

Stability Testing of a Phase Change Material for Refrigeration Applications

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University of
South Australia

John Severino, Martin Belusko, Ming Liu, Frank Bruno

What are PCM's

- * PCMs = Phase Change Materials
- * Store energy by changing from a solid to a liquid.
- * Ice is the traditional PCM
- * UniSA developed materials range from -50°C to 1414°C



Salt



Paraffin

- * We use salts – cheaper, store more energy

What is PCM thermal storage

Sensible Thermal Storage	PCM Thermal Storage
Domestic hot water heater	Ice in an Eski
Your home	Igloo
Hot water bottle	Dry ice (frozen CO ₂)
Thermos flask	

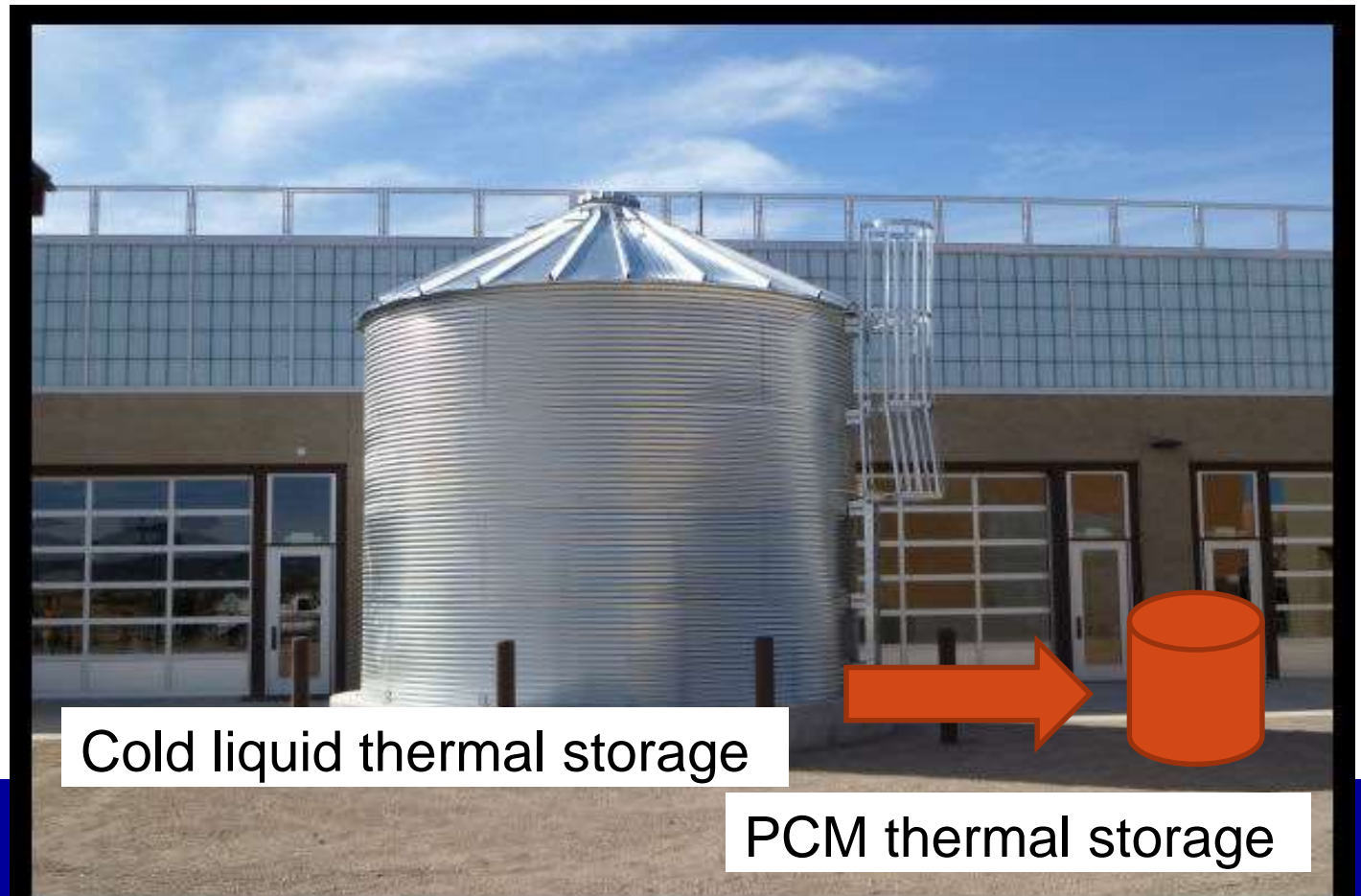


Why PCM?

Constant Temperature

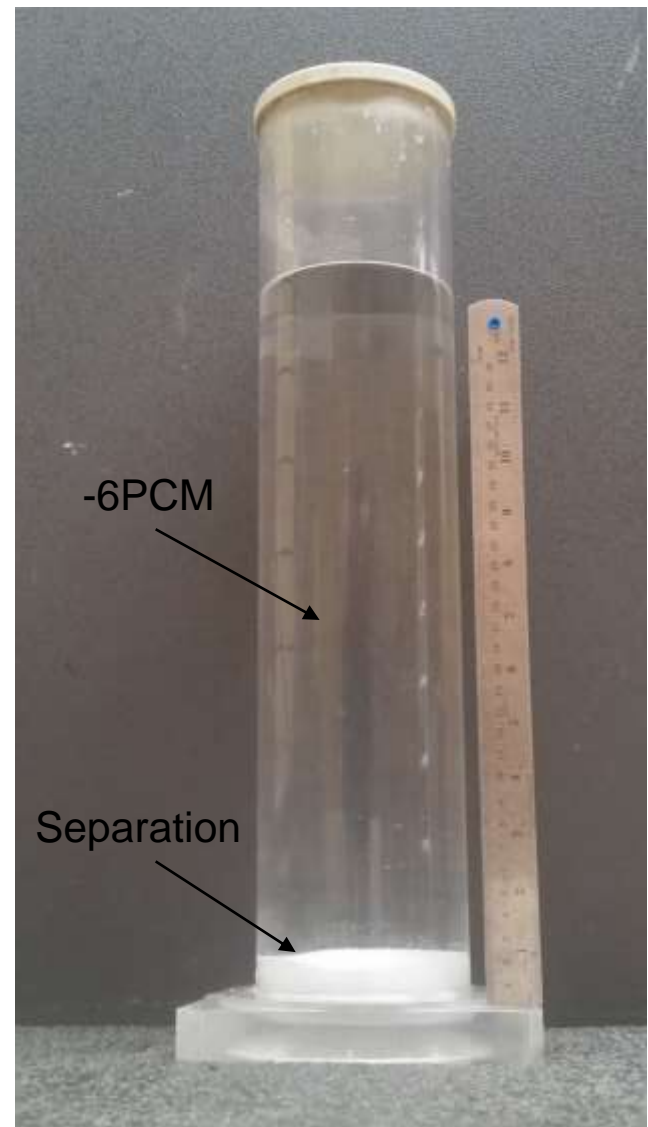
Energy to freeze = Raising water by 80°C

