4	2.4	0.60
Sep	99.6	100.6	98.7	1.9	0.48

* power outage caused data loss of 2.5 weeks in Aug

Maintenance and manual cleaning had to be done ~every 2 weeks, or when water return temp < 90 °C



Case Study at Sanwa: 10-25% reduction in kW consumption



- Unscheduled maintenance due to mold temperature falling too low.
 - kW greatly improved after cleaning

- Greatly reduced maintenance
- No unscheduled maintenance
- Mold temperature ~4 higher

Reduced TCU temperature to match molding parameters in baseline



Case Study at Sanwa: Production equipment maintenance, CT water use reduced



50% reduction of Cooling Tower Water Thrown Away



Maintenance greatly reduced



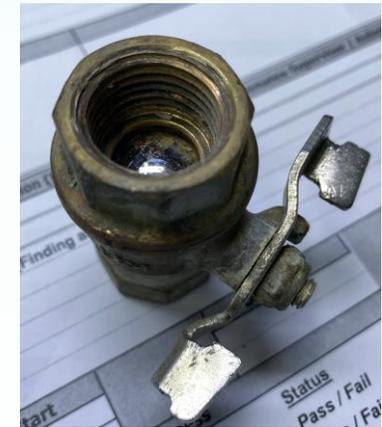
Water level switch(Float Switch) jammed. Full of residue



After running for several months, the float switch look clean and no jam



Ball valve clogging badly



Look clean even after many months



Heater always burn off



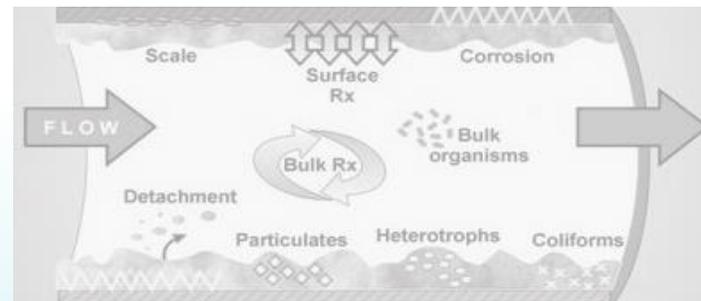
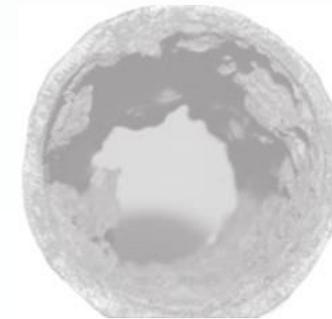
Even old heater still ok. No burn



So what happened?

Built up in

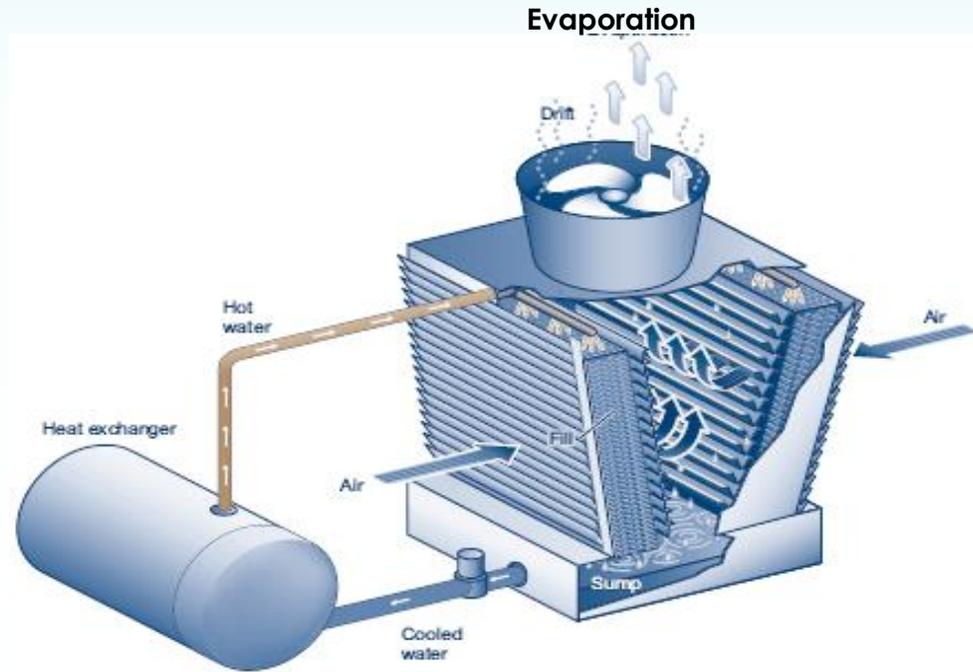
- TCU
- Piping
- Mold cooling channels
- Valves
- WCPU



