

From Waste to Clean Food: Future of Sustainable Technology

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SIMON FRASER UNIVERSITY



- Transport phenomena in fuel cell catalyst layers
- Passive cooling systems for power electronics
- Thermal management of batteries
- Efficient heating ventilating air-conditioning, refrigeration (HVAC-R)
- Atmospheric water harvesting and greenhouse systems
- Sorption chillers, thermal storage, dehumidification



Natural Sciences and Engineering Research Council of Canada (NSERC); Automotive Partnership Canada (APC)

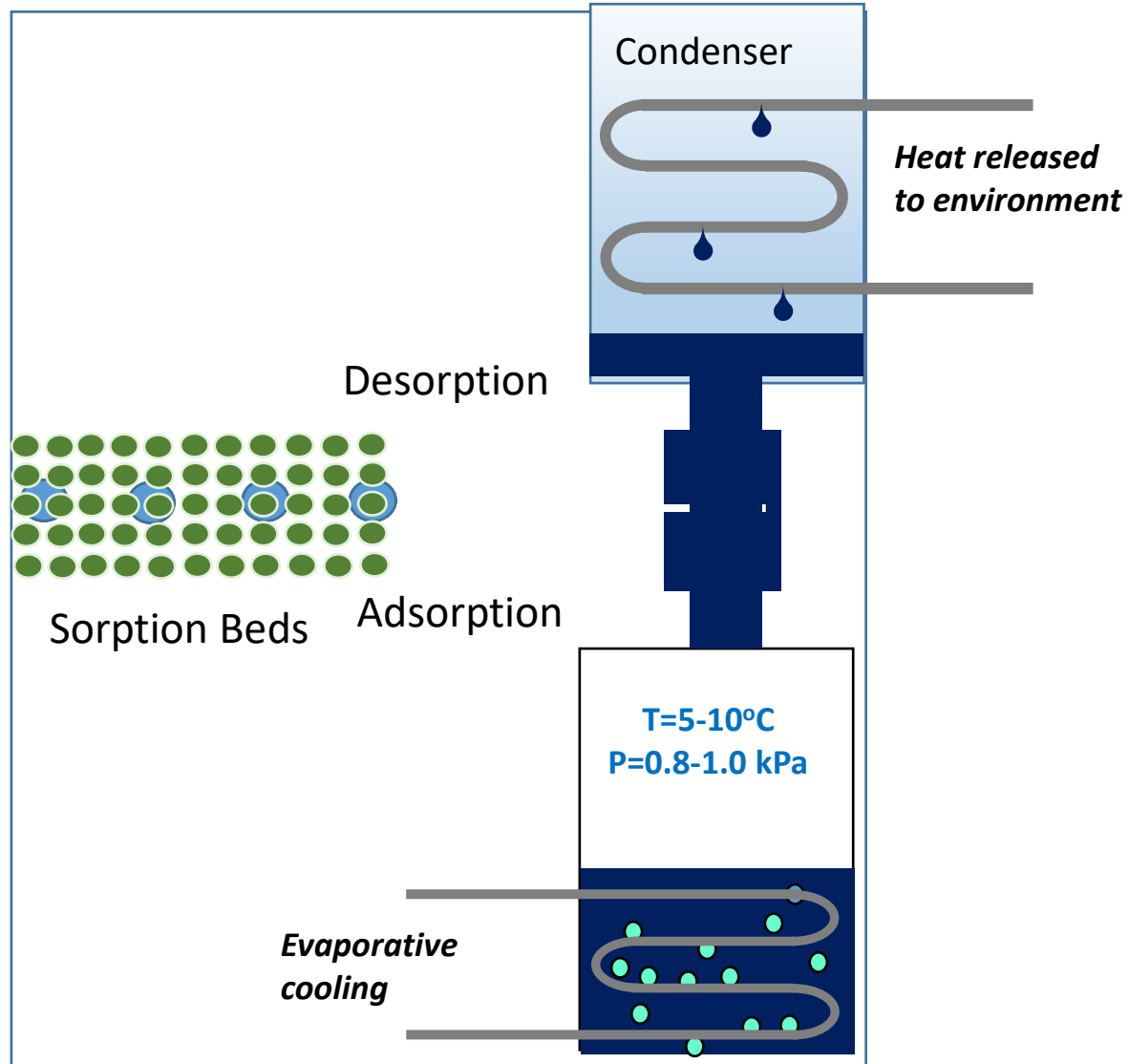
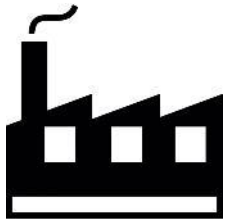
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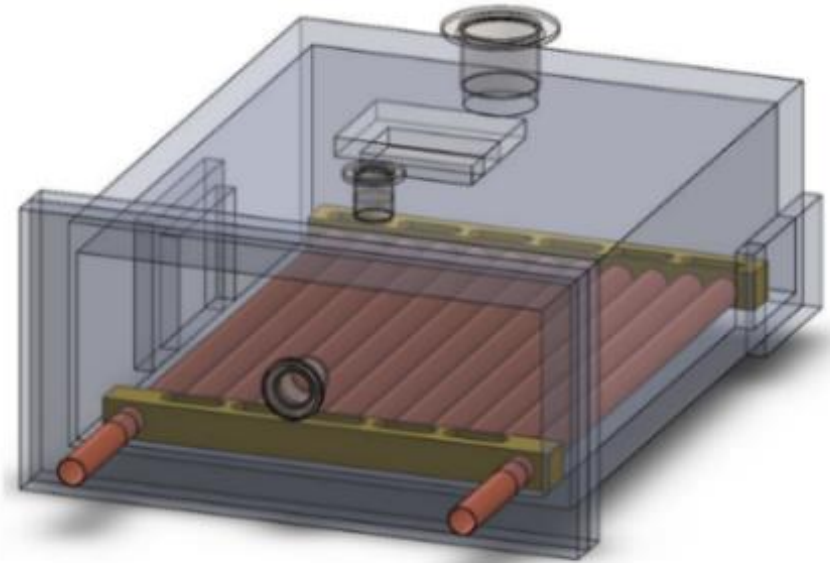
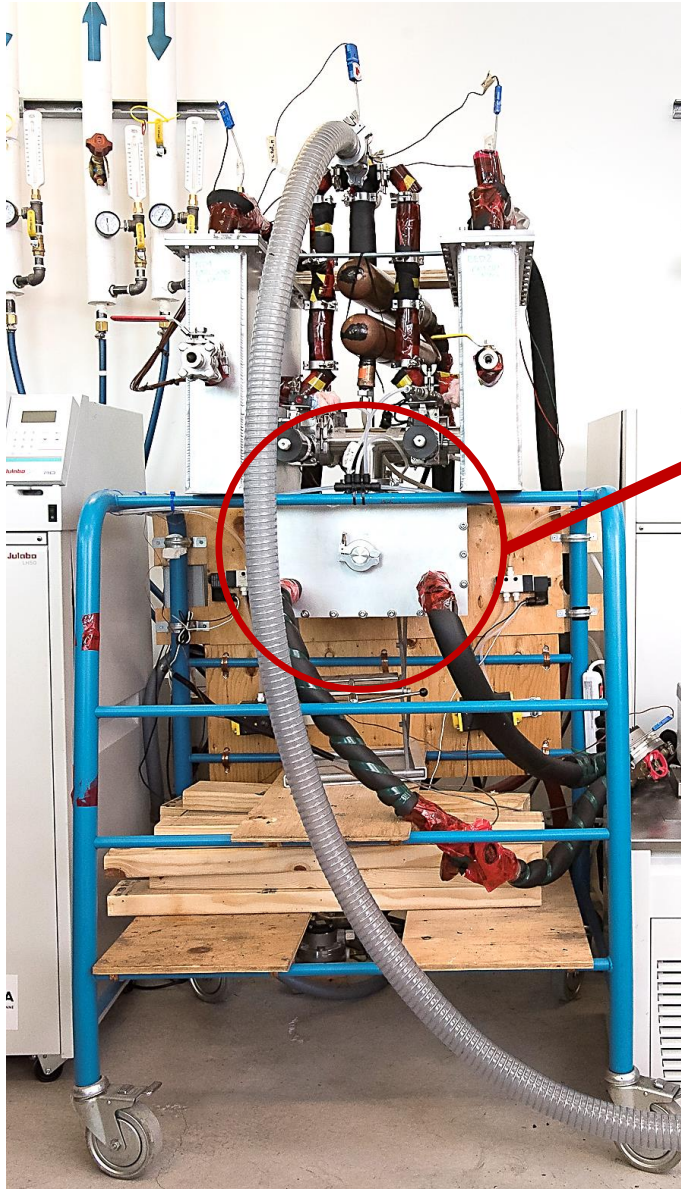
Dr. Karine Brand,
Dr. Achim Gotterbarm,
Director Global R&D