10x smaller



Failure

Failure by separation



Solutions

Thickeners

Balls

Pouches

All very expensive



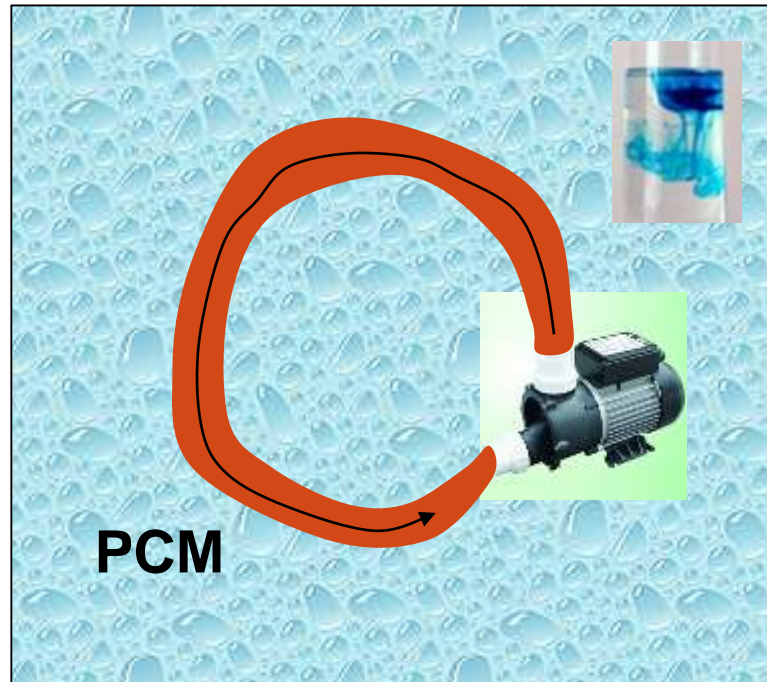
Pouches



Containers

Our solution is Dynamic Melting

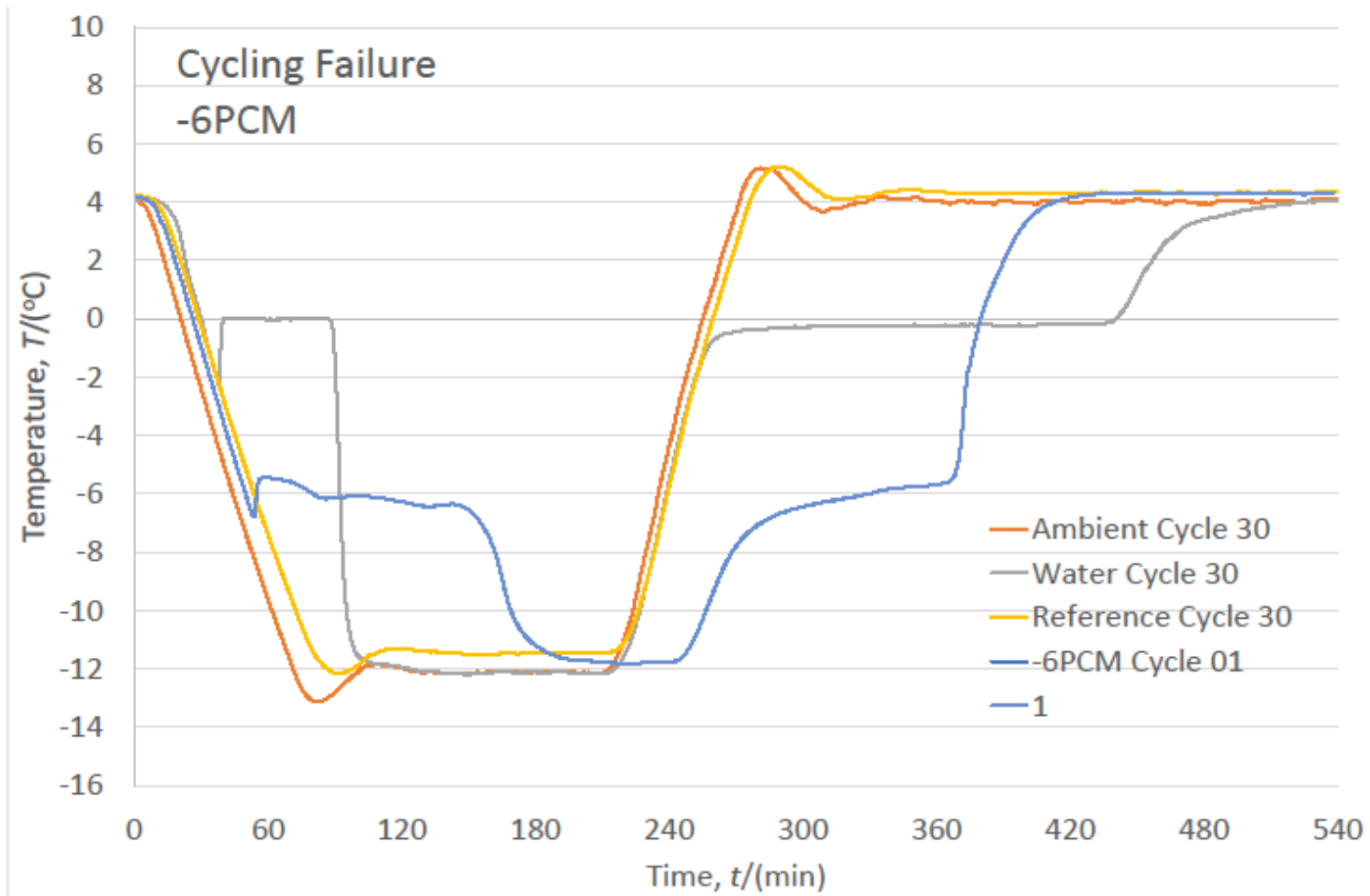
- * Mix or agitate PCM when melting
- * Stabilises PCM – no additives required
- * discharges quicker / more cooling

