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New Insulation Material for Solar Thermal Collectors

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Abstract : 1973 energy crisis (rising oil prices) pushed the world to consider other alternative energy resources to existing conventional energies consisting predominantly of hydrocarbons. Renewable energies such as solar, the wind and geothermal have received renewed interest, especially to preserve nature (the low-temperature rise of global environmental problems). Solar energy as an available, cheap and environmental friendly alternative source has various applications such as heating, cooling, drying, power generation, etc. In short, there is no life on earth without this enormous nuclear reactor, called the sun. Among available solar collector designs, flat plate collector (FPC) is low-temperature applications (heating water, space heating, etc.) due to its simple design and ease of manufacturing. Flat plate collectors are permanently fixed in position and do not track the sun (non-concentrating collectors). They operate by converting solar radiation into heat and transferring that heat to a working fluid (usually air, water, water plus antifreeze additive) flowing through them. An FPC generally consists of the main following components: glazing, absorber plate of high absorptivity, fluid tubes welded to or can be an integral part of the absorber plate, insulation and container or casing of the above-mentioned components. Insulation is of prime importance in thermal applications. There are three main families of insulation: mineral insulation; vegetal insulation and synthetic organic insulation. The old houses of the inhabitants of North Africa were built of brick made of composite material that is clay and straw. These homes are characterized by their thermal comfort; i.e. the air inside these houses is cool in summer and warm in winter. So, the material composed from clay and straw act as a thermal insulation. In this research document, the polystyrene used as insulation in the ET200 flat plate solar collector is replaced by the cheapest natural material which is clay and straw. Trials were carried out on a solar energy demonstration system (ET 200). This system contains a solar collector, water storage tank, a high power lamp simulating solar energy and a control and command cabinet. In the experimental device, the polystyrene is placed under the absorber plate and in the edges of the casing containing the components of the solar collector. In this work, we have replaced the polystyrene of the edges by the composite material. The use of the clay and straw as insulation instead of the polystyrene increases temperature difference (T2-T1) between the inlet and the outlet of the absorber by 0.9°C; thus increases the useful power transmitted to water in the solar collector. Tank Water is well heated when using the clay and straw as insulation. However, it is less heated when using the polystyrene as insulation. Clay and straw material improves also the performance of the solar collector by 5.77%. Thus, it is recommended to use this cheapest non-polluting material instead of synthetic insulation to improve the performance of the solar collector.

Keywords : clay, insulation material, polystyrene, solar collector, straw
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