YAZAKI

YTC America Inc.

NON-CRYSTALIZING WORKING PAIRS FOR ABSORPTION CHILLERS

Extending the Working Range of Absorption Chillers

The working range of Lithium-Bromide (LiBr) based absorption chillers (such as a Yazaki Aroace) is restricted to generator temperatures of ≤80 °C due to the risk of LiBr crystallization in the absorber. In this operating regime LiBr absorption chillers require water cooling and the chilled water output temperature is limited to ≥7 °C. We are developing ionic liquid based working pairs to overcome the risk of crystallization, thereby extending the generator temperature to ≥90 °C, which is ideal for Combined Cooling Heating and Power (CCHP) applications and chilled water temperatures of ≤0 °C. Moreover, air-cooling is feasible.

Issues with traditional LiBr absorption chillers

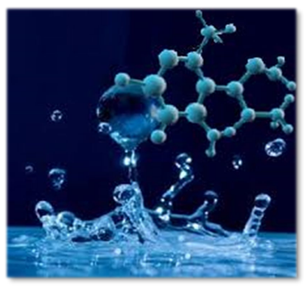
LiBr Absorption Chiller

Needs Water Cooling

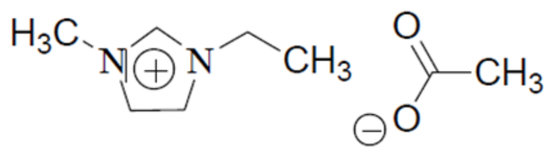
LiBr Corrosion

LiBr Crystallization

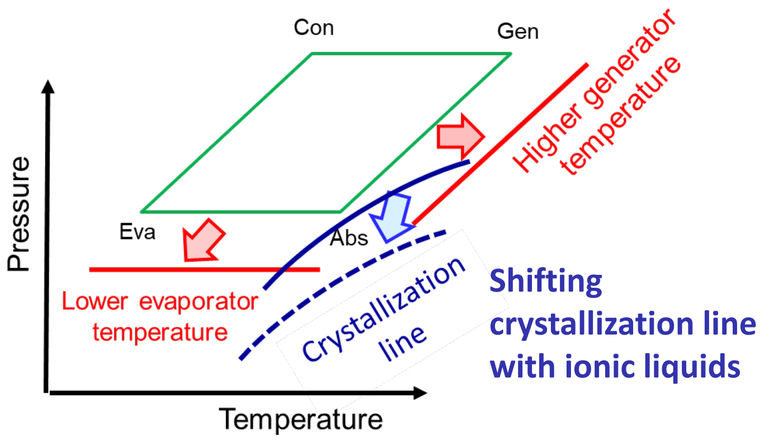
Ionic Liquids are liquid salts at room temperature and many have much lower crystallization temperatures than water



We identified the ionic liquid 1-Ethyl-3-Methylimidazolium acetate [EMIM][OAc] as a suitable absorbent

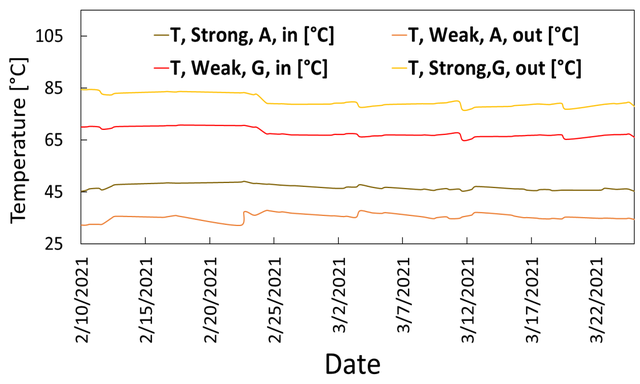


- Moderately low viscosity
- High hygroscopicity
- Commercial availability

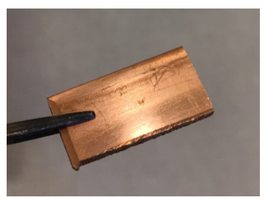


Shifting crystallization line with ionic liquids

Duhring Plot



Passed 1,000 hour stability test

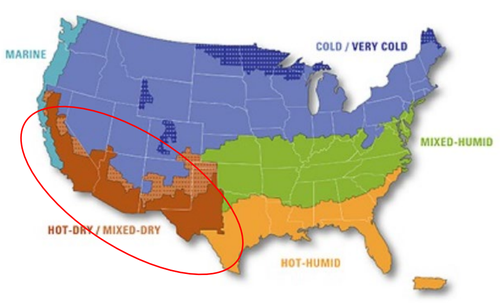


Non-Corrosive

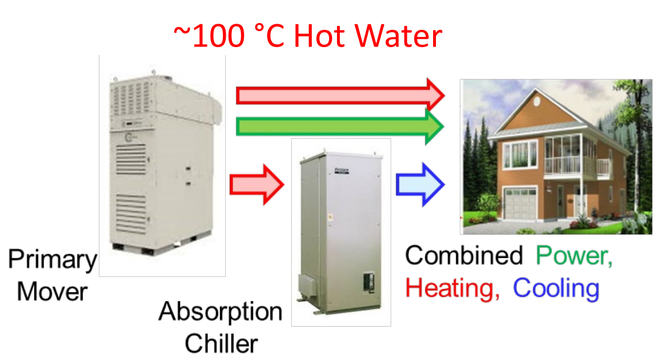
An absorption chiller test-rig was custom-designed and built to investigate novel working pairs

Opportunities

Refrigeration (-1 °C to 4 °C)



Air Cooling in hot dry climates



Combined Cooling, Heating, and Power

HIGHLIGHTS

- Avoidance of crystallization by use of ionic liquid based working pairs
- Identified [EMIM][OAc] as suitable ionic liquid absorbent
- [EMIM][OAc] is non-toxic, non-corrosive, and thermally stable at 100 °C
- Passed 1,000 hour stability test at generator temperature of 85 °C
- Generator temperature of ~95 °C can be achieved and is under investigation
- Ideal for CCHP applications using for example 105 °C hot water from a microturbine
- Air-cooling in hot, dry climates feasible
- Chilled water temperatures of -4 °C may be achievable enabling use for food refrigeration and becoming competitive with ammonia-chillers

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