Bio-
fouling



Scaling is due to mineral build-up from evaporating water



- ▶ Evaporation cools the recirculation water
- ▶ Dissolved minerals left behind after evaporation
- ▶ Concentration builds up, eventually **hitting saturation**

What if we directly
remove these minerals?



Changing the way we treat water

Principle

Traditional Chemical Methods

Force water to hold more

Forced trade-offs:

1. Scaling vs Corrosion
2. Water vs Energy

DCI – Electrolysis method

Directly remove minerals

Maximise anti-scaling &
anti-corrosion

Save both water and
energy

Water use

**Throw water to dilute
concentration**

To flush removed minerals

Scaling

**Tolerated gradual
increase, till scheduled
shutdown**

**Scale-free all the time,
even in piping**



Prevent scaling AND Remove existing scaling

Problems in cooling tower water



Scaling

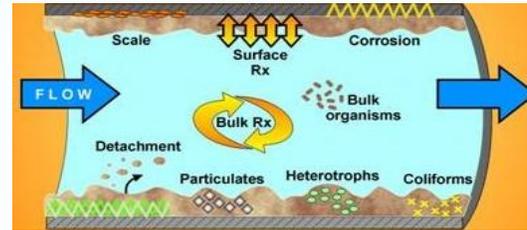
- 1. Loss in heat exchange efficiency
- 2. Higher PSI for pipes

Impact

DCl effects

Electrolysis directly removes Mg, Ca scaling minerals in water.

- 1. Prevent formation of scale
- 2. Remove current scaling in piping and circuit



Bio-fouling

- 1. Loss in Energy Efficiency
- 2. Bacteria health hazard

Electrolysis produces small amt of biocides in water using chloride in water



Corrosion

Leaks and cost to replace

Electrolysis raises pH of water to 8.6-9.

Removes Dissolved O₂(lowers ORP)
 $O_2 + 2H_2O + 4e = 4OH^-$

Best passivation range



Case Study at SIMTech A*Star Cleanroom: Effects of scaling on cleanroom temperature and energy use

