

Design, manufacturing and evaluation of a solar heating system with Fresnel concentrator for greenhouse

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Abstract

Energy consumption is very high in greenhouses mainly due to off-season production. The main source of its energy supply is fossil fuels. Due to the disadvantages of fossil fuels consumption and preventive laws in the incoming years, study on reducing consumption and replacing a part of them with renewable energy is essential. In this research, a solar heating system, equipped with a concentrator and Fresnel lens, adjustable to all regions in Iran, was designed and manufactured in Faculty of Agriculture, Tarbiat Modares University. Thermal heating requirement of a cucumber greenhouse was calculated and then solar heating system and thermal storage system were designed and manufactured. For more energy saving, besides insulation of the reservoir tank with an elastomeric layer, copper tubes and paraffin was used. Then, behavior of the system was evaluated under three thermal conditions of 35, 50 and 65°C. The results of variations of water temperature in the tank showed that mean descending rate of temperature, with a higher initial temperature, has been faster in the tank as compared to the tank with lower initial temperature. But, with proper volume and insulation and use of phase-change materials, particularly in the melting point range of paraffin, temperature in the tank remains constant and the cooling process is slower. Therefore solar heating system and thermal tank with suitable volume and insulation can be used for heating the greenhouses.

Keywords: Solar energy, Heat-saving system, Phase-changing materials.

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