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"CFD ANALYSIS ON SOLAR POND USING PCM MATERIAL"

Mehboob Alam [1]***, Rajneesh Kumar Gedam*** [2]

[1] M. Tech Scholar, Department of Mechanical Engineering, BERI Bhopal, M.P, India

[2] Assistant Professor, Department of Mechanical Engineering, BERI Bhopal, M.P, India

ABSTRACT

A solar pond is a pool of saltwater which collects and stores solar thermal energy. The saltwater naturally forms a vertical salinity gradient also known as a "halocline", in which low-salinity water floats on top of high-salinity water. The layers of salt solutions increase in concentration (and therefore density) with depth. Below a certain depth, the solution has a uniformly high salt concentration. In this paper pcm and without pcm material testing has done by CFD analysis so its clear that more temperature seen when used pcm materials.

Keyword*: Solar pond, energy, salt water,CFD, pcm*

I. INTRODUCTION

Heat may be used in a variety of contexts and result in significant savings in terms of fossil fuel consumption. Various chemical, culinary, and textile goods can be manufactured with the use of the pond's extracted heat. In addition to heating greenhouses and swimming pools, the pond's heat may be utilised to warm cattle barns. The organic Rankine cycle engine, which uses the heat to generate electricity, is a cost-effective and efficient way to transform solar energy into usable forms in rural areas. Through desalination, the solar pond can clean water for municipal systems, and it can also be used to dispose of brine left over from the offshore drilling process to obtain crude oil.

SOLAR POND

Individuals may also use a solar pond as a collector if you don't need really high temperatures for your project. Applications in industry and agriculture at low temperatures, as well as heat and energy generation, water desalination, and more, are all possible with this versatile resource.

It takes use of an elementary phenomena to function. Hot water causes the lake or pond's surface to rise. Salt is put to a solar pond to act as a thermal mass, with the concentration of the salt increasing with depth. Due of its density, it remains on the ground, preventing the sun's warmth from escaping into the atmosphere. When the sun hits the water, the temperature can reach over 90 °C, but the surface of the pond is often only around 30 °C.

There are three distinct layers of water in the pond:

- The upper layer, also known as the surface, or UCZ (Upper Convective Zone), is the warmest part of the atmosphere. It has barely any salt.
- The hot zone, or lower convective zone (LCZ), is located at the bottom of the water column (Lower Convective Zone). 70–85 ° C. The salt content is rather high. The power it provides comes mostly from the heat it produces.
- The separation zone is referred to as the "NCZ" (Non-Convective Zone). As one delves deeper into this

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region, the concentration of salt increases. Since the water above a certain layer is less dense due to its reduced salt content, that water cannot rise into the lower layer. Sunlight is trapped by the salt gradient, which also functions as an insulator.

The acquired energy is of a somewhat low quality and can only produce temperatures of around 70–80 °C. Larger systems, on the other hand, may be constructed for far less money by utilising a membrane to cover the pond. While these solar ponds might be built anywhere, but are also most effective when situated near the ocean.

How they work

Solar pond containment entails making choices between several approaches for the pond's placement, excavation, liner, insulation, and overall shape. When choosing a location, it's crucial to take into account the local geology, especially in regards to avoiding any potential subterranean aquifers. The pond is typically surrounded by a 3 or 4 m deep excavation. Building a wall of soil around the pond can reduce the need for extensive digging. The pond's leaky sides might waste a lot of salt solution and wasted energy. These consequences can be particularly severe in the event of porous soil, thus caution should be exercised while lining the bottom and sides. It is possible to employ synthetic materials such as butynol, nylex solid vinyl, ethylene propylene diene monomer, and ethylene propylene diene monomer as a membrane liner. The soil can be treated to make it impervious to hot brine solution as an alternative to using a liner. It is common practise to bury low-cost liners behind a compacted layer of soil.

