Study of Metal-Organic Framework (MOF)/water pairs for adsorption heat transformer applications

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ABSTRACT

Metal-organic frameworks (MOFs), an advanced subset of porous coordination polymers, have emerged as innovative adsorbents, drawing the interest of researchers globally across a wide array of adsorption-related applications. An adsorption heat lifter or adsorption heat transformer (AdHT) plays a crucial role in elevating the temperature of a waste heat source. This is achieved by harnessing the adsorption enthalpy or isosteric heat of adsorption. The performance of the AdHT system, like all systems driven by the principle of adsorption, is influenced by the working pairs. This suggests a potential application for MOF/water working pairs in such a system. In this study, 2-Tank, 3-Tank, and 4-Tank systems are invoked to investigate and compare the coefficient of performances (COPs) of three MOFs: MOF–801, aluminum fumarate, and MIL–100(Fe) paired with water while considering an atmospheric temperature of 303.15K. With a waste heat source and cooling water temperature difference (T_D) of 70K in the 4-Tank system, MOF–801/water outperforms aluminum fumarate and MIL-100(Fe). Considering a temperature driving force that explains the temperature change of heat transfer fluid during the flowing procedure inside pipes, ΔT= 5K, the MOF–801/water pair can provide a gross temperature lift of around 30K at a relatively good COP of 0.5047. There are

very few articles that studied the MOFs/water pair for AdHT 2-Tank, 3-Tank, and 4-Tank system applications. Hence, the results of this study highlight their viability for designing environmentally friendly and energy-efficient heating systems.

Keywords: adsorption; aluminum fumarate; heat transformer; MIL-100 (Fe); MOF; MOF-801.