Operating Capacity

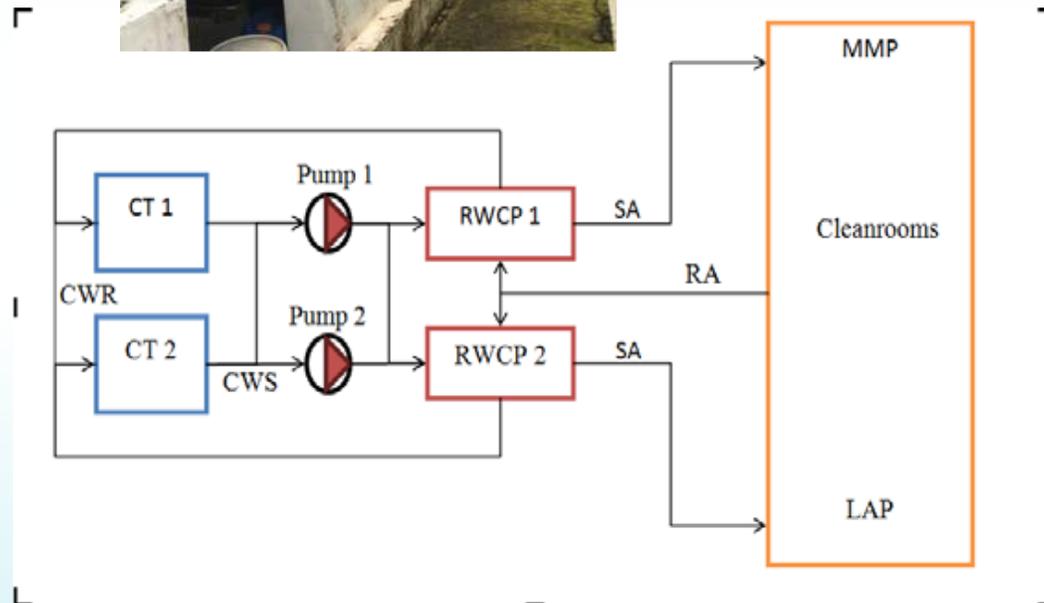
164 RT (250RT CT)