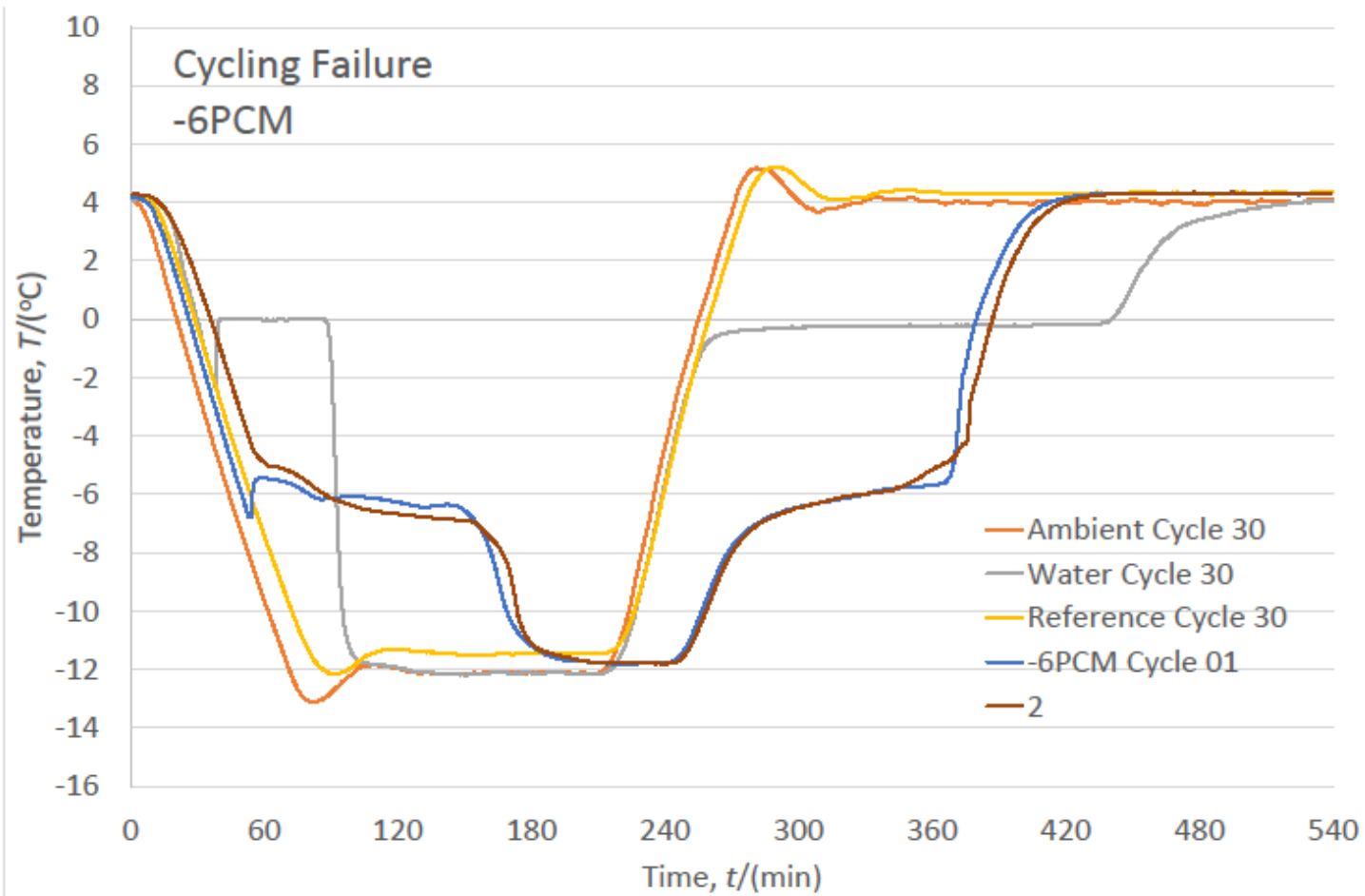


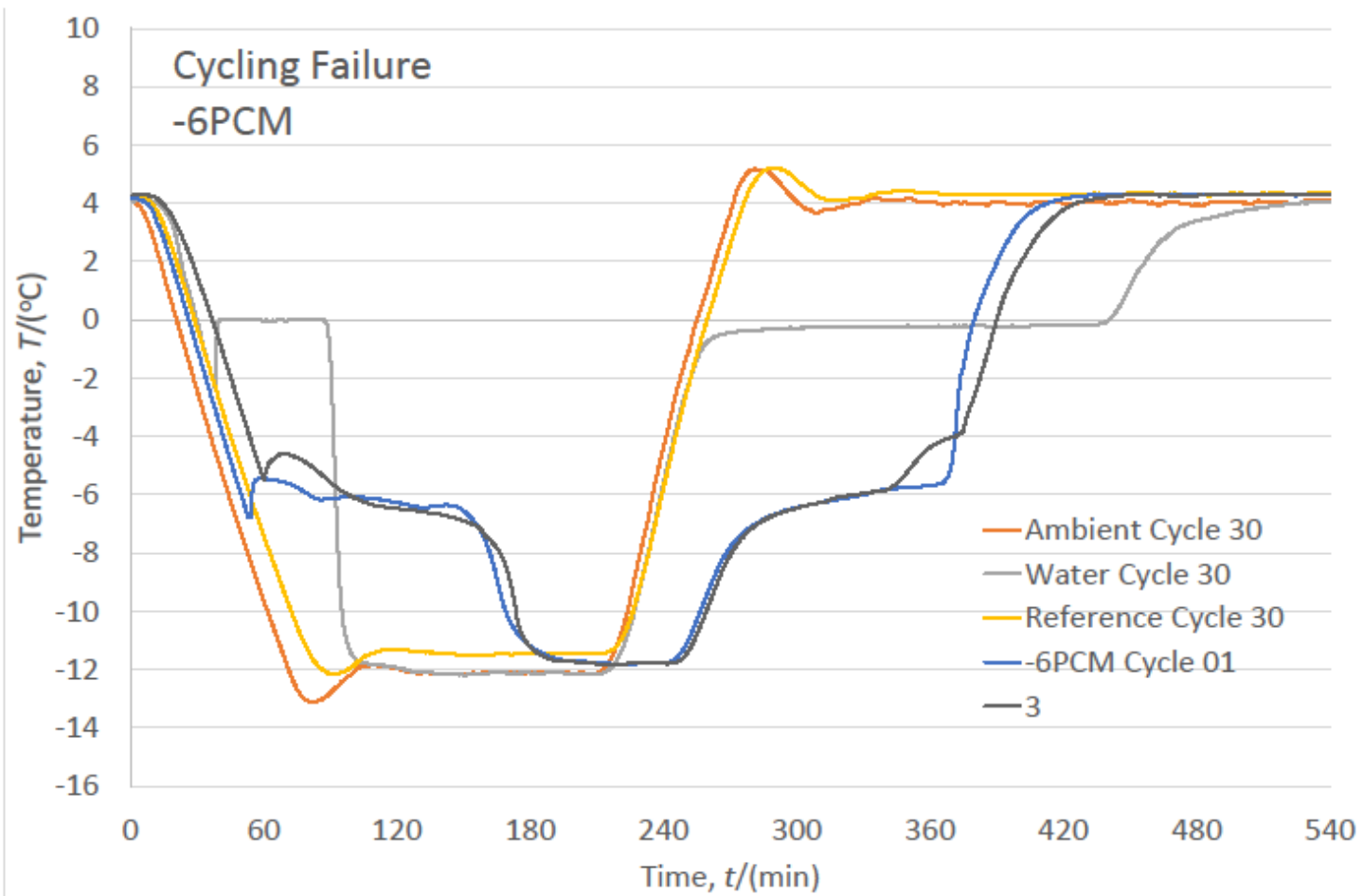
Experiments

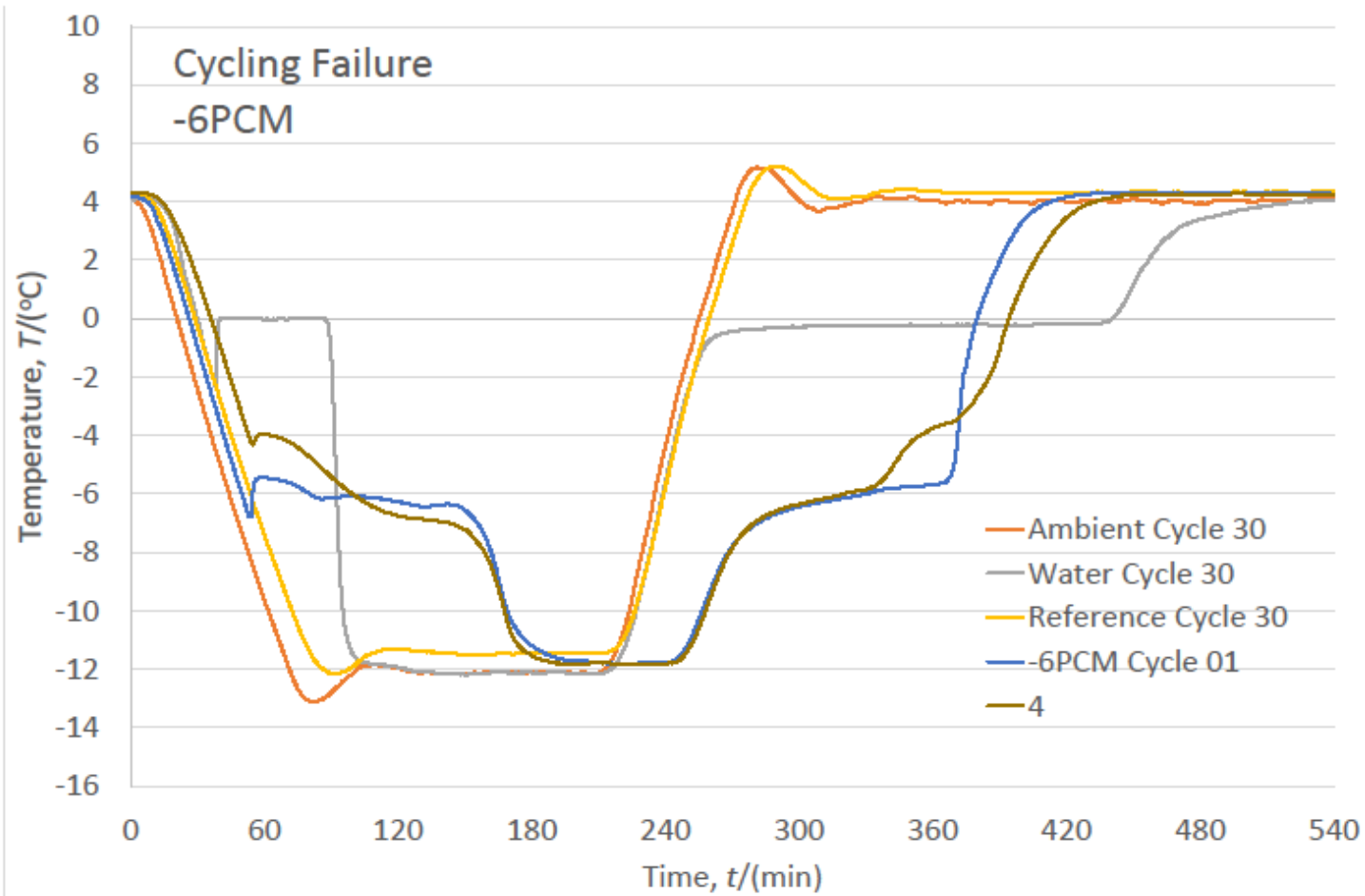
Cyclic failure rig

