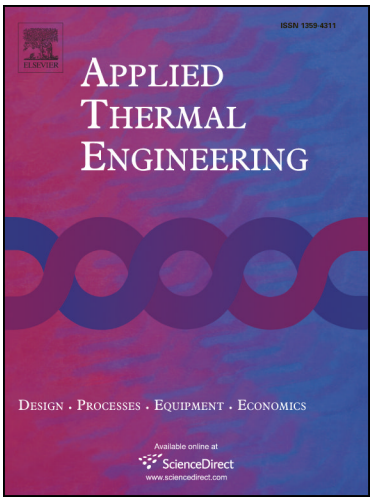

A novel chemical heat pump cycle for cooling and heating

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A novel chemical heat pump cycle for cooling and heating

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Abstract: The absorption heat pump cycle based on $LiBr/H_2O$ has shortcomings of easy crystallization, severe corrosion, and the limitation in the temperature rise. In this study, a novel chemical heat pump cycle is proposed to overcome these issues. The thermal performance of the chemical heat pump using $NaNO_3/H_2O$ is simply calculated for communication. The results show that the chemical heat pump can work at a lower generating temperature of 73.9 ^oC and avoid the crystallization issue when simultaneously supplying heating and cooling at 60 ^oC and 7 ^oC, respectively. Moreover, the annual corrosion rate of carbon steel in the $NaNO_3/H_2O$ strong solution is only 7.09 μm y^{-1} at 180 ^oC. The chemical heat pump has the advantages of lower generating temperature and corrosiveness, as well as larger temperature operating range and temperature rise in comparison to the absorption cycle using $LiBr/H_2O$ and other alternative working pairs. However, the chemical heat pump has a lower thermal performance, and the $COPc$, COP_h, and COP_o are 0.11, 1.11, and 1.22, respectively. In the future studies, it is expected that the chemical heat pump will achieve a much higher COP, after taking into account of a multiple-effect cycle, as well as a chemical refrigerant with a larger dissolution enthalpy and solubility slope.

Keywords: Chemical heat pump; chemical refrigerant; thermodynamic properties; thermal performance

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