Dr. Evraam Gorgy,
Director of R&D
Mr. Bill Korpi
Wolverine Tube, Inc.



- ❑ Refrigerant water
- ❑ Low-grade heat sources <math><100^{\circ}\text{C}</math>






Capillary-assisted low-pressure evaporator
(CALPE) chamber

- ❑ Low specific cooling power (SCP)
- ❑ Low coefficient of performance (COP)



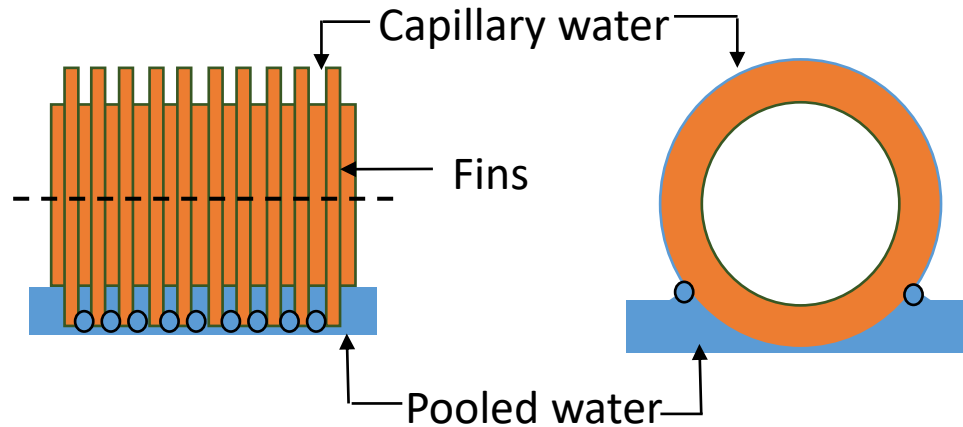
Large size and mass
compared to a VCR system

- ❑ A vapor passage constriction between the evaporator or condenser and the sorber beds can significantly reduce the SCP

