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Genset Heat Recovery Adsorption Chiller for Military Forward Operations Bases

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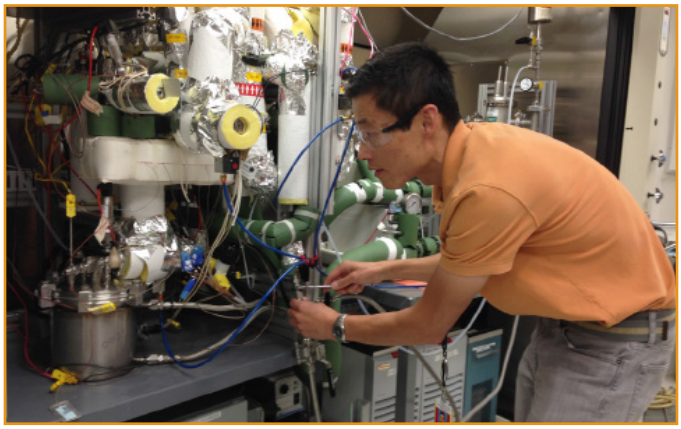
SUMMARY

Compared with operating conditions surrounding typical A/C systems in homes, the conditions on military forward operating bases (FOBs) can be harsh. High temperatures and limited electrical power and water supplies place heightened demands on cooling technologies.

To combat this problem, PNNL and collaborators are developing an adsorption chiller that will run off waste heat generated by portable power-generating equipment onsite.

The technology used in this project was initially developed under the ARPA-E BEETIT program. The goal of the program is to design, manufacture and test a ¾ ton adsorption chiller that is substantially smaller and lighter than traditional adsorption chillers, and that far exceeds the Navy's operating performance requirements for forward operations base deployments, all while meeting cost targets.



IMPACT

Typical adsorption chiller machines are big and heavy, with a low coefficient of performance (COP). For this project, PNNL replaced silica gel with advanced metal organic framework sorbent materials exhibiting super-hydrophilic properties, giving sorbent three times the capacity of silica gel and 20% faster adsorption kinetics. PNNL also incorporated a new multi-bed heat exchanger design in the adsorption chiller.

The changes made to the module and system design minimized the overall size and weight of the adsorption chiller, and provided rapid heat transfer and efficient internal heat recuperation. As a result, this project makes it possible provide cost-effective and efficient air conditioning to military FOBs through compact and lightweight equipment.

This approach is projected to reduce fuel use by up to 50%, and generate cost savings of up to $22 million per year at Navy FOBs.

INNOVATION

Metal Organic Framework (MOF) Sorbents

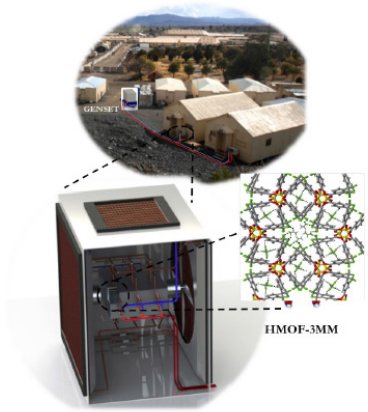
- Crystalline solids with self-assembled structural building units
- Contains a continuous porous network with tunable binding energy for gases and liquids
- New scalable MOF synthesis technology developed and licensed to InnaVenture LLC
- MOF sorbent charge for ¾ ton chiller completed using InnaVenture's implementation of continuous synthesis capability

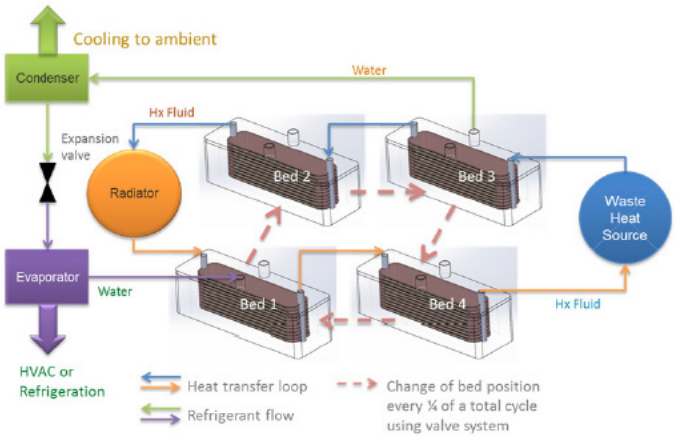
Advanced Design Concepts

- Working capacity of MOF sorbent is maximized through improved heat transfer in the adsorption modules
- Thermal swing performance is improved via microchannel heat exchanges
- Highly efficient internal heat recuperation is gained through novel adsorption module design

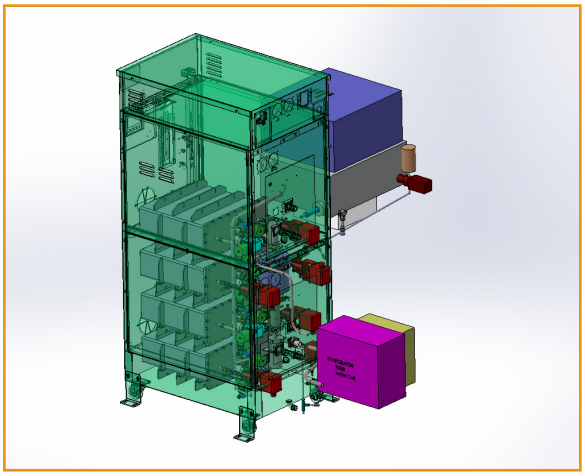
Demonstration System Development and Testing

- Custom designed evaporator provides efficient thin film boiling at low water vapor pressure
- Use of efficient cooling fans limits impact on overall COP
- Final assembly and testing of chiller performance being performed at B/E Aerospace chiller manufacturing facilities in Anaheim, CA





Schematic of MCA multi-bed adsorption chiller with heat recuperation



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