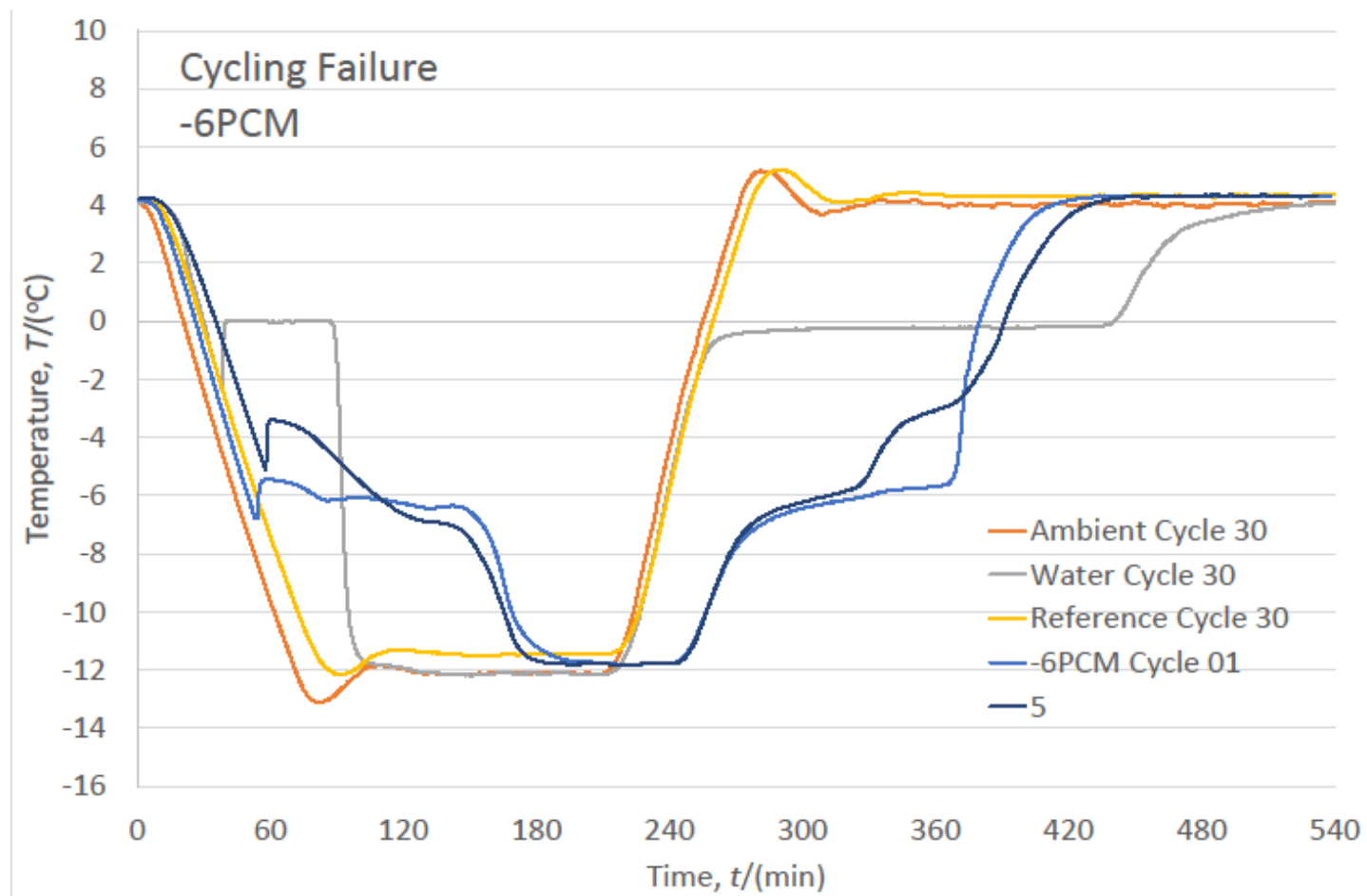


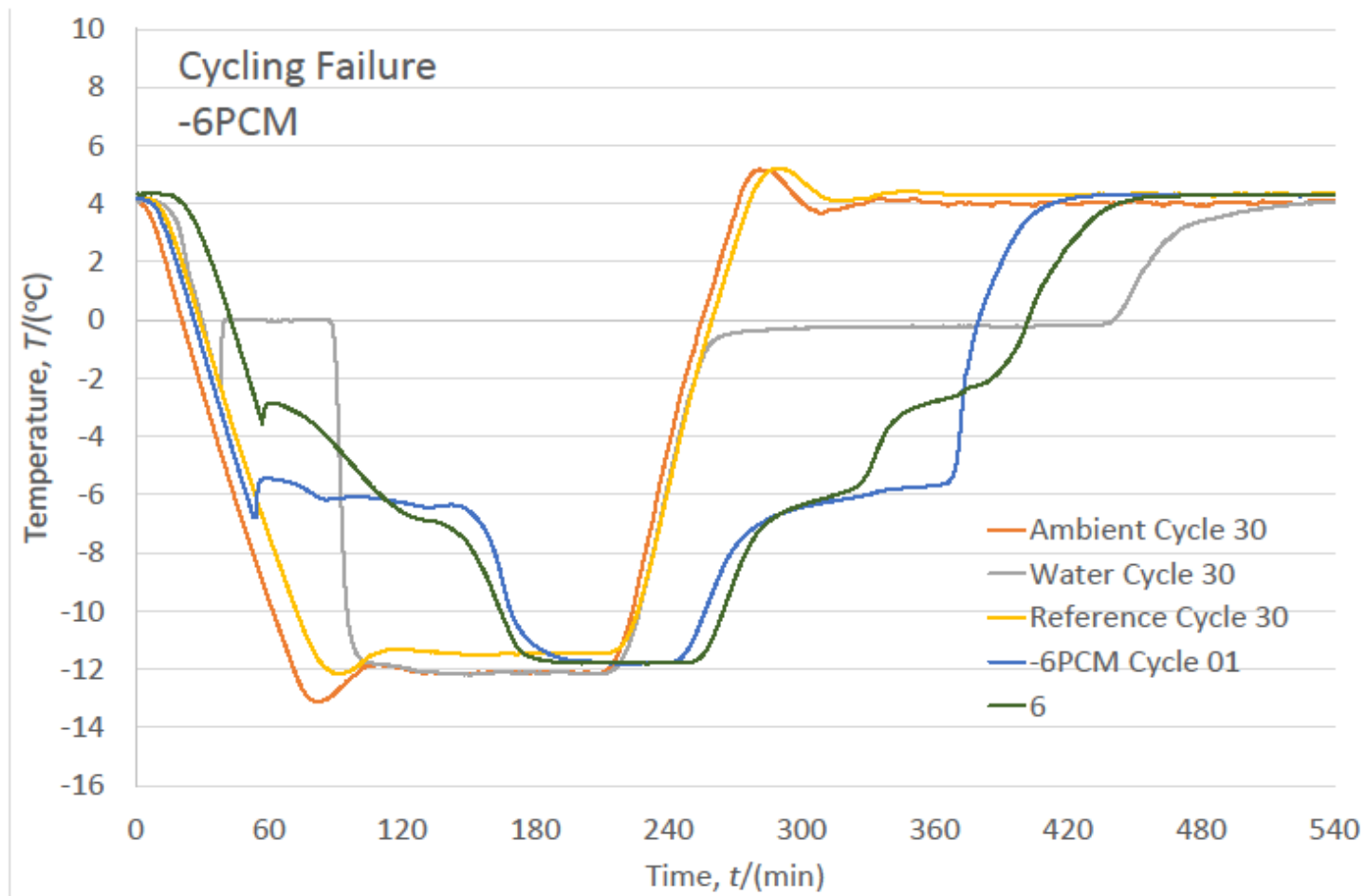


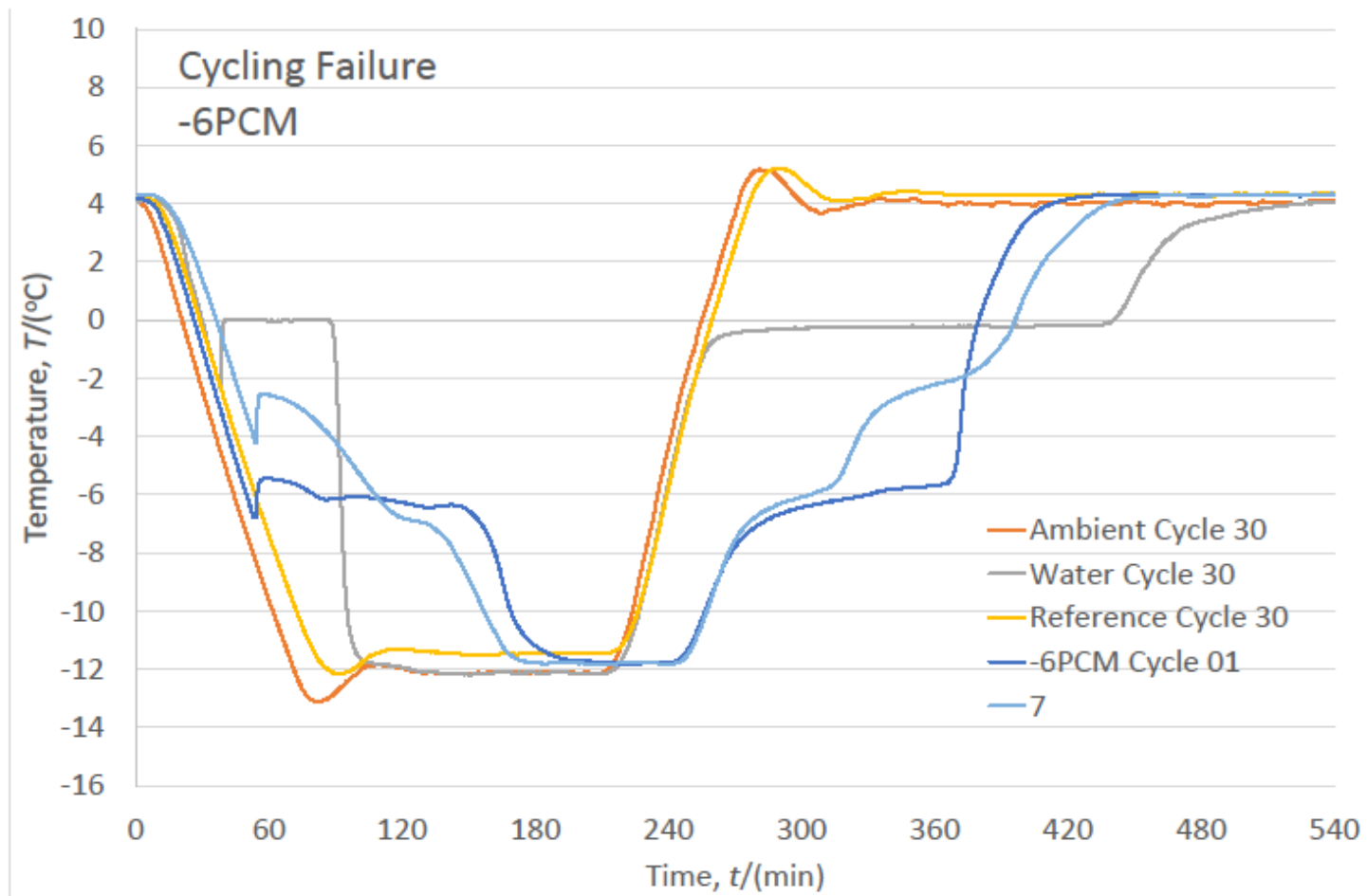


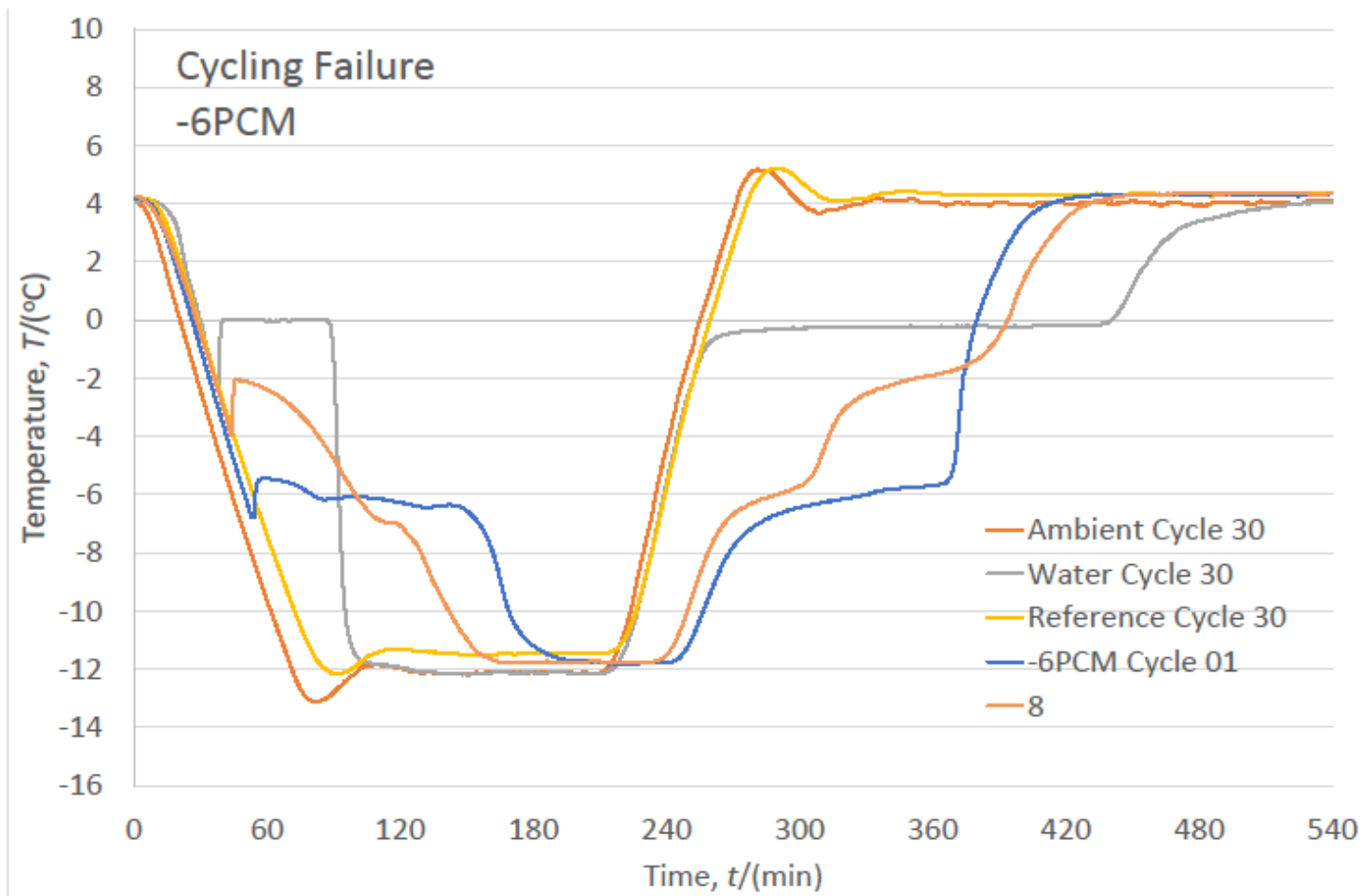


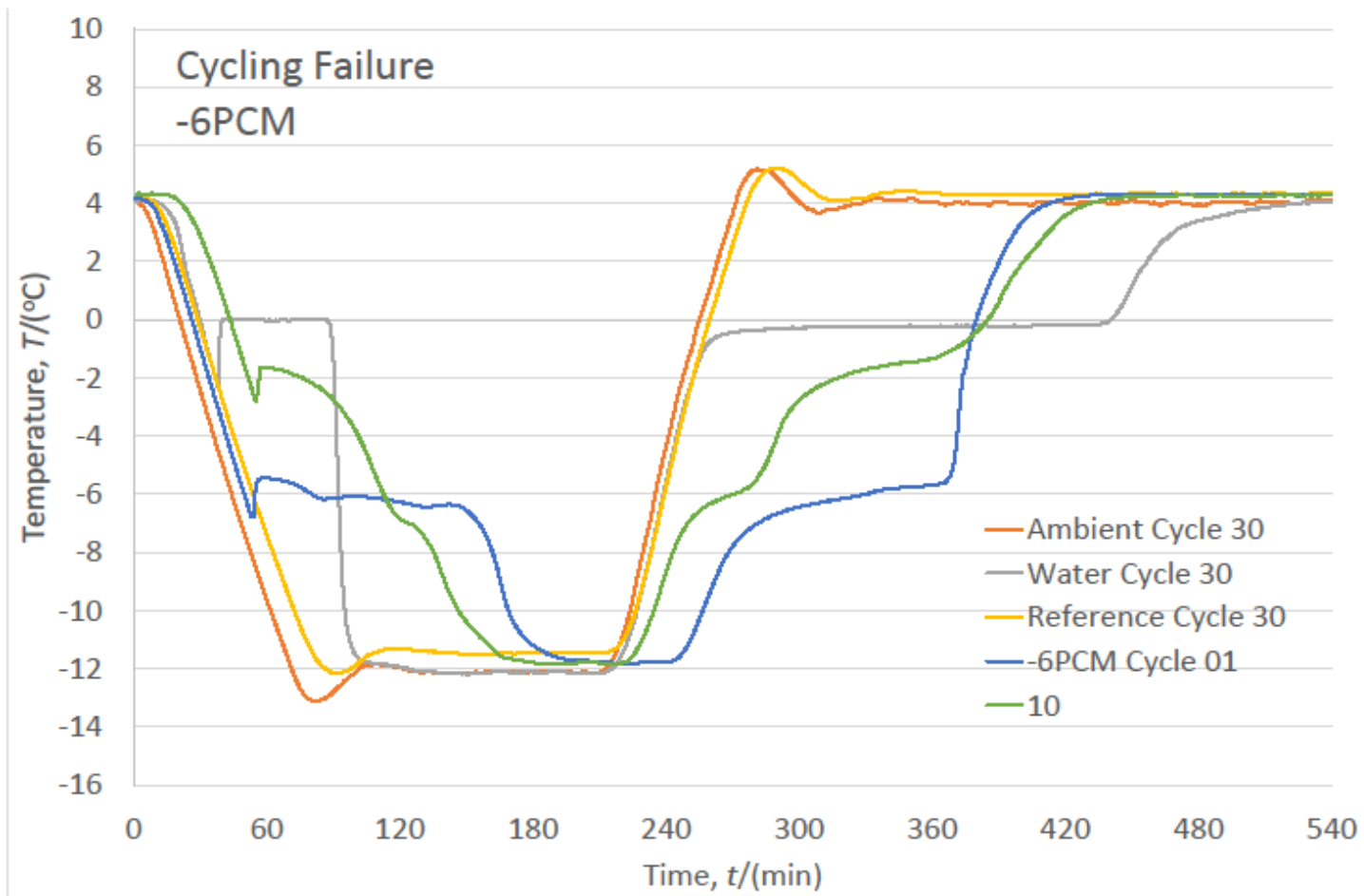