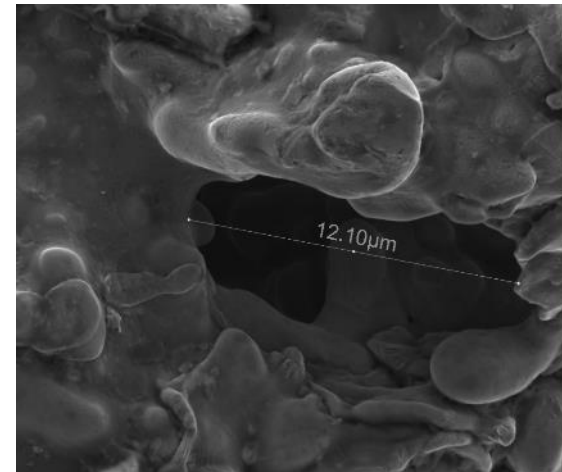
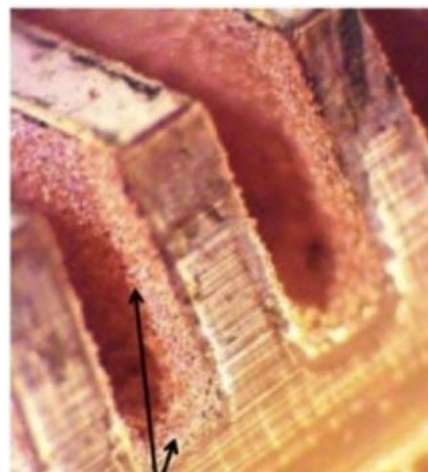
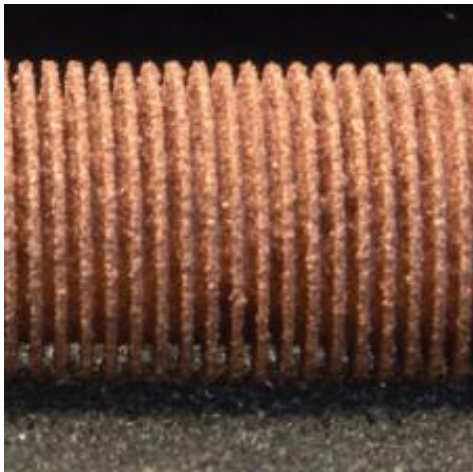
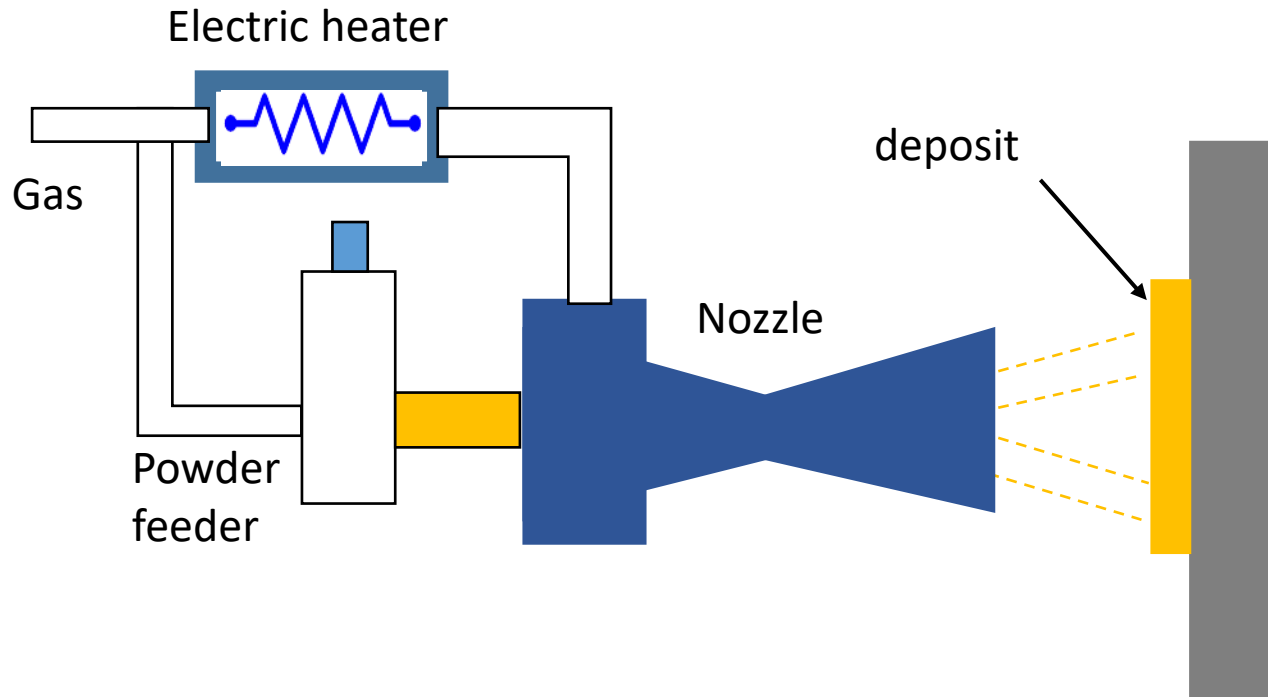


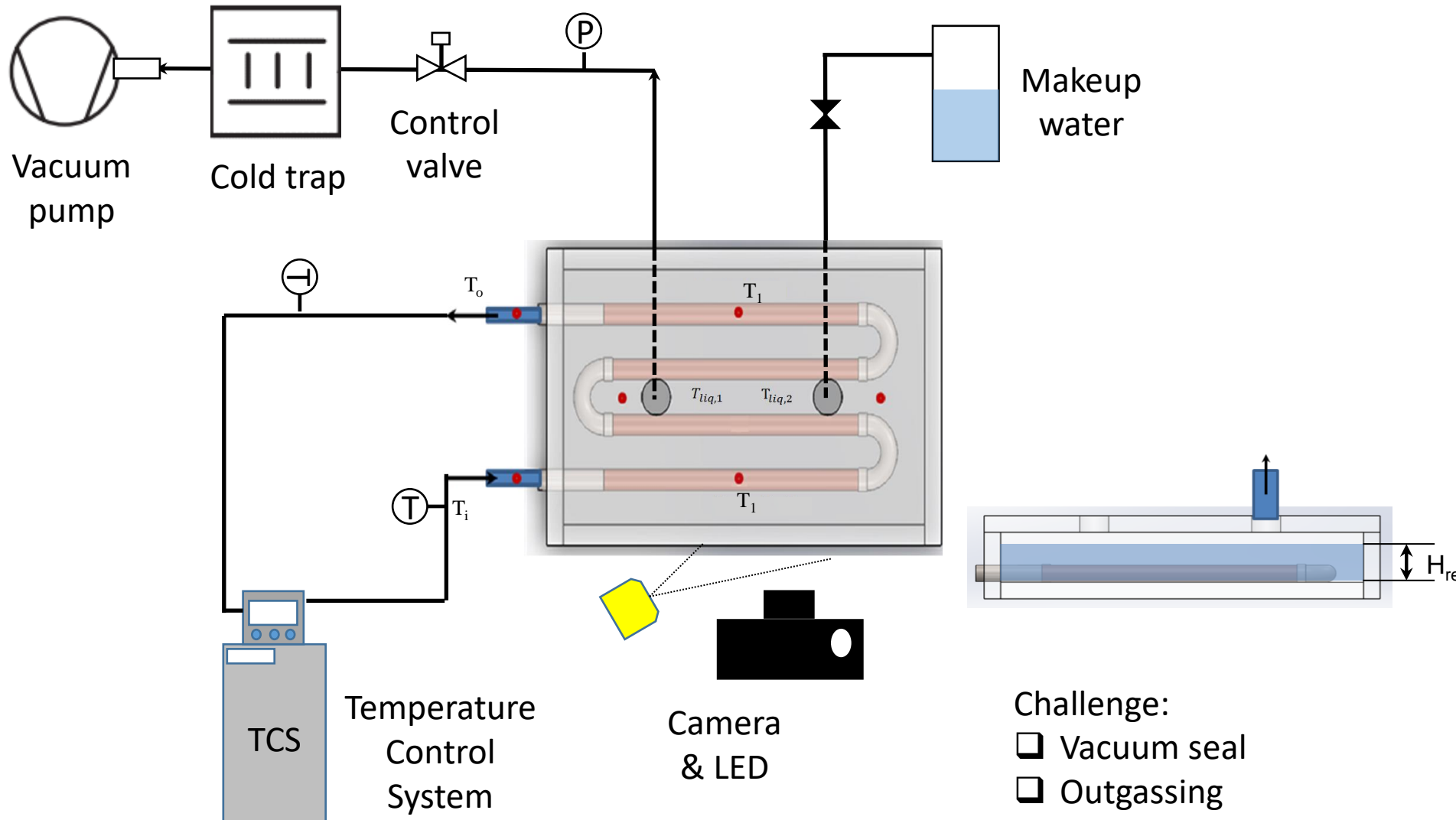
Development of efficient (combined) evaporator/condenser unit (ECU) is key