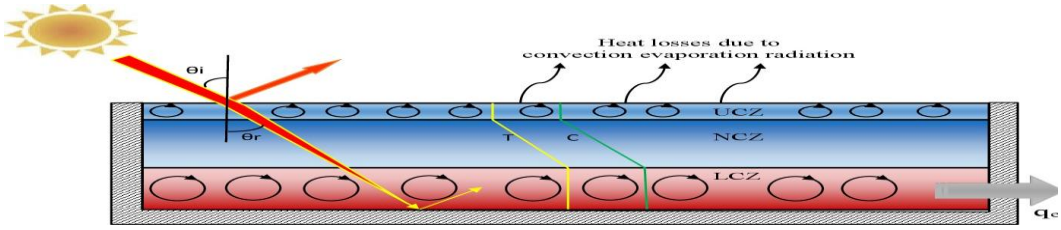

Fig. 1 Diagram of a solar pond showing the temperature and saline gradient

II. RESULTS

Modeling Solar pond

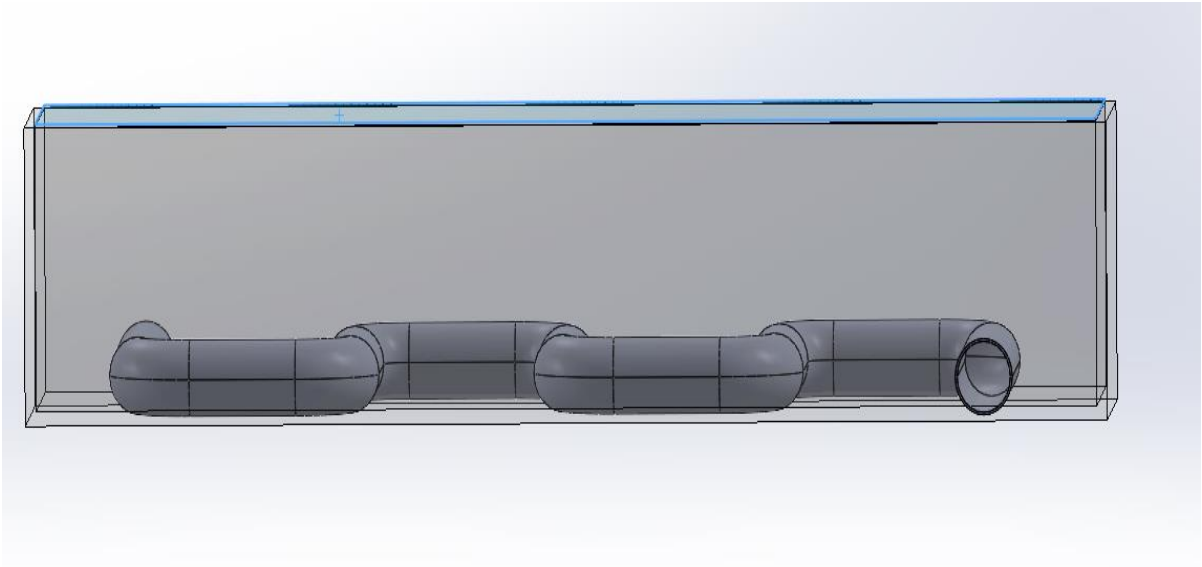

Fig.2 Front view of solar pond

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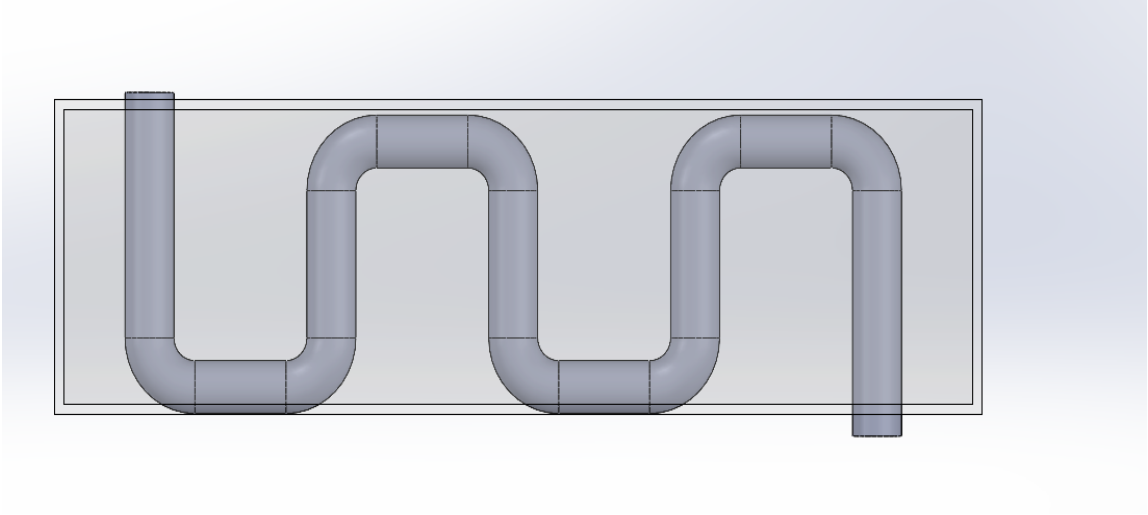

