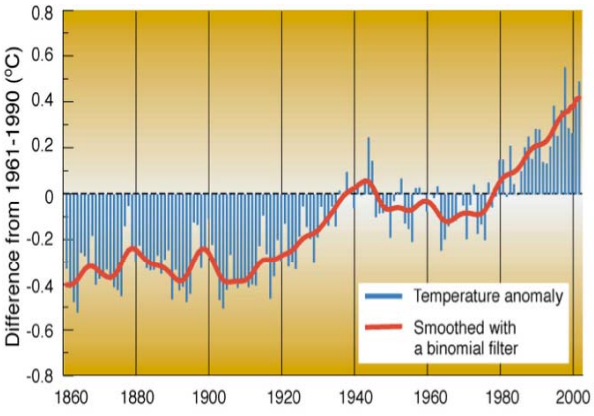
Adsorption chiller

Presented by

Xiaolin Wang
E-mail: xlwang@mech.uwa.edu.au
The University of Western Australia
WA Geothermal Centre of Excellence

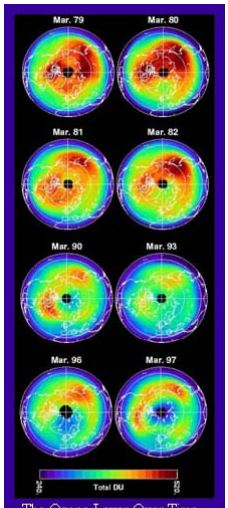
Background

- **Environmental issue**
  - Globe warming



Global Warming, IPCC

Ozone depletion



The Ozone Layer Over Time. Image Credit: Institute for Studies in Development, Environment, and Security.

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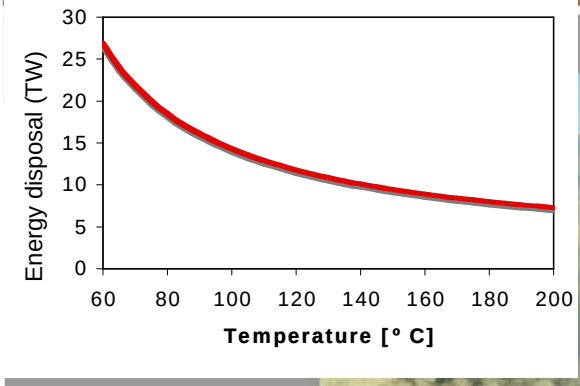
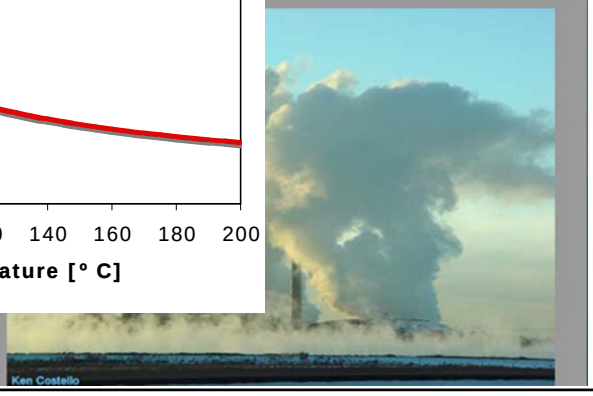
Background

Massive Waste Heat Disposal





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Two-bed silica gel – water adsorption chiller

Material:
Carbon steel

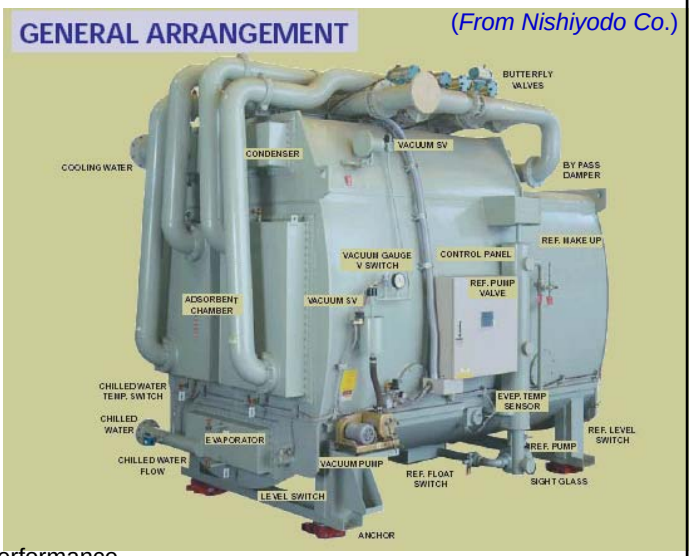
Advantages:

- Low maintenance cost-no moving parts
- Benign environment –water/silica gel
- Energy recovery – conversion of waste heat to effective cooling

COP = 0.3 ~ 0.7

$$COP \equiv \frac{\text{cooling capacity}}{\text{heat input}}$$

→ Coefficiency of performance



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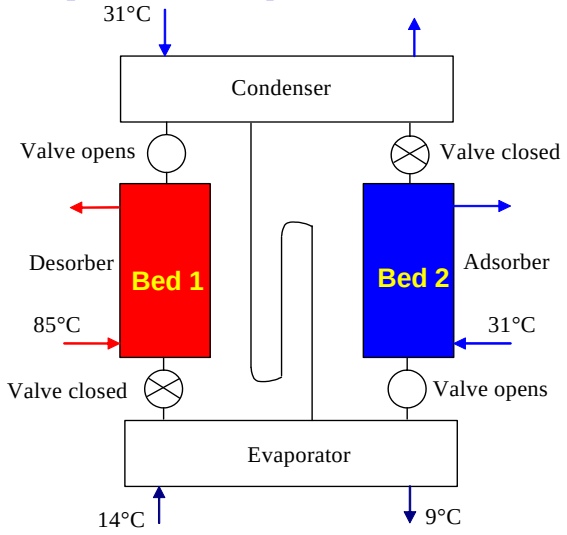
Standard operational sequence of a two-bed adsorption chiller



Silica gel + water adsorption chiller

Operation time frame ~ 420 s

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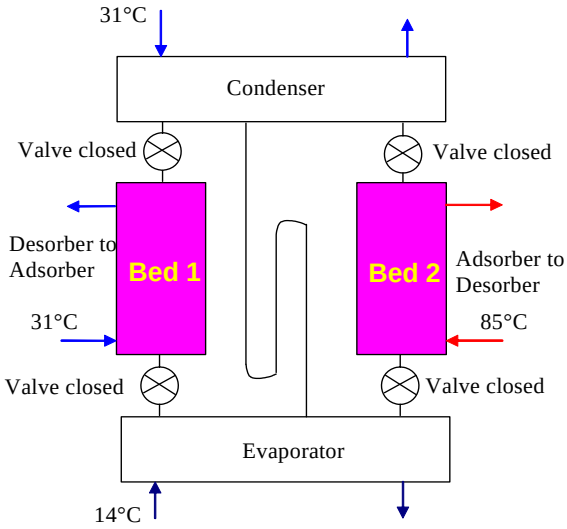
Standard operational sequence of a two-bed adsorption chiller



Silica gel + water adsorption chiller

Operation time frame ~ 30 s

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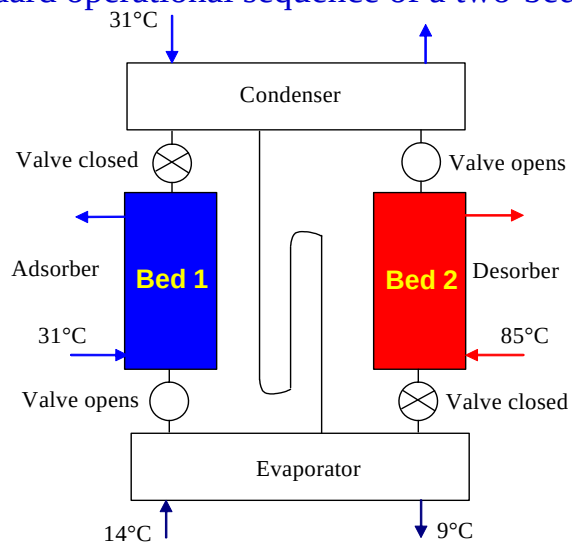
Standard operational sequence of a two-bed adsorption chiller