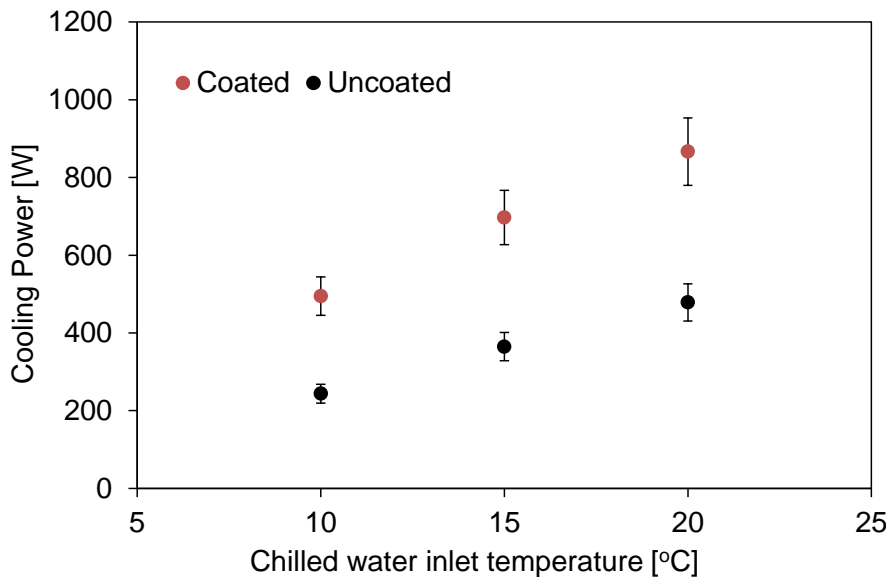
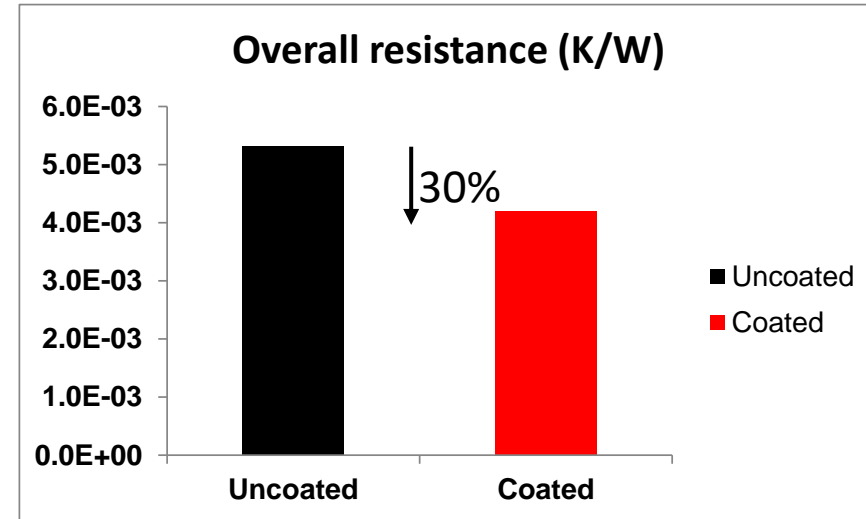
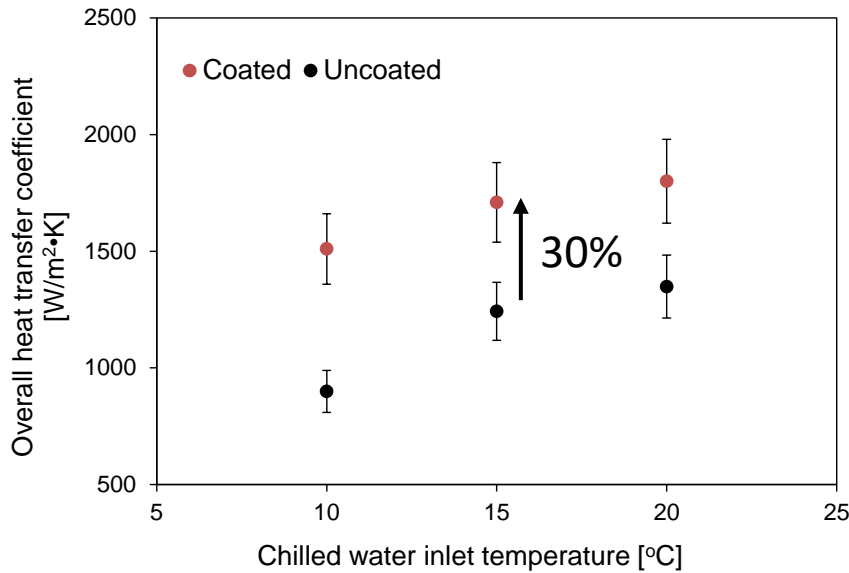
Comprehensive experimental studies to investigate the performance of our CALPE