Water Type

Portable Water

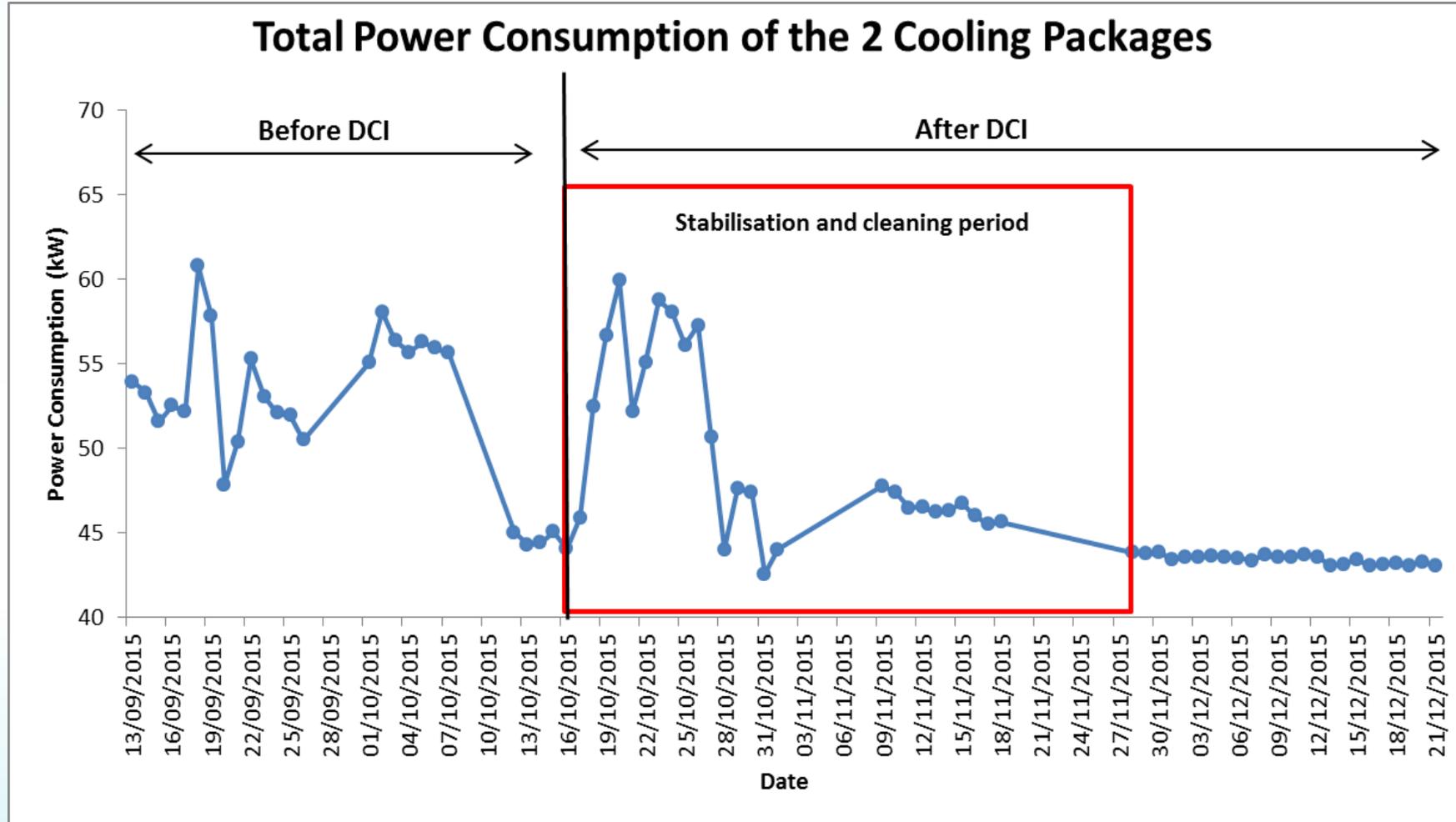
Savings (24h/7d)

