# ABSTRACT

It is envisaged that the compressor driven solid sorption cooling would be a potential choice in future. Its unique capability of handling high vapour pressure fluids associated with high heat of adsorption (or desorption) makes this cooling technique effective over a wide temperature range between cryogenic to ambient temperatures. However, compressor driven sorption cooling process is intermittent in nature. Intermittency can be avoided using multiple adsorbent beds. Consequently, the operational hazards of connecting the bed alternatively to heat sink and heat source are inevitable.

In a recently proposed 'compressor driven solid sorption' process, rapid pressurisation and depressurisation has been found creating differential temperature across the length of the tube. Being able to generate temperature gradient across the tube, one can connect the two ends of the bed to heat sink and heat source permanently. It enables obtaining continuous sorption cooling in a single adsorbent column with substantial reduction in the operational complexity. A systematic investigation of this newly proposed alternative sorption cooling process has been presented in this dissertation.

Solid sorption cooling process has been found depending on multiple parameters. Experimental studies have been planned to understand the dependence of sorption cooling on some of those variables. The list includes operating pressure, orifice opening, adsorption desorption cycle time and different length to diameter ratio. Realising that the experimental investigations involving all parameters would become cost prohibitive and time intensive, development of theoretical modelling involving transient heat and mass transfer equations along with appropriate boundary conditions has also been carried out simultaneously. An essential prerequisite towards that the theoretical development is the reliable equilibrium adsorption capacity data for the adsorbent-adsorbate pair used. Isotherms have been measured experimentally using volumetric capacity measurement technique.

Theoretical models have been validated using the experimental data. Successful development of theoretical models is followed by the theoretical parametric variations in the form of sensitivity analysis. The effects of several thermo-physical parameters, operating variables and geometrical dimensions have been examined. Finally, the cooling performance has been evaluated theoretically. Prior to that, the energy distribution among the various elements such as adsorbent, tube wall etc has also been estimated.