# Low Carbon Cooling Solutions for the Apparel Industry: Open Cycle Desiccant Cooling Systems

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Use of mechanical ventilation and air conditioning is becoming more prevalent in commercial and industrial sectors due to warm and humid outdoor conditions in most parts of the country. Such change in the use of energy for comfort is further supported by the requirements for clean air in working environments specified in relevant health and safety regulations. The common practice in maintaining required relatively comfortable indoor conditions is to use mechanical ventilation plus conditioning of air using conventional vapour compression refrigeration. Undesirable aspects of this technology are the use of environmentally harmful refrigerants and use of electricity that in many cases add a substantial running electricity bill. A more sustainable and low carbon alternative to vapour compression refrigeration based air conditioning would be to consider technologies that incorporate natural phenomena of cooling that use low-grade energy from industries or any other renewable source. Here, an evaporation and regeneration-based desiccant cooling system provide a satisfactory alternative for applications where indoor conditions are not very closely controlled.

This paper presents a study of a desiccant cooling system. The analysis is based on a software tool; TRNSYS, which enables detailed modelling of the heat and mass transfer process in a desiccant system, particularly the regeneration process and heat/ mass transfer process in desiccant wheel. The performance of a cooling solution is parametrically studied, where the regeneration energy to drive the cooling cycle is determined by examining the humidity ratio and temperature profiles for a year on an hourly basis. The results of the simulations, at different conditions, in an air dehumidifier, are used to propose an optimum coefficient of performance (COP) of the cooling system for a selected case study.

Comfort indoor conditions specified in ASHRAE standards, i.e., of 25°C dry bulb temperature and 50% relative humidity were considered in the simulations as the desired indoor conditions. The results indicate that hot water storage at 100°C via a heat exchanger can produce the thermal energy required to heat up the return air at 70°C to regenerate the desiccant. The ventilation air flow rate is maintained at 20,000 kg/hr while the hot water flow rate required to produce the necessary energy of 250 kW is 1.2 kg/s. The cooling load met by the system is 120 kW and the calculated coefficient of performance of the desiccant cooling system is 0.48, which saves up to 40% in current electrical energy use of the application concerned.

This study makes it clear that use of low grade heat or renewable sources to drive the thermally activated component of a desiccant system have a number of benefits including reduction of peak demand and less energy consumption; i.e., a low carbon footprints. This work shows that a desiccant cooling concept could maintain satisfactory indoor conditions at a lower energy consumption level and presents a sustainable alternative to supplement industrial space cooling demands.