- Energy: 17.5%
*Est. Annual Energy Savings
80,680kWh = 32.96 Ton CO₂*
- Blow-down water: not tracked
No water meter installed
- Zero chemical discharge
- Running Water-cooled Package Units



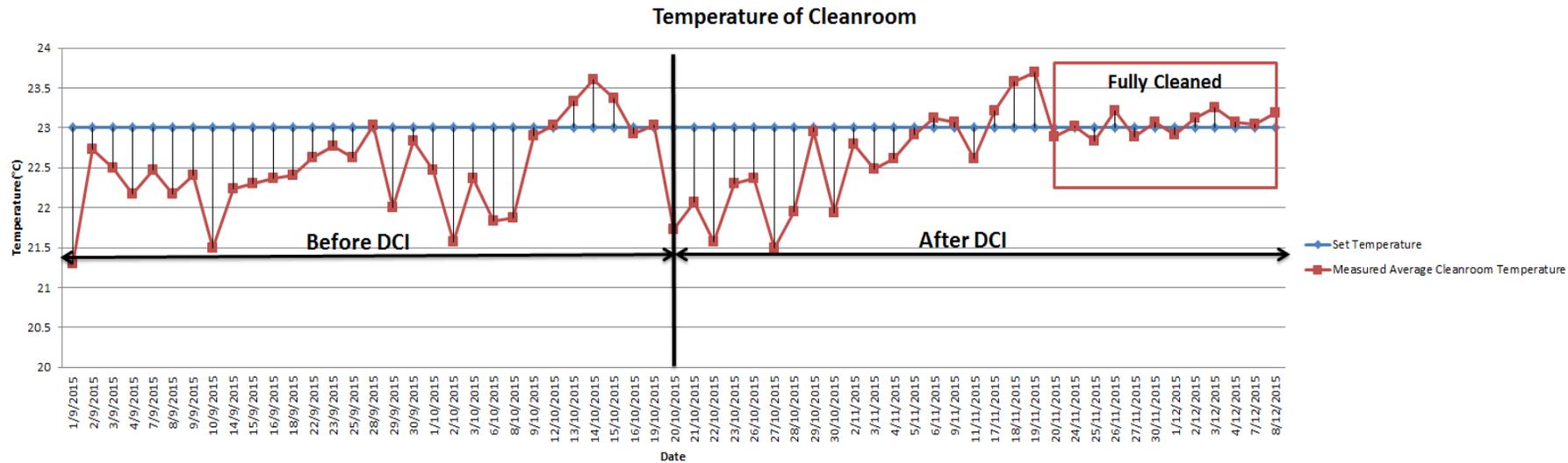


Case Study at SIMTech A*Star Cleanroom: Power reduces and stabilises

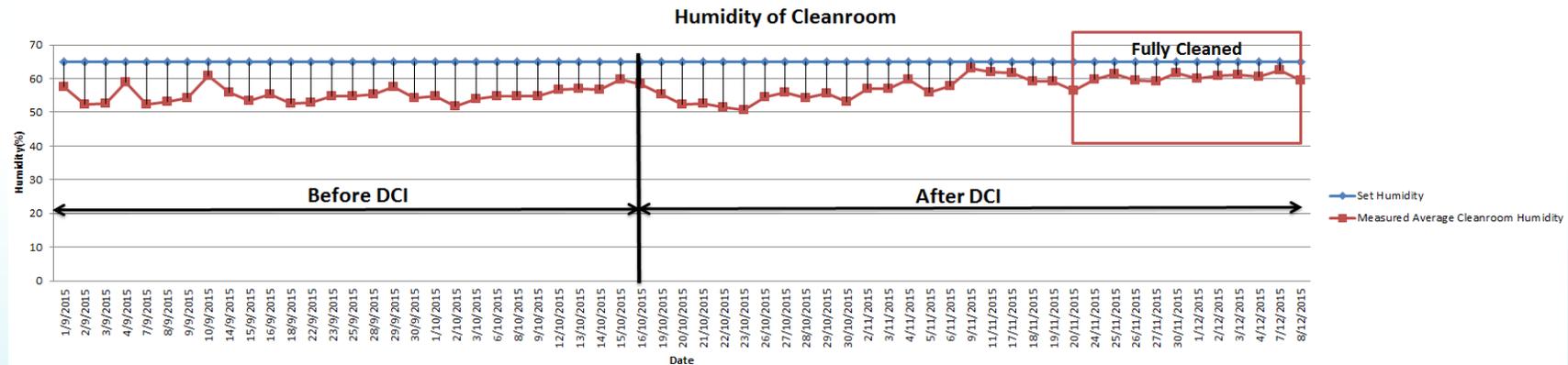




Case Study at SIMTech A*Star Cleanroom: Temperature deviation reduced 1.5°C → 0.04°C



Average temp difference from set point = 0.04 °C



Average RH difference from set point = 4.84%



Case Study at Keppel: Helping GM Plat holder save even more

Keppel Bay Tower first to bag Singapore environmental award, Property

Property News -Its annualised energy consumption will be almost half of levels at typical office buildings here.. Read more at straitstimes.com.



Friday, December 11, 2020

Operating Capacity

1120 RT (avg load 590RT)

Water Type

Portable Water

Savings (14h/6d)

