CHAPTER I

INTRODUCTION

1.1 Sun - as Alternate Energy Source

The need to supplement conventional sources of energy with alternative sources becomes imperative at this juncture when the problem of energy poses challenge to mankind. Alternative energy sources have to be thought of to meet the growing energy demands. The supply of the conventional fuels is becoming uncertain due to the hike in price as well as threat of depletion of oil resources. The developing countries are the hardest hit under the above conditions. In rural areas, the availability of commercial fuels is much more limited and the increase in energy demand has resulted in rapid degradation and depletion of natural resources. It has been estimated that only 15 per cent of the total energy is contributed from the renewable sources of energy. The burning problem of energy has hence to be solved by utilising to the maximum possible extent, all the other renewable sources of energy which are the offspings of the parent source the 'Solar Energy'. The energy from the sun is inexhaustive. At the outer atmosphere, it has been estimated that 48×10^{17} KJ (122) of energy is available. This quantum of energy is only a fraction (4.5×10^{-10}) (71) of the energy intercepted by earth, out of the emitted radiation from the sun. The major contribution of energy is in the spectral range of 0.3 to 3 μm (28) which covers 97 per cent (28) of the energy incident from the sun.

Efficient utilisation of this unending energy source will certainly make a break through significantly in various applications of the energy demand. Solar energy is being used from dates-back in different applications like sun drying of agricultural products, fruits and vegetable dehydration, space heating and cooling, desalination etc.

1.2 Potential Use of Solar Energy in India

Tropical countries have the great potential to harness the free source of energy which is clean and decentralised. On an average 500 Cal/cm^2/day of energy is available in latitudes between 15° and 35°N or S with minimum 3000 hours of sun shine. Between 15° and 15°N or S latitudes minimum of 300 to 500 Cal/cm^2/day of energy is available with 2500 hours of sun-shine. The geographical location of the Indian subcontinent which extends between 8°N and 38°N can clearly harness the maximum available energy.

1.3 Energy Consumption for Drying Crops

Many systems have so far been developed for drying paddy but most of them are suitable for commercial application at large scales. There is a need for developing a process suitable for farmers of small holdings. The system has to be less expensive and adaptable to village level. A drying system has been designed to meet the needs of the farming community, which is the out-come of the research work at the Post Harvest Technology Centre, Indian Institute of Technology, Kharagpur. Production of paddy touching 138 million tonnes in 1980-81, needs 30×10^{12} KJ of energy for drying as a raw paddy and 90×10^{12} KJ for drying as parboiled paddy. Utilisation of solar energy for drying in some mechanical drying system will be the best alternative to adapt. The drying rate can be increased if the drying air temperature is raised by 5 to 10°C. The present work is aimed to study the possibility of utilising the energy from the sun through a combination of a high temperature flat plate collector and a packed bed storage collector for drying the paddy crops.

1.4 Importance of the Drying System

Drying of crops becomes inevitable in order to bring down the moisture content to safe storage level.

Paddy in particular which is the staple food crop of the Indians is highly susceptable to fungus and mould growth. The losses during the transportation are reduced by harvesting the crop at high moisture content. This prevents the shattering losses during harvest and transport. The recommended percentage of moisture at the time of harvest is 24 per cent (wet basis). Hence the need for drying. The proposed integrated solar drying system has the following practical importance for the farming community.

1. The drying system can be fabricated with the locally available materials.
2. The cost of drying is less as compared to mechanical dryers.
3. The batch dryer can be used as storage bin when the system is not in use.
4. The system appears to be economical due to low operating cost, as the energy is available free of cost from the sun.

1.5 Objectives

Finally the work was initiated with the following major objectives :

1. Development of a suitable selective surface on galvanized iron sheet by chemical or electro-deposition process;

2. Comparing the performance of the selective surfaces under simulated condition - indoor and in actual field condition - out door. The change in surface behaviour will be predicted through accelerated tests;

3. Characterisation of the surfaces by scanning electron microscope (SEM) and X-ray diffraction studies;

4. Development of a system with a combination of the best selective flat plate collector and a packed bed storage collector for drying a batch of 100 Kg high moisture paddy, without sacrificing the milling qualities;

5. Predicting a model to optimise the dimensions of the packed bed for different cover systems;

6. Suggesting an economical design for 1 tonne/day capacity of the solar drying system.