

CHAPTER 1
INTRODUCTION

In a Country like India where about 80% of the population live in rural areas, primary medical facilities to all is very essential for the well being of its people and for the development of the Country as a whole. The Government is taking all possible steps to provide basic medical facilities in the rural areas primarily to the infants and mothers. One of the still unresolved bottle necks hampering the progress is the non availability of refrigeration system to store medicines in the Primary Health Centers that do not have reliable electric supply. As most of India experience good sunshine most part of the year, a solar energy based refrigerator is an appropriate option for storing vaccines. Hence the development of a reliable, efficient, maintenance free and above all economical refrigeration system is of paramount importance to India and also to many of the other developing countries.

This thesis deals with the attempt made to develop such a refrigerator working on the Solid Adsorption principle. In order to assess the stability, reliability and life of the solid adsorbent used in the work which is a synthetic zeolite called Molecular Sieve 13X, the Thermoluminescence (TL) characteristic has been utilized as the tool for the first time. The TL properties of the adsorbent has given a clear indication as to the stability of the material at the operating temperatures and also clearly indicated the operating conditions beyond which

irreversible damage could take place. In a solid adsorption based refrigerator the maximum operating temperature experienced by the adsorbent will be below 200 degree C and the TL study on Molecular Sieve 13X has indicated that upto 800 degree C it remains stable, which, beyond any doubt, demonstrate the suitability of the selected adsorbent for the particular application.

Molecular Sieve 13X is an indigenously manufactured solid adsorbent having applications in petro chemical industries and the industry sources indicate it's life to be about 20 years. The refrigerator developed in this work operates solely on solar thermal energy and works on intermittent cycles. Water is used in the system as the refrigerant and evaporation of water during adsorption cycle (night cycle) produces cooling. During the day, the solar energy is utilized by the system to regenerate the adsorbent so that adsorption cycle can take place in the subsequent night time.

The harmful nature of the refrigerant gases used in conventional Vapour Compression Cooling devices is well documented. The refrigerant gases called Chloro Fluoro Carbons (CFCs) have been proven to cause thinning of the protective ozone layer surrounding the earth leading to the entry of harmful Ultra Violet radiation and also leads to global warming. The refrigerator developed in this study is a CFC free device confirming to the Montreal Protocol. As a signatory of the Protocol, India has agreed to phase out CFC production and use by

the 1st of January 1999. The solar refrigerator developed under this study can be further engineered to become a commercial product suitable for applications in rural areas.

The thesis is divided into eight chapters as follows :

Chapter 1 gives a general introduction.

Chapter 2 deals with the basic properties and applications of thermoluminescence.

Chapter 3 covers in brief, solar radiation, its measurement and collection devices.

Chapter 4 covers relevant aspects of natural and synthetic zeolites.

Chapter 5 outlines the various methods of using solar energy to obtain refrigeration.

Chapter 6 explains the TL studies and their results and also the laboratory level experiments to obtain design data.

Chapter 7 gives the details of the development of the first prototype of the solar refrigerator, and also the engineered model. The performance data is also given.

Chapter 8 gives the conclusions that emerged from the study.