- Energy: 7.1%

*Est. Annual Energy Savings @ 590 RT
113,704kWh = 46.45 Ton CO2*

- Blow-down water: 81.4%

*Est. Annual Water Savings
1,846 m3*

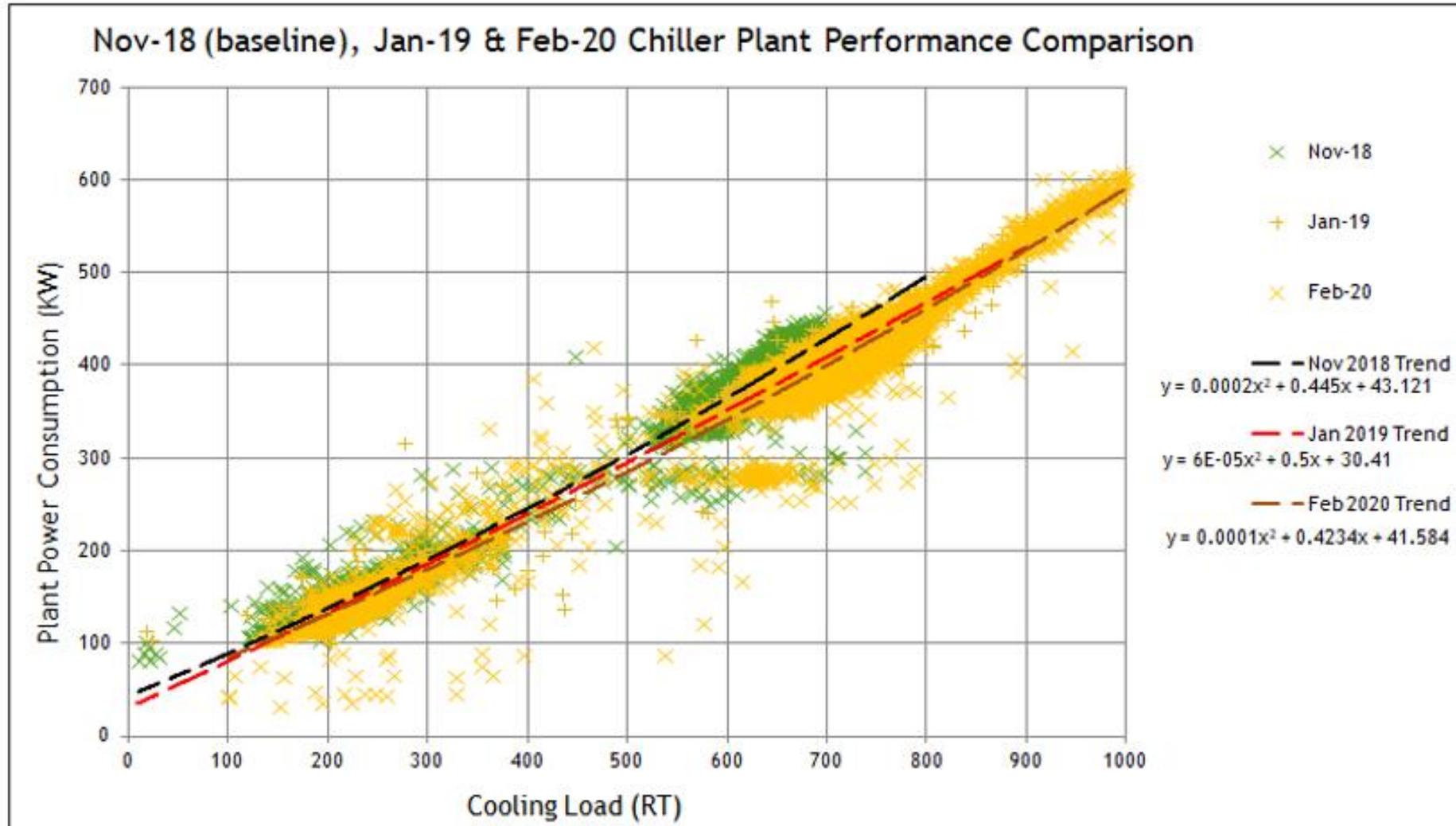
- Zero chemical discharge

- Already Green Mark Platinum
- Chemical dosing, auto-tubing shut off

Toward Super Low Energy Building (SLEB) Status



Case Study at Keppel: Chiller Performance Improved





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% |



Case Study at Keppel:

Blowdown water reduced by 80%

Parameters	Units	Normalised Baseline	Post-Retrofit	Actual Change	Change (%)
Make-up Water	m ³ /day	57.5	52.5	- 5.0	- 8.7 %
Blowdown Water	m ³ /day	7.2	1.34	- 5.9	- 81.4 %
COC *	-	8.0	39.2	+ 31.2	+ 390.3 %



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DCI Technology has been used across industries

Commercial

Keppel Land

UOB
大華銀行

Logistics

Realcool
COLD STORAGE TAURANGA LTD

Seeka
SELECT EXCELLENCE

Industrial

3M

PANDUIT

Linde

MICROCHIP

SANWA INTEC

Food &

POKKA P

BARRY CALLEBAUT

TOOHEYS

KERRY

Medical

Perkins

HARRY PERKINS INSTITUTE
OF MEDICAL RESEARCH

Waikato District Health Board

Canterbury District Health Board
Te Poari Hauora o Waitaha
Christchurch Hospital

LAKES DISTRICT HEALTH BOARD



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THANK YOU

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