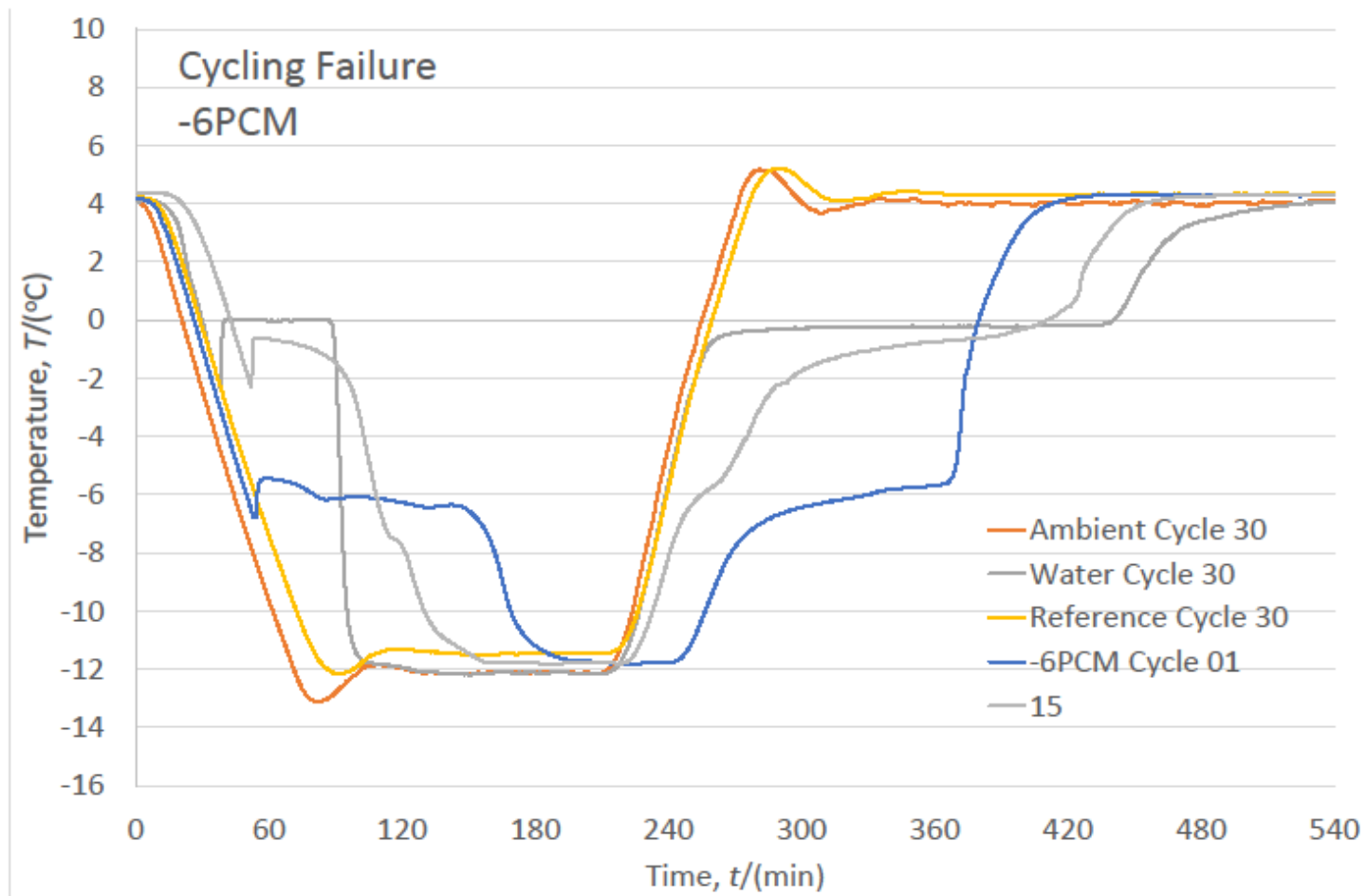


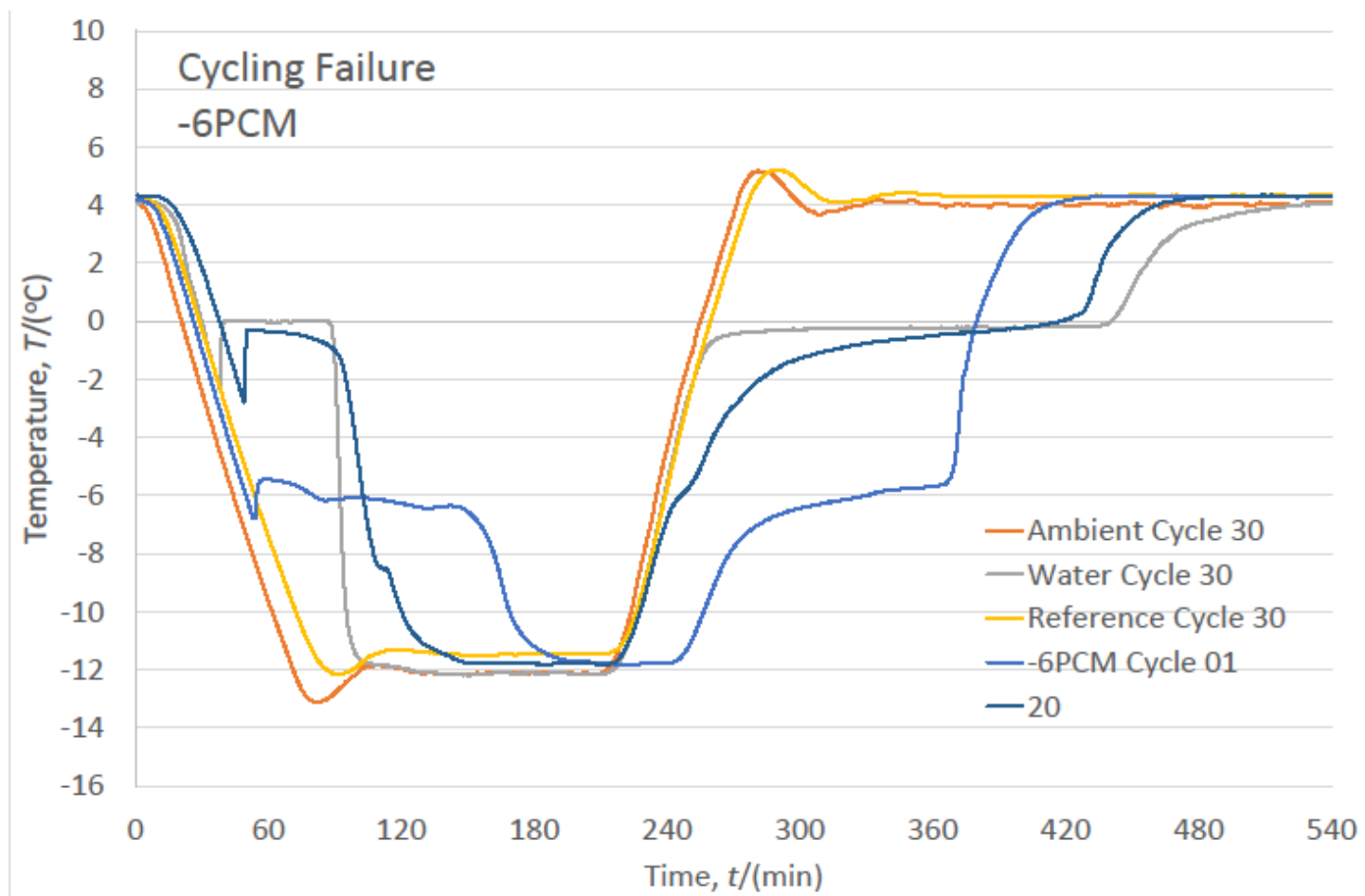


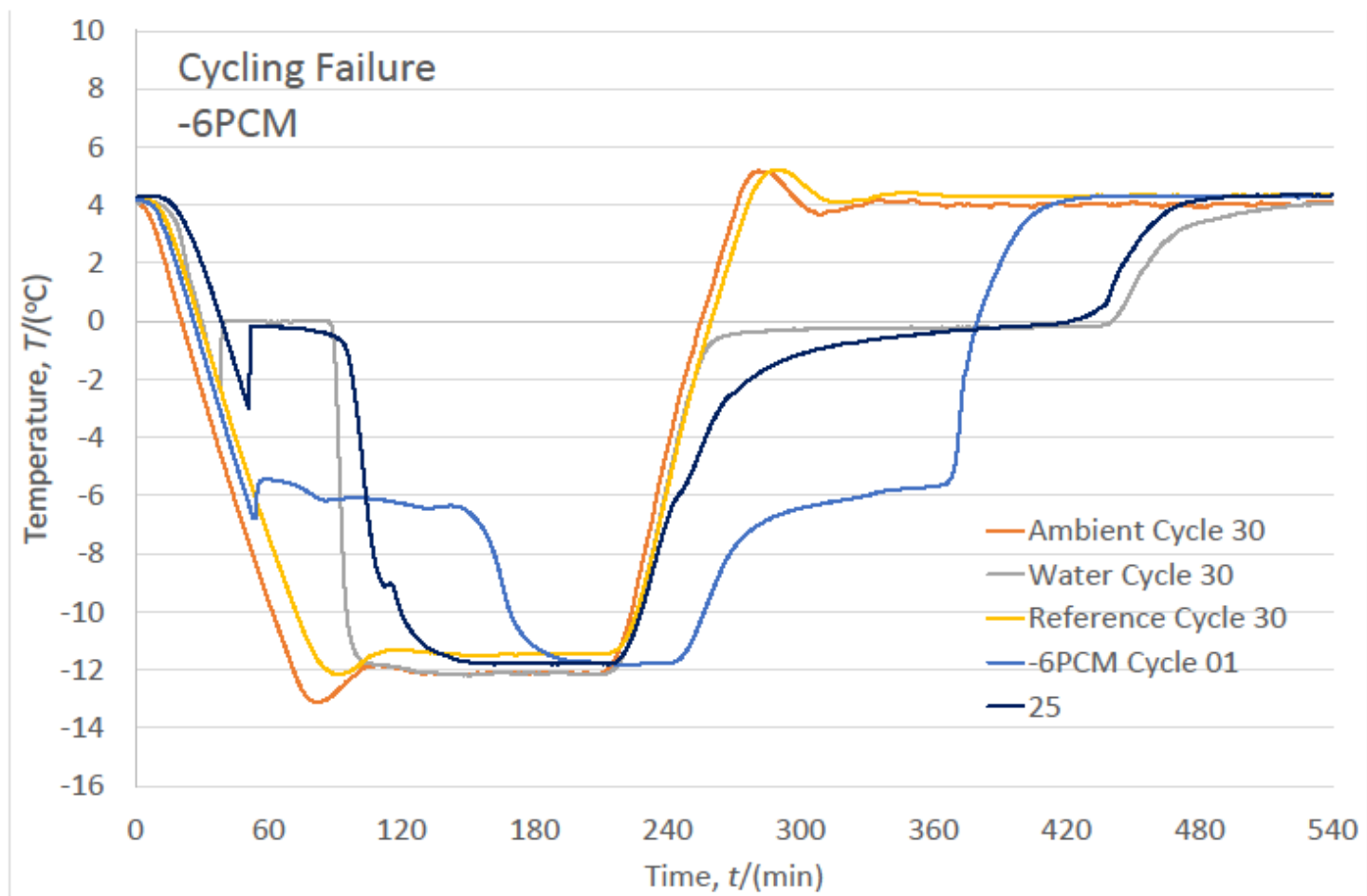