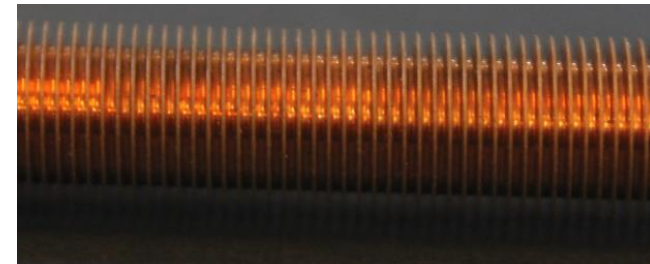
Our Experimental results indicated external thermal resistance on the outside of tubes accounts 60% of the overall thermal resistance



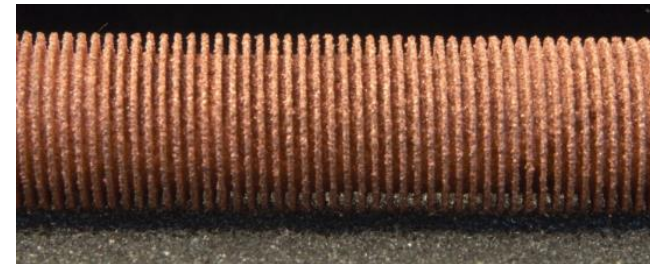


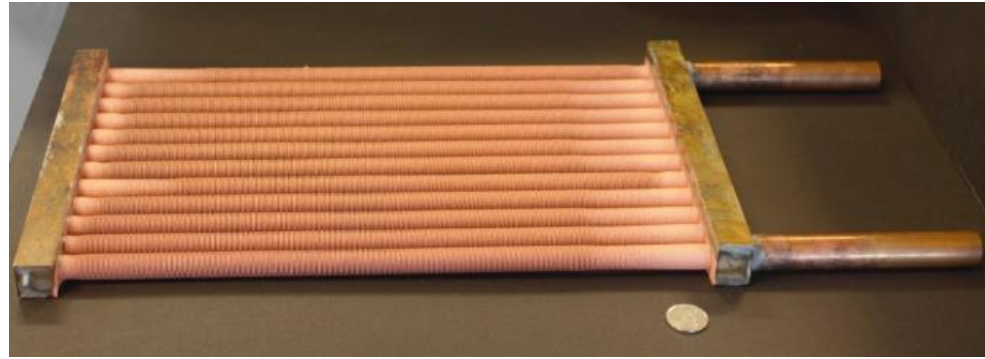
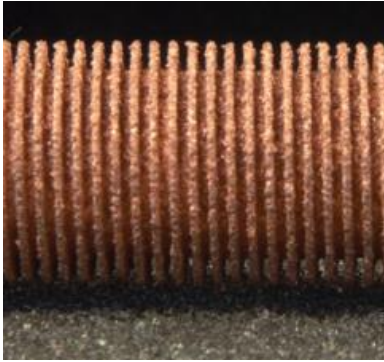


Uncoated

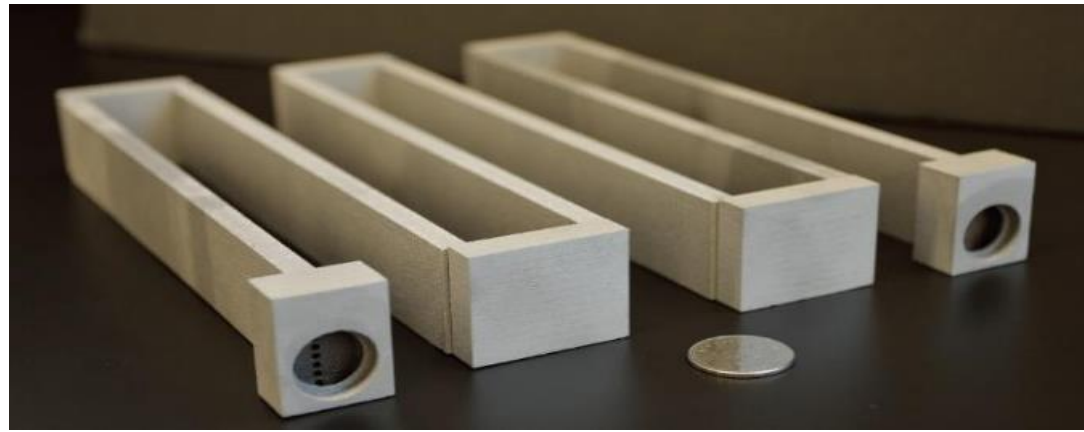
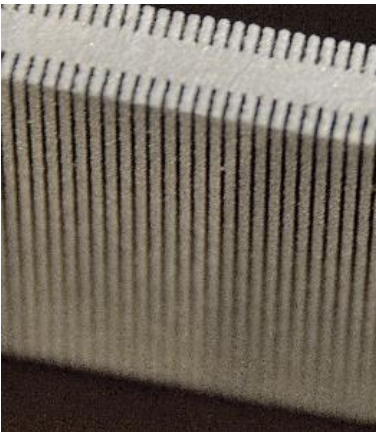