Silica gel + water adsorption chiller

Operation time frame ~ 420 s

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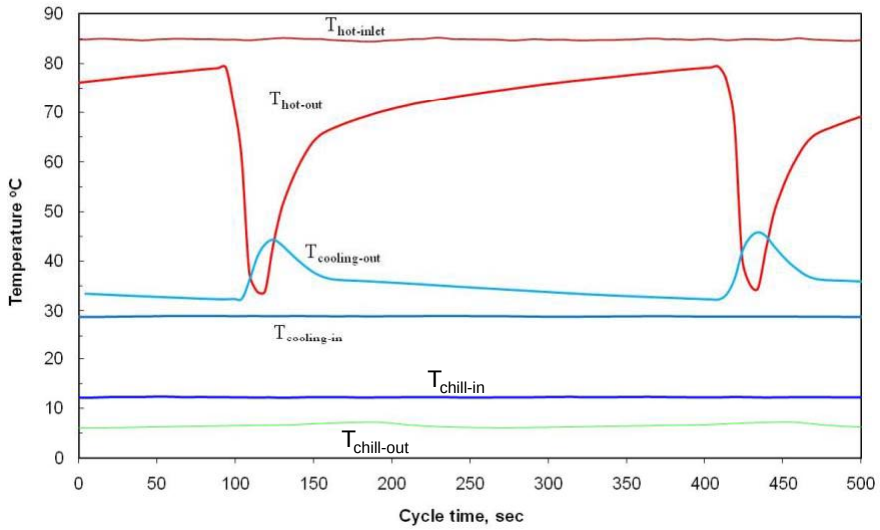
Cyclic steady state behavior of a two-bed adsorption chiller



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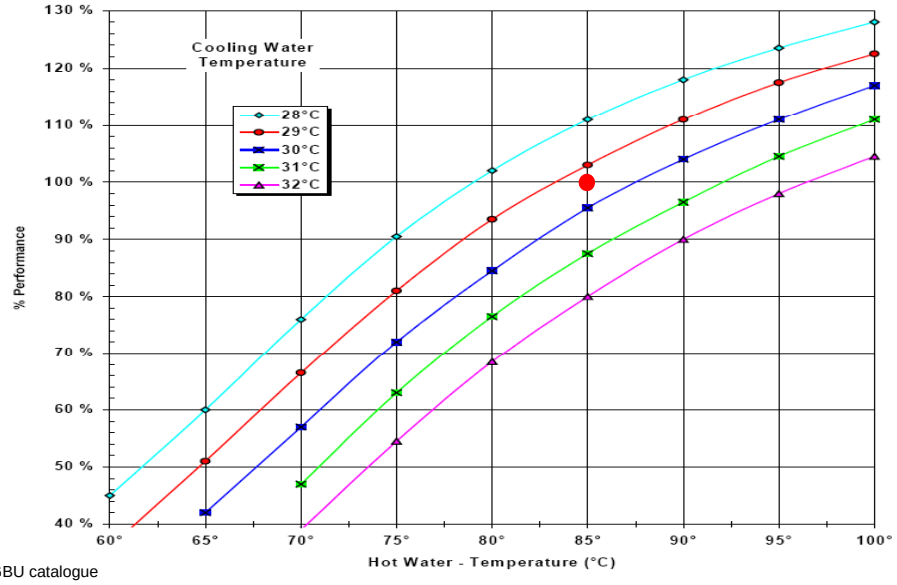
Hot water efficiency for chilling temperature 12°C – 7 °C



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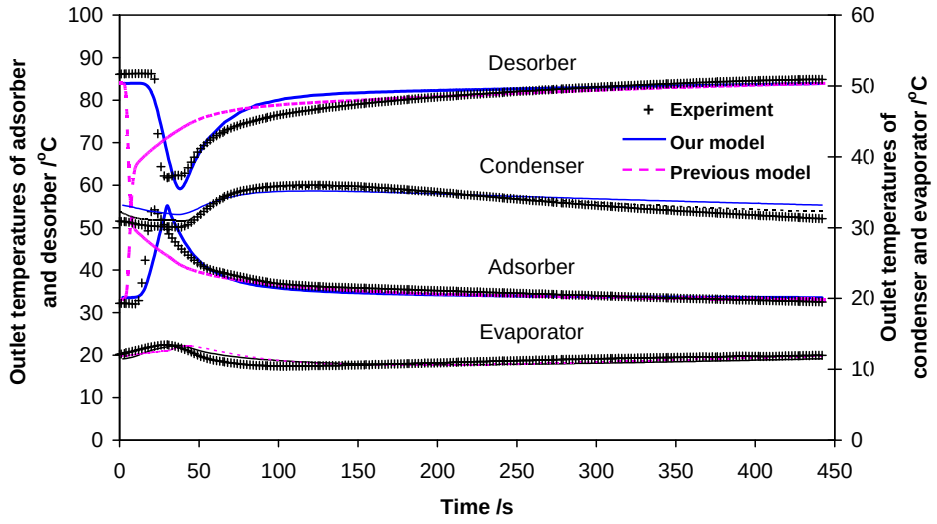
Cyclic steady state behavior of a two-bed adsorption chiller



HT Chua, KC Ng, W Wang, C Yap, and XL Wang, *Int J Heat Mass Transfer*, 47, pp.659 (2004).