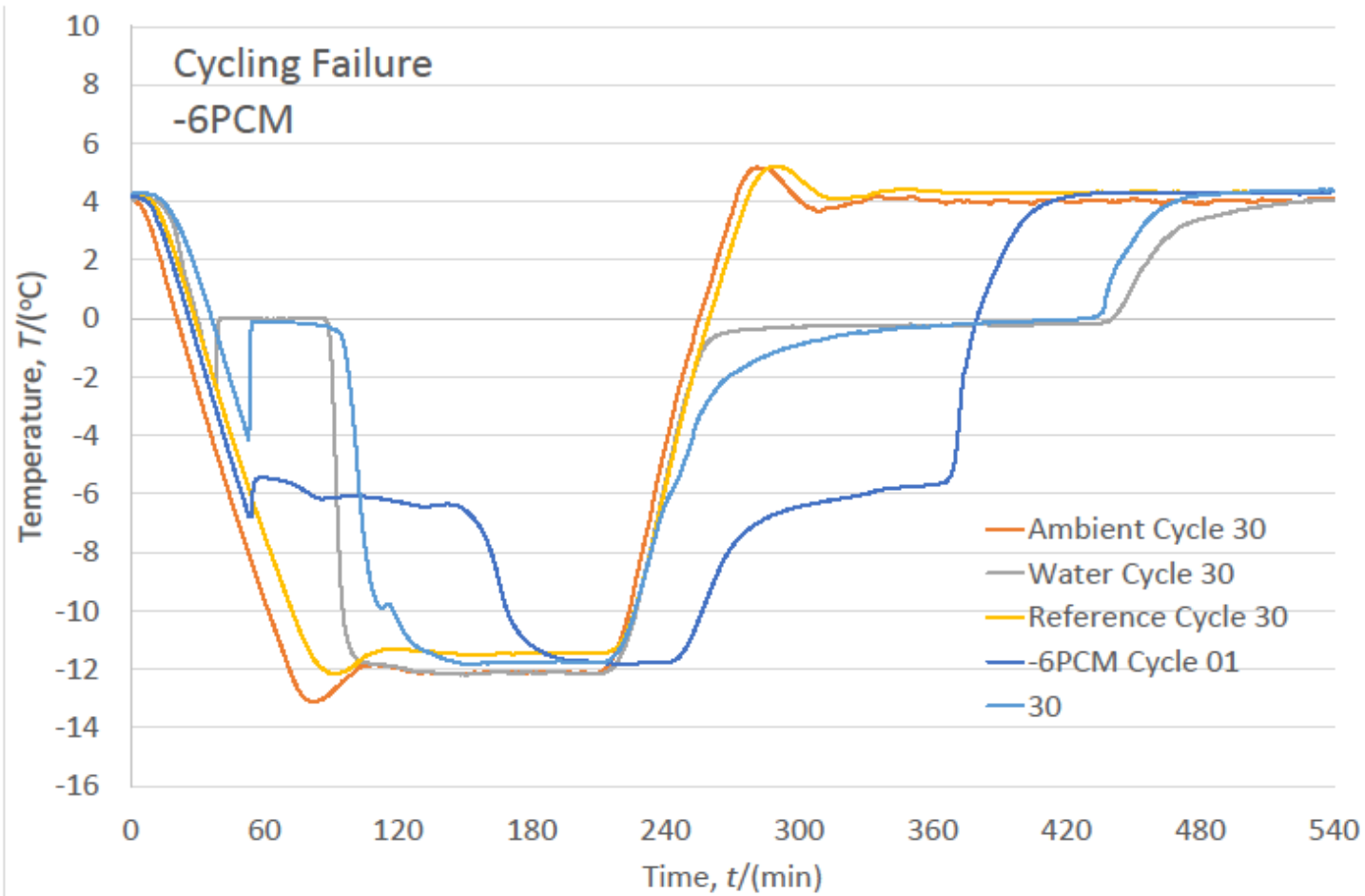












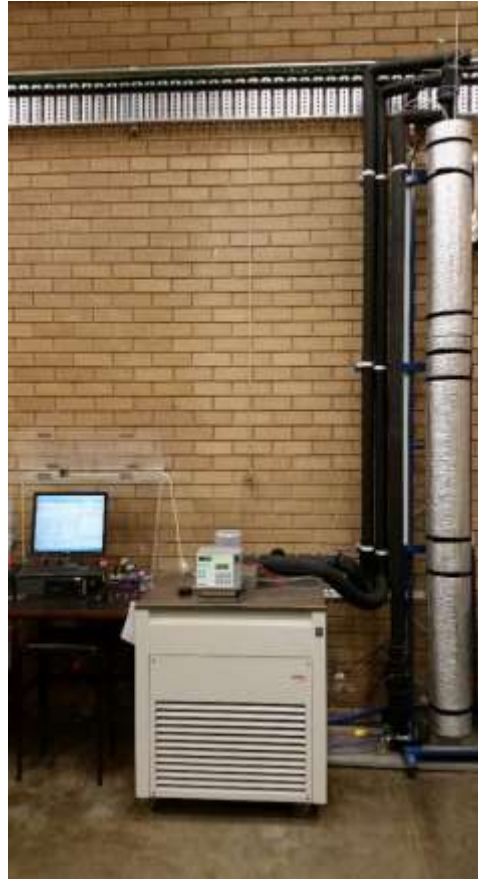
Experiments

Pseudo T-history rig

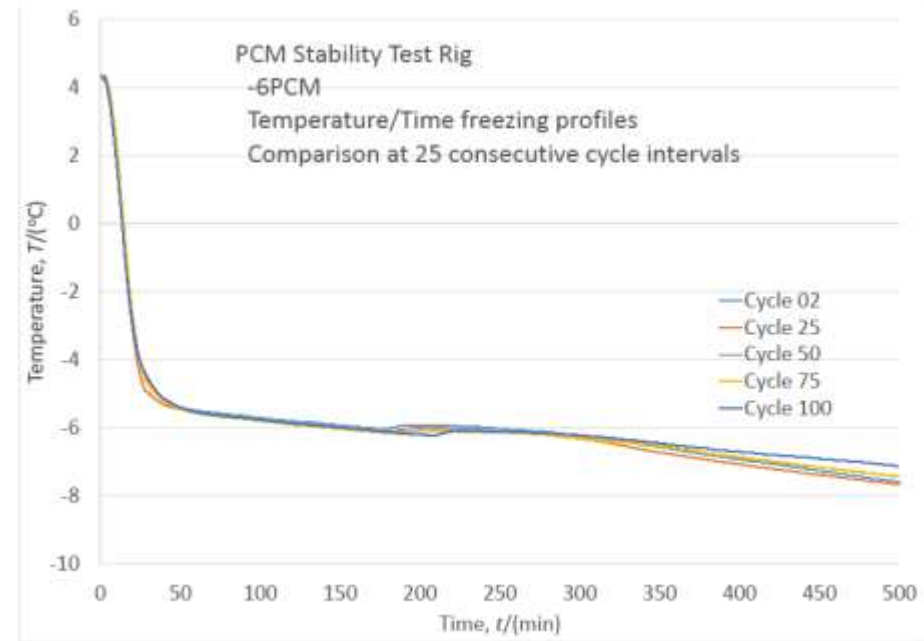
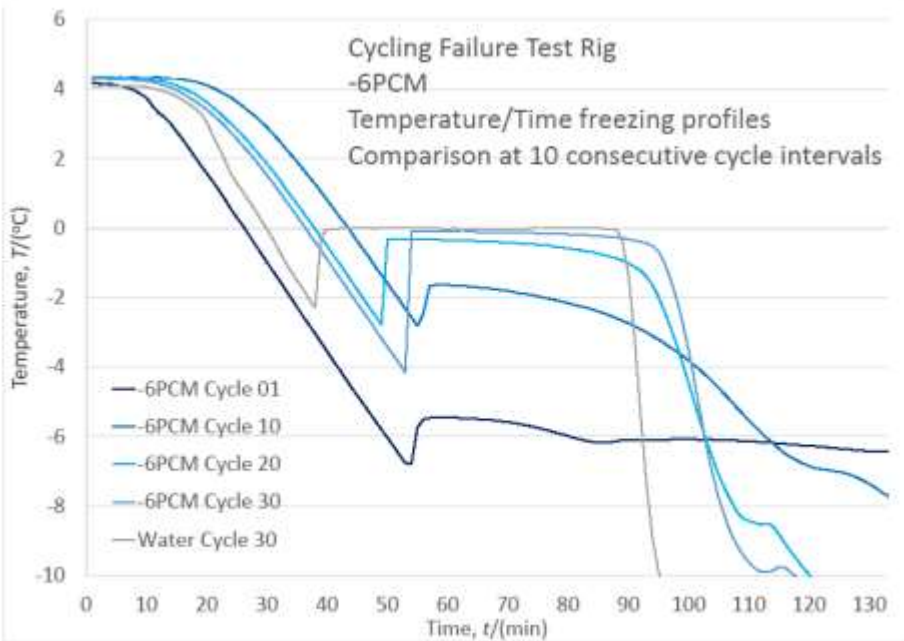


Experiments

Stability test rig



Results



Sample testing

Latent Heat of Fusion	Pseudo T-History	DSC
Cycle #	$L_{Ps\ T-History}/(kJ/kg)$	$L_{DSC}/(kJ/kg)$
0	281	256
25	302	253
50	289	262
75	299	263
100	293	259
	292±11	259±6

Values of Latent Heat of Fusion as determine by the Pseudo T-history and DSC test methods.

Conclusion

It works