Coated





Thermal spray porous copper coating on finned tube heat exchanger



Direct metal sintering of finned aluminum microtube heat exchanger

Cooling Power

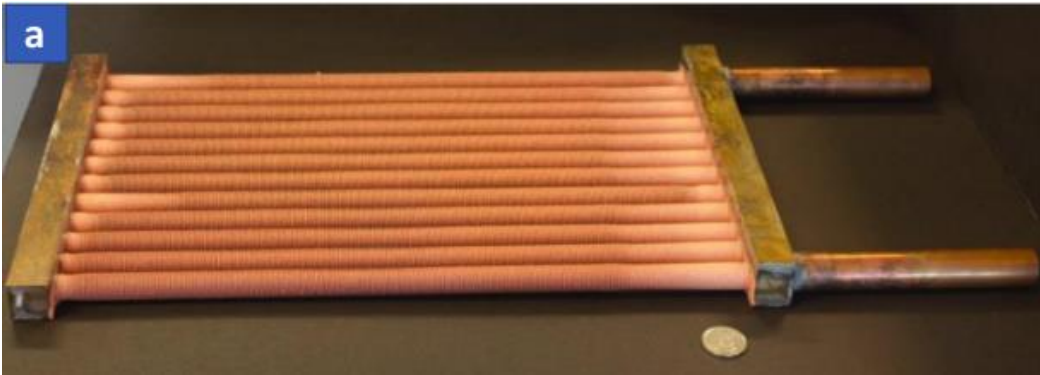
Porous copper evaporator:

0.3 kW/kg

Sintered aluminum evaporator:

1.2 kW/kg

Objective: To examine the condensation performance of the coated ECU



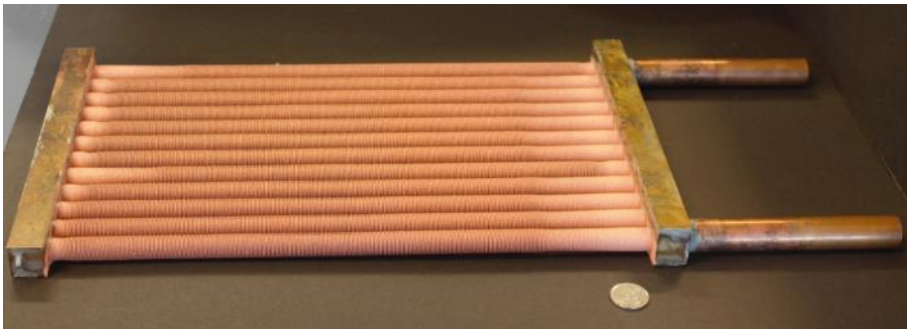
Coated evaporator/condenser unit (ECU)

