INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	**Ph.D.**

Thesis Title: **Performance Investigation and Optimization Studies on a Solar-Assisted Liquid Desiccant Air Conditioning System**

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Thesis Submitted to the Department/ Center	:	**School of Energy Science and Engineering**
Date of completion of Thesis Viva-Voce Exam	:	**11/08/2021**

Key words for description of Thesis Work	:	**Liquid desiccant mixture; Packed bed dehumidifier/ regenerator; Solar collector based desiccant regeneration; Heat and mass transfer; Artificial Intelligent Models; Multi-objective optimization; Novel desiccant doped hydrogel films**

SHORT ABSTRACT

Liquid desiccant dehumidification is a promising energy-extensive process for air dehumidification, which can easily be driven by any waste or renewable heat sources. In the current thesis, efforts are devoted to explore the thermo-kinetic properties of pure LiBr, $CaCl_2$ as well as their mixtures through numerous material characterization techniques. Further, a thermal model for assessing the heat and mass transfer characteristics of the liquid desiccant dehumidifier/regenerator is developed based on the finite difference method. In order to assess the performance of the overall liquid desiccant system using a novel desiccant mixture, an experimental setup of solar-assisted liquid desiccant dehumidification has been fabricated, where solar evacuated tube collectors were used as a regeneration source to drive the liquid desiccant system in a close-loop. The overall energy balance between the ambient air and the liquid desiccant was estimated. Effects of independent parameters such as the solution to air flow rate, solution concentration and temperature on the dehumidifier-regenerator performance parameters such as latent heat ratio, condensation rate, desiccant mass fraction index, evaporation rate and latent and enthalpy effectiveness were analyzed. The results obtained from the present investigation showed that high solution to airflow (L/G) ratio enhanced the dehumidification and low L/G ratio enhanced the liquid desiccant regeneration rate. For tested liquid desiccant dehumidifier, condensation rate and latent effectiveness lie in the range of 2.2 to 5.6 g/m^2-s and

36 to 68%, respectively. The evaporation rate, sensible and the latent effectiveness of the regenerator lies in the range of 0.1 – 11.2 g/m^2-s, 25.9 – 63% and 10 – 92% depending on the operating conditions. The maximum latent heat ratio for the dehumidifier at the design condition was 0.62, and the thermal coefficient of performance of the system was found as 1.1. Further, the relationships between the performance parameters and control variables is developed through the application of various well-known artificial intelligence (AI) based methods such as artificial neural network (ANN), adaptive neuro-fuzzy inference system (ANFIS), and gene expression program (GEP). Subsequently, best AI model (GEP) based fuzzy logic is developed for optimizing dehumidifier/regenerator inlet process parameters in terms of multi-responsive performance characteristics using genetic algorithm. At a near-optimum point, the experimental results condensation rate (CR) of 5.584 g/m^2-s, moisture effectiveness (ε_m) of 42% and latent heat ratio (LHR) of 0.83, respectively, were obtained. Lastly, an effort has been made to develop a novel liquid desiccant doped sodium carboxymethyl cellulose (NaCMC) films using citric acid as a crosslinker to explore the air dehumidification and regeneration capability of films.