National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: DESIGN AND DEVELOPMENT OF NOVEL DESICCANT COATED FIN TUBE HEAT EXCHANGER FOR AIR CONDITIONING APPLICATION
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Venue	: ME Seminar Hall Room No.: 001 (Offline mode)
Date and Time	: 10 May 2024 (4:00 PM)

Abstract

: To improve indoor air quality, enhance the energy exchange capabilities, and minimize the spread of microbial pollutants, desiccant coated fin tube heat exchanger (DCFTHE) seems a promising alternative to conventional heat exchangers such as rotary wheel and adsorber beds. Thus, precise prediction of the design and performance characteristics of DCFTHE is vital for improving the overall air conditioning system performance. Therefore, two dynamic models based on the Laplace transform and finite difference approach (FDM) are developed to assess the adsorption/desorption kinetics and thermal effects of DCFTHE. The interactive effect of the Lewis number and Stanton number on the performance parameters has been examined judiciously. Three different AI/ML models namely adaptive neuro-fuzzy inference system (ANFIS), k-nearest neighbor (KNN), artificiaheural network (ANN), have been developed to predict the exit parameters of DCFTHE and a physics-informed neural network (PINNs) based deep learning model has been established by integrating the underlying physical laws with the neural network. A novel DCFTHE has been proposed, designed, and fabricated. Silica gel is used as a solid desiccant material. Experiments have been carried out to assess the coupled heat and mass transfer characteristics of the novel DCFTHE Phase change material (paraffin wax) has been integrated with the novel DCFTHE to evaluate its dehumidification characteristics and the performance for thermal energy storage in its latent and sensible form. Two case studies have been carried out: first, a dehumidifier is integrated with an M-cooler/solar heater to evaluate the cooling/drying performance during dehumidification. Second, a thermal energy module is integrated withan industrial waste heat-driven DCFTHE during the regeneration process to assess the performance potentiality and energy storage capability of five different PCMs, respectively. Silica gel&rsquos adsorption kinetics revealed that the maximum water uptake capability for the given operating range is 0.345 $g.g^{-1}$. The findings of the case study reveal that inlet cooling water temperature and inlet air temperature are the most significant parameters for the M-cooler and solar heater, which produce the lowest/largest temperature at the M-cooler/solar heater outlet, respectively. The effectiveness of thermal energy storage and the sensible energy efficacy ratio is maximum for Palmitic acid, with corresponding values of 0.73 and 5.489.