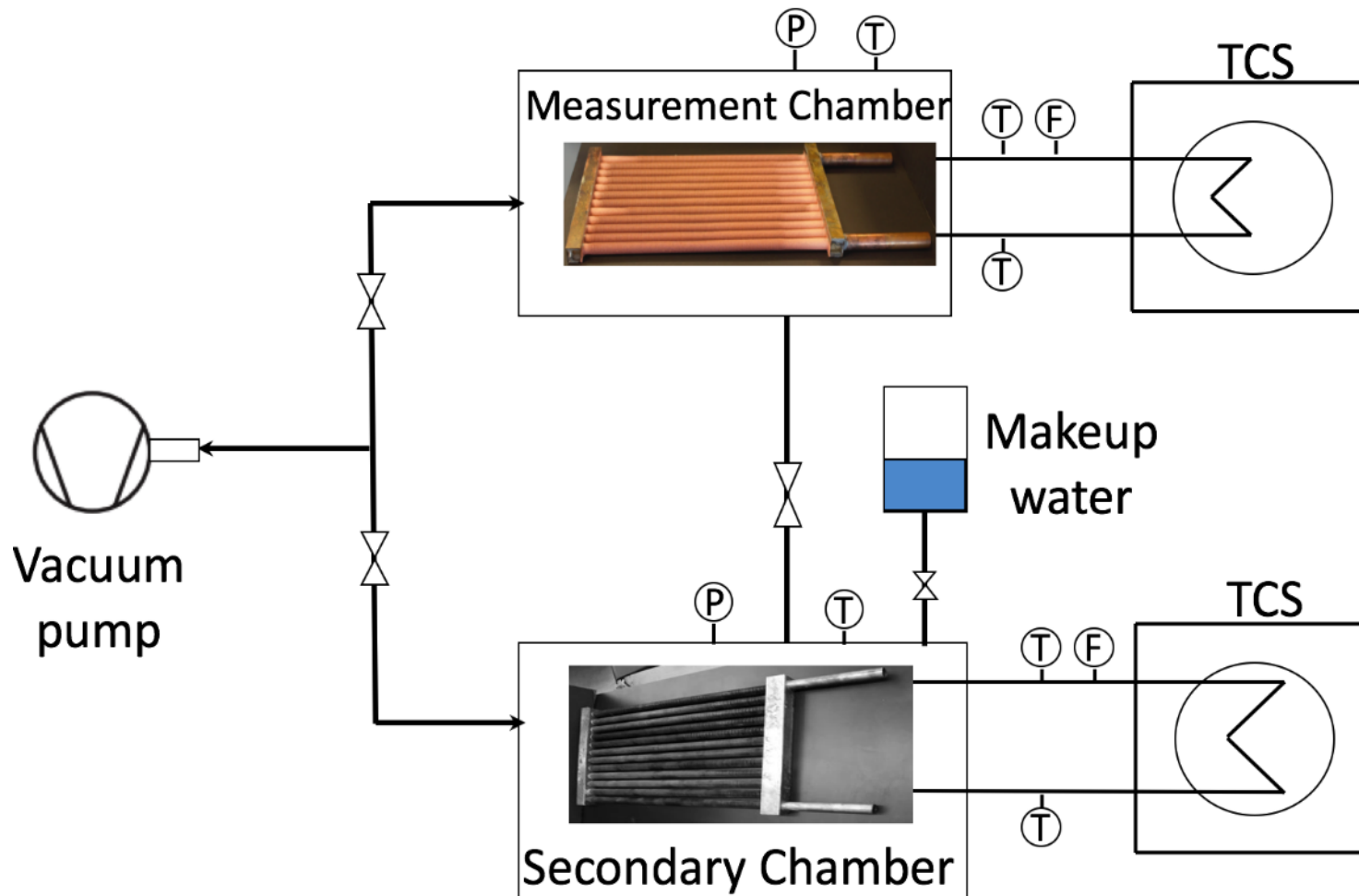


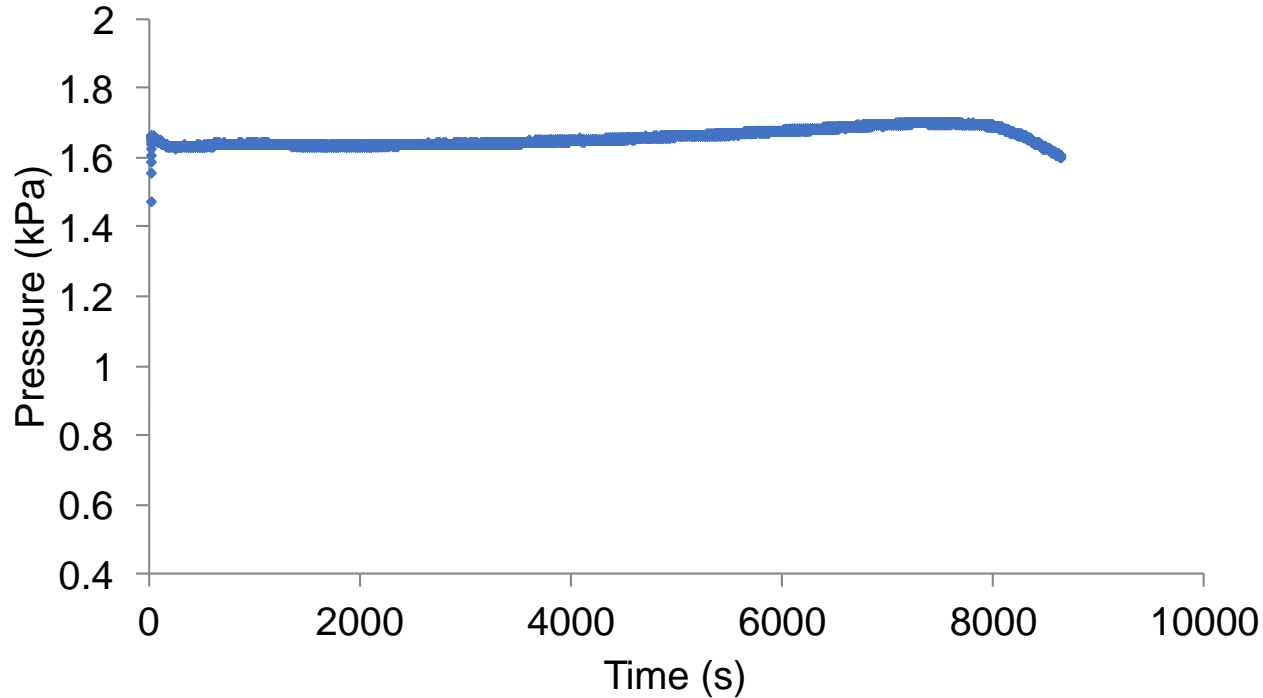
Off-the-shelf
condenser

- ❑ A porous copper coated evaporator/condenser unit (ECU) was built
- ❑ A comprehensive experimental study was performed

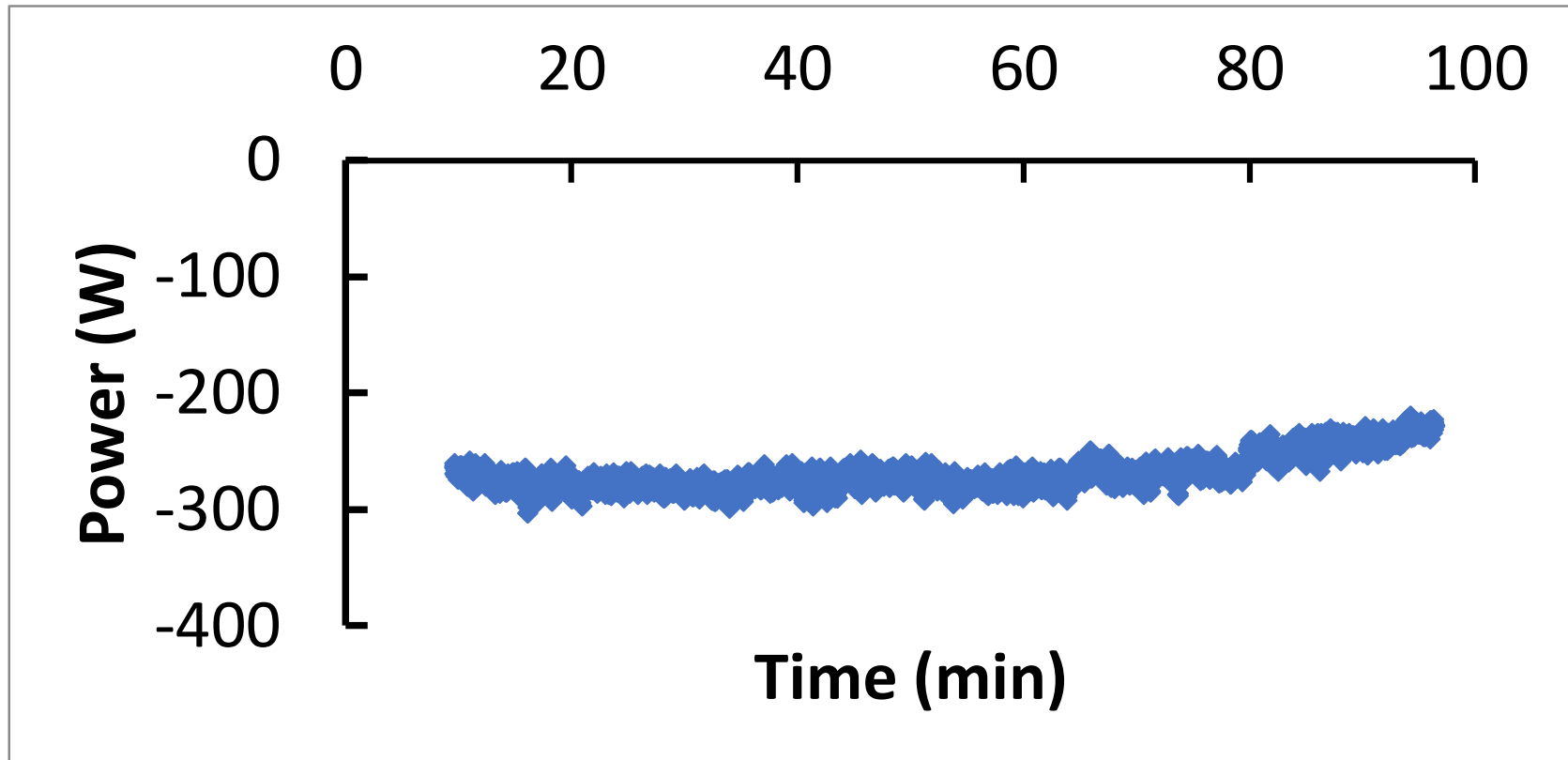
	Porous coated condenser	Commercial condenser
Tubes	GEWA®-K-2615 (Wieland Thermal Solutions)	King B Coil, (Wolverine Tube Inc.)
Outside diameter:	1/2" (12.7 mm)	1/2" (12.7 mm)
Number of Fins	26 fins per inch	9 fins per inch
Inside surface area:	0.024 m ² /m	0.024 m ² /m
Outside surface area:	0.024 m ² /m	0.33 m ² /m