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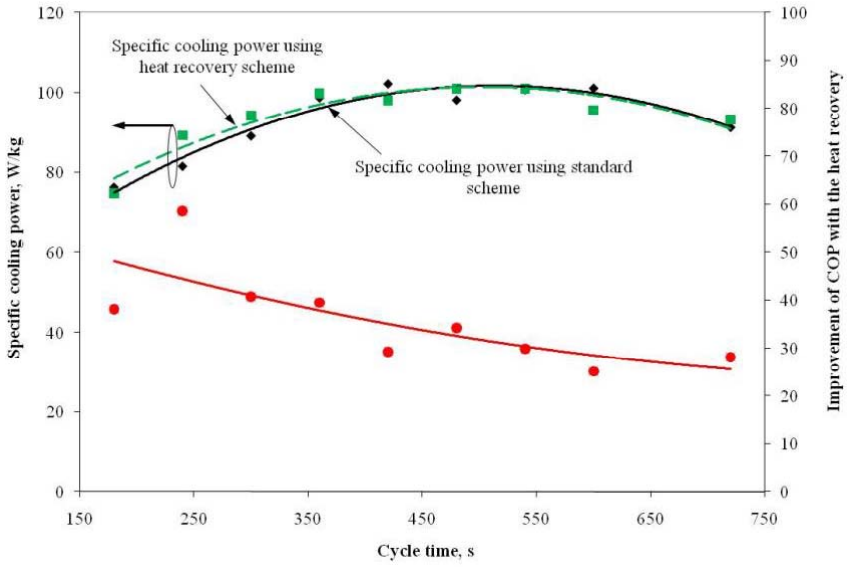
COP comparison by mass & heat recovery scheme



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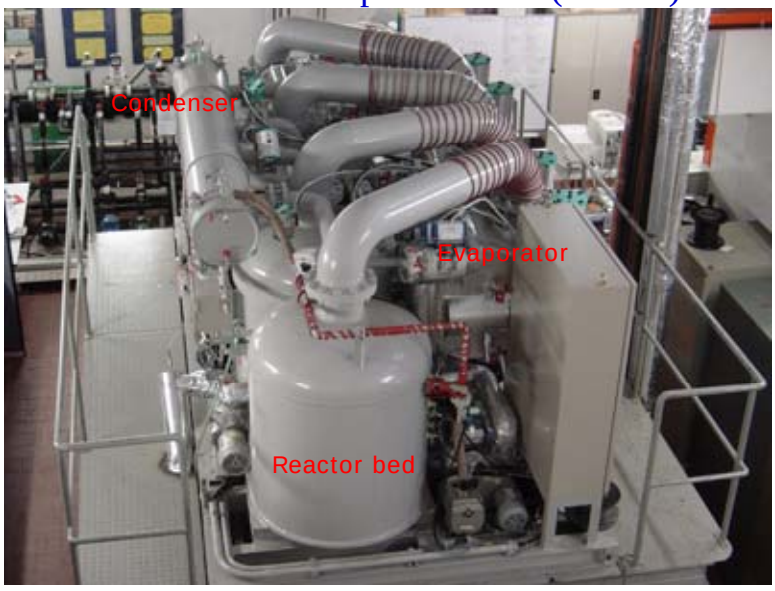
Four-bed adsorption chiller (5Rtons)



XL Wang, HT Chua, KC Ng, *International Journal of Refrigeration*, Vol. 28(5), pp:756, 2004.

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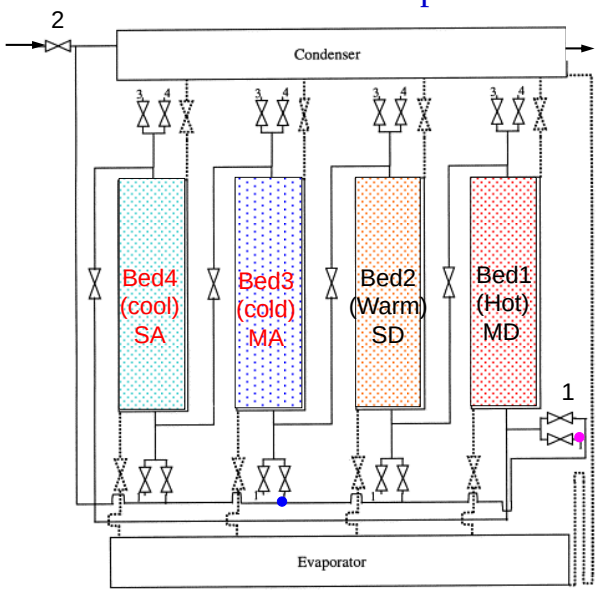
Schematic of four-bed adsorption chillers



X Wang, et al., *International Journal of Refrigeration*, Vol. 28(5), pp:756, 2004.

