Effect of Solar Fraction on the Economic and Environmental Performance of Solar Air-Conditioning by Adsorption Chiller in a Tropical Region

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ABSTRACT
Solar air-conditioning (AC) is an attractive AC system but it has intermittent output, and therefore, a conventional heater is needed as a backup. This study presents the effect of ratio of heat delivered by solar (Q_{solar}) to the total heat delivered to an adsorption chiller ($Q_{solar} + Q_{heater}$) or solar fraction (SF) on the economic and environmental performance of a solar AC. This solar AC is not a solar-assisted AC, and therefore, it needs to fully cover the cooling load. The cooling demand of an office building in Kuala Lumpur, and the performance of flat-plate collectors and the adsorption chiller were calculated by EQUEST and WATSUN software and by a mathematical model, respectively. Economic performance was analyzed by life-cycle cost analysis, whereas the environmental performance was analyzed by using typical emissions rate of energy systems used. It was found that a boiler was a better solution than an electric heater as a backup heater. Furthermore, the net profit (NP) at lower SF was higher because of its lower capital investment, but more emissions were released compared to the conventional AC because of the boiler operation. Thus, when economic and environmental performance were fairly considered, it is appropriate to have solar AC with an SF around 0.74.

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