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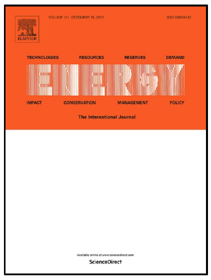

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Numerical investigation of a solar/waste energy driven sorption/desorption cycle employing a novel adsorbent bed

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Abstract: This paper presented a numerical investigation into a solar/waste energy driven sorption/desorption cycle employing a novel LiCl-Sillicon-Gels adsorbent bed. Several adsorbent materials available for air drying, e.g., silica gel, zeolites, silica gel haloid compound, consolidated composite desiccant, etc., were compared each other, leading to the selection of a most suitable desiccant material (i.e., LiCl-Sillicon-Gels), which has an adequate regeneration temperature of 80^{o}C and relatively higher moisture absorption capacity of 0.5 g/g. A dedicated adsorbent bed structure was devised to allow both solar radiation and warm air (generated from the waste heat) to pass through to vaporize the water reserved in the voids of the bed. The mass and energy conservation principles were applied to both air and adsorbent within the bed, leading to the development of a specialist mathematical model able to characterize and evaluate the performance of the sorption/desorption cycle. On this basis, the desorption process driven by both solar radiation and waste heat and associated sorption process were simulated side by side. The performance of the sorption/desorption cycle, represented by moisture extraction volume (D_{me}), moisture extraction/removal efficiencies (η_{me}/η_{mr}), and dehumidification coefficient of performance (DCOP), and their correlations with the major operational factors, e.g. swapping time of working mode, parametrical data of the process/regeneration air and solar radiation, were investigated and characterized. The results of the research indicated that the system can achieve a good performance (i.e., moisture extraction volume of 7 to 7.2g/kg, moisture extraction/removal efficiencies of 0.4 to 0.5 and 0.5 to 0.57, and DCOP of 0.35 to 0.37) under a typical wet climatic condition (i.e., 30-35^{o}C and 70 to 80% RH). Increasing solar radiation intensity to 1,800W/m^2 could lead to a significant rise in DCOP (from 1 to 5). Furthermore, the geometrical set-up of the