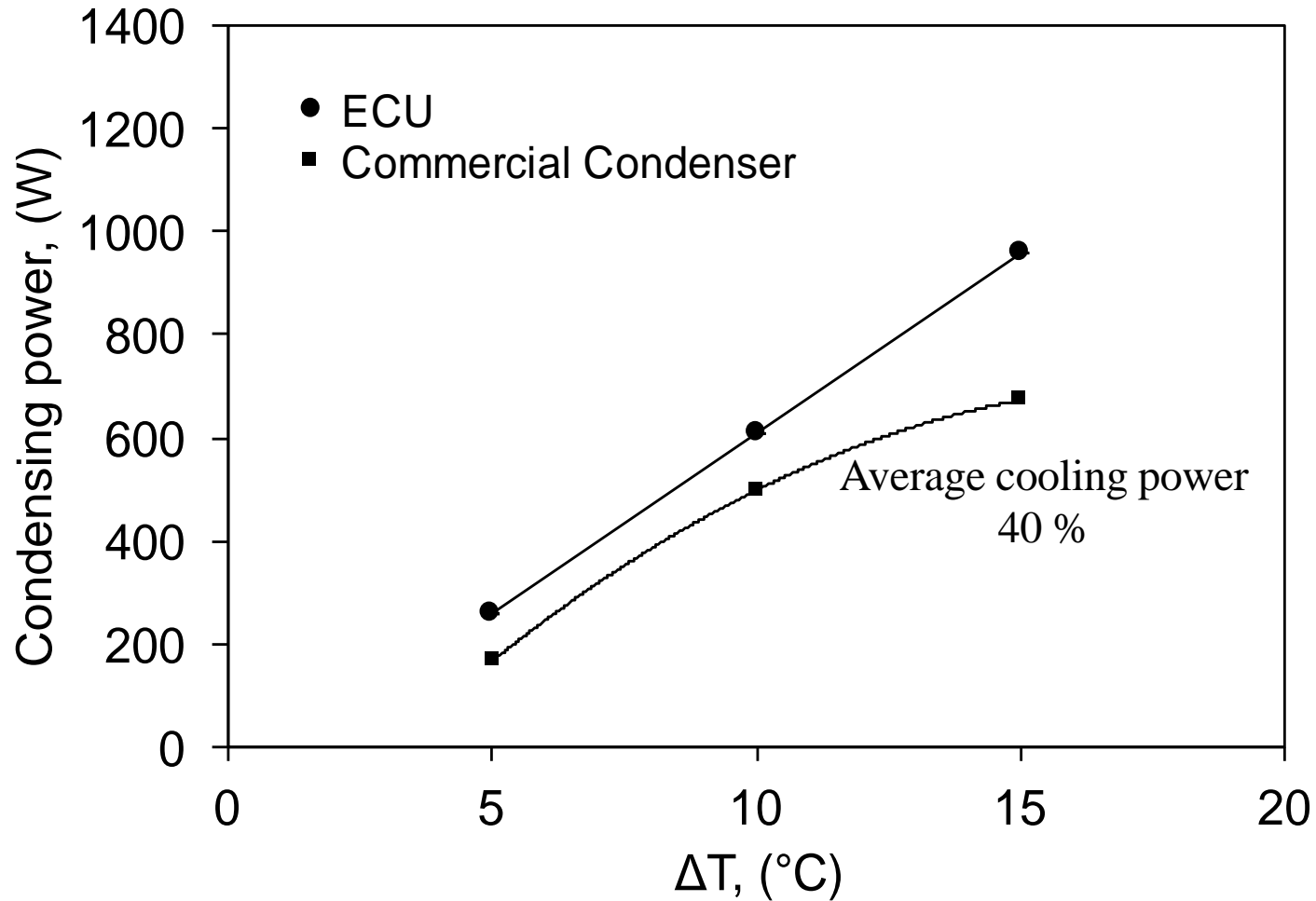




- Operating pressure of condenser with coated ECU at cooling water inlet temperature of 10°C over time.
- Data collection period is marked.



- ❑ Average cooling power: 260 W
- ❑ Cooling water mass flow rate: 2.5 L/min at 10 °C



- ❑ Suitability of a porous copper coated evaporator/condenser unit (ECU) was tested for adsorption chillers
- ❑ A porous copper coated evaporator/condenser unit (ECU) was built and tested
- ❑ The test results were promising and showed that the condensing power of the ECU was on average 40% higher than that of the commercial condenser