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Performance evaluation of mechanical booster pump-assisted adsorption chiller cycle

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Large amounts of waste heat below 100°C from the industrial sector are released into the atmosphere. The development of new technologies aiming to reduce problems related to energy consumption has become urgent. Adsorption chiller, as one of the heat energy conversion apparatus, can use low-temperature heat source of 60°C-100°C to generate the desired cooling effect for reducing air-conditioning loads. However, the adsorption chiller cycle still has a few problems in practical use; by reason of the cooling power per unit volume of the adsorber and the COP are smaller than that of absorption chiller or vapor compression chiller. To solve the problems associated with the adsorption chiller cycle, we proposed a hybrid adsorption chiller which contained a mechanical booster pump (MBP) in the adsorption process or desorption process. The objective of this study is to investigate the possibility to apply an MBP–assisted adsorption chiller cycle to improve and generate cooling power at a wider operational temperature range, such as operation at a waste heat temperature below 60°C or a lower evaporating temperature. The MBP was set either between the evaporator and the adsorber to increase the vapor pressure in the adsorber or between the adsorber and the condenser to decrease the vapor pressure in the adsorber. The results indicate that the increase of adsorber vapor pressure in the adsorption process contributed to a higher equilibrium adsorbed amount, and the decrease of adsorber vapor pressure in the desorption process resulted in a lower equilibrium adsorbed amount. The cooling heat output and the amount of cooling heat were improved and increased with the input electrical power of MBP.

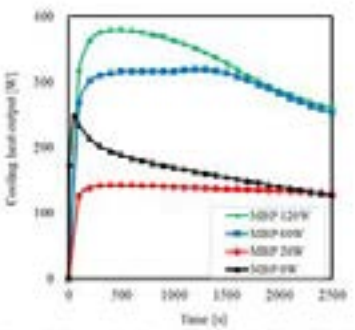

Figure 1. Time variation of cooling heat output for different MBP powers at 15 °C.

Recent Publications

1. Huang H et al. (2015) Performance analysis of a MCFC/MGT hybrid power system bi-fueled by city gas and biogas. Energies 8(6):5661-5677.
2. Li J et al. (2016) Modeling of ammonia combustion characteristics at preheating combustion: NO formation analysis. International Journal of Global Warming 10(1-3):230-241.

3. Zeng T et al. (2017) Evaluation of performance of thermal and electrical hybrid adsorption chiller cycles with mechanical booster pumps. Journal of Materials Science and Chemical Engineering 5:22-32.
4. Zeng T et al. (2017) Performance of an activated carbon-ammonia adsorption refrigeration system. Natural Resources 8:611-631.

Biography

Tao Zeng obtained his Master's Degree in Chemical Engineering, Nagoya University (Japan). He is currently pursuing PhD in Chemical Engineering at the same school. His research interests are mainly focused on the development of adsorption refrigeration systems. He has been a member of the Japan Society of Energy and Resources for the past two years.

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