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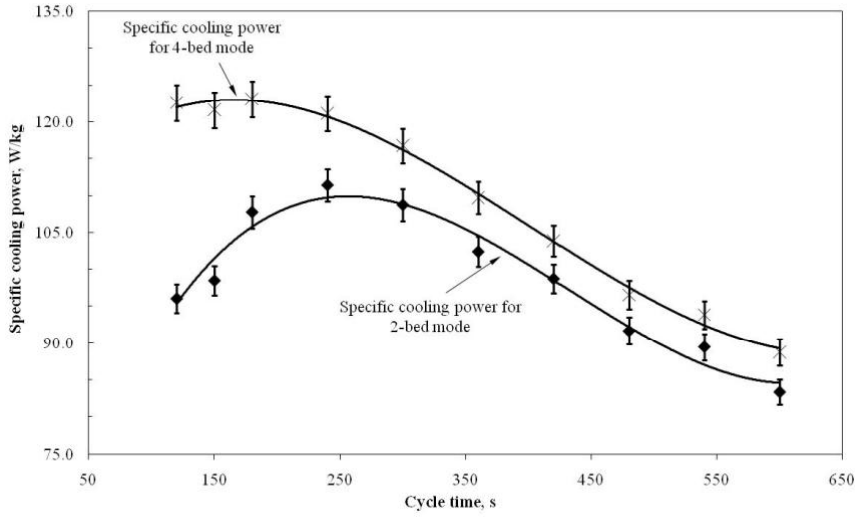
Performance comparison between 2-&4-bed adsorption chillers



X Wang, et al., *International Journal of Refrigeration*, Vol. 28(5), pp:756, 2004.

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Four-bed adsorption chiller (45 Rtons)

A new adsorption chiller process was developed recently and is going to be patented by UWA

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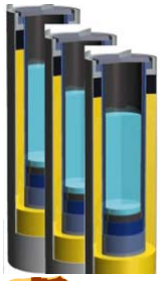
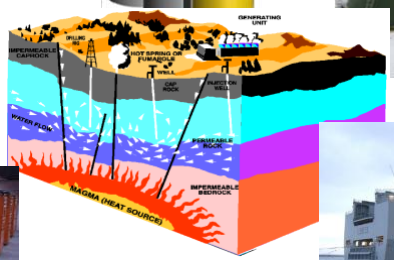
Applications

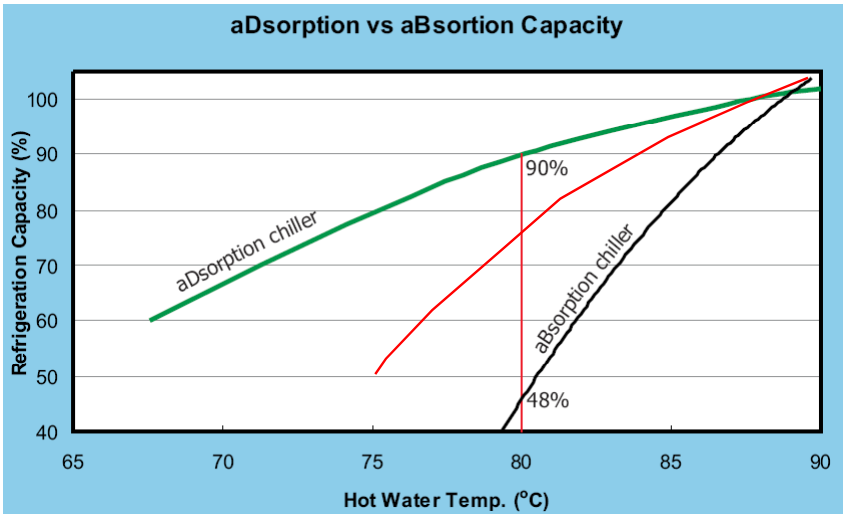




Comparison between Adsorption and Absorption chillers

Parameter	Adsorption chiller	Absorption chiller
Initial Investment Cost	Slightly High due to less production	Low
Size	Bulky	Compact
Working medium	Silica gel – water	LiBr – water
Thermal Energy	Temperature as low as 55°C	Temperature as low as 75°C
Cooling temperature	Any low temperature, fluctuation is not a problem	>22°C and must be stable
Corrosion	No	Yes (strong)
Crystallization	No	Yes
Operation cost	Low	High
Maintenance cost	Low	High
Performacne	For low temperature heat source, it is good	For high temperature heat source, it is good
Reliability	Robust	Not robust

Comparison between Adsorption and Absorption chillers



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Q&A ?