Fig.3 Top view of Solar pond

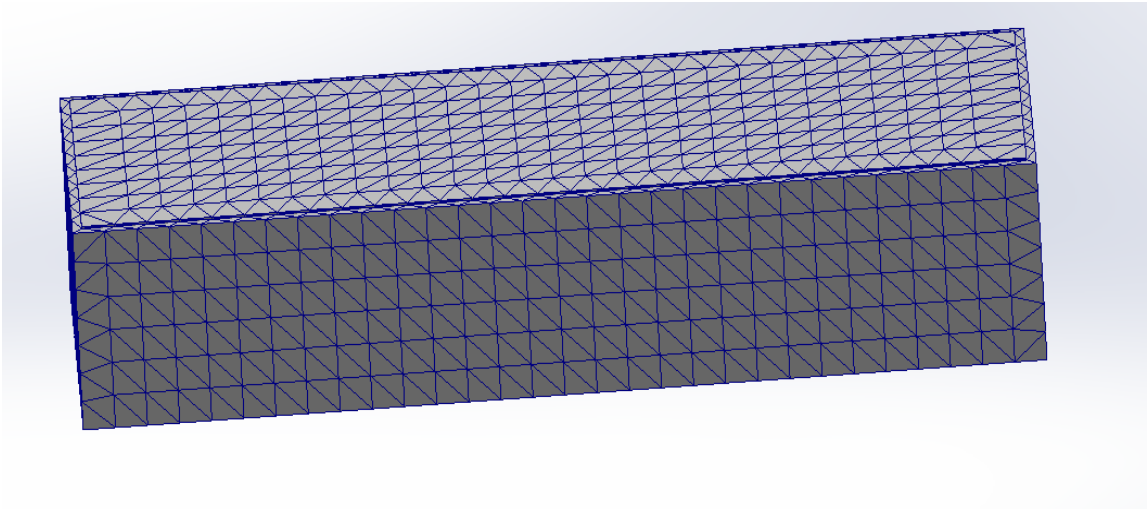

Fig.4 Meshing creating of solar pond

Simulation Solar pond

With PCM

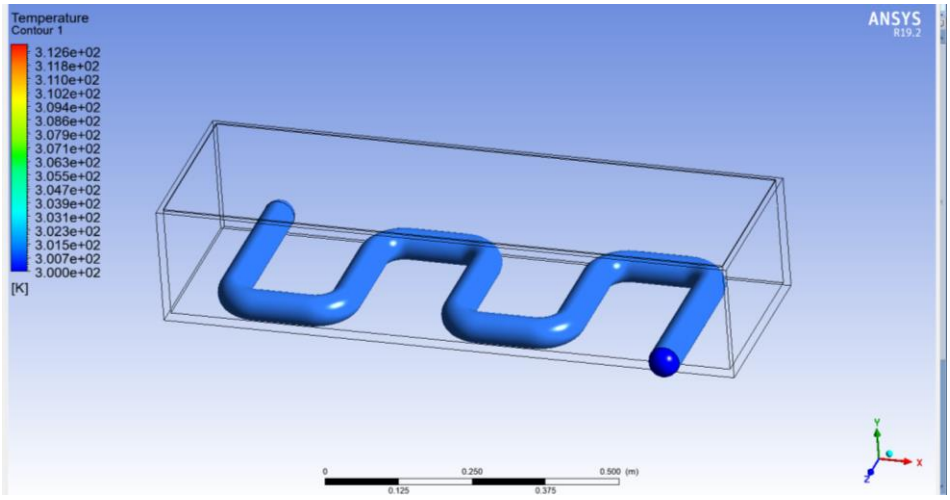

Fig.5 Total temperature of the water pond without PCM max temperature 312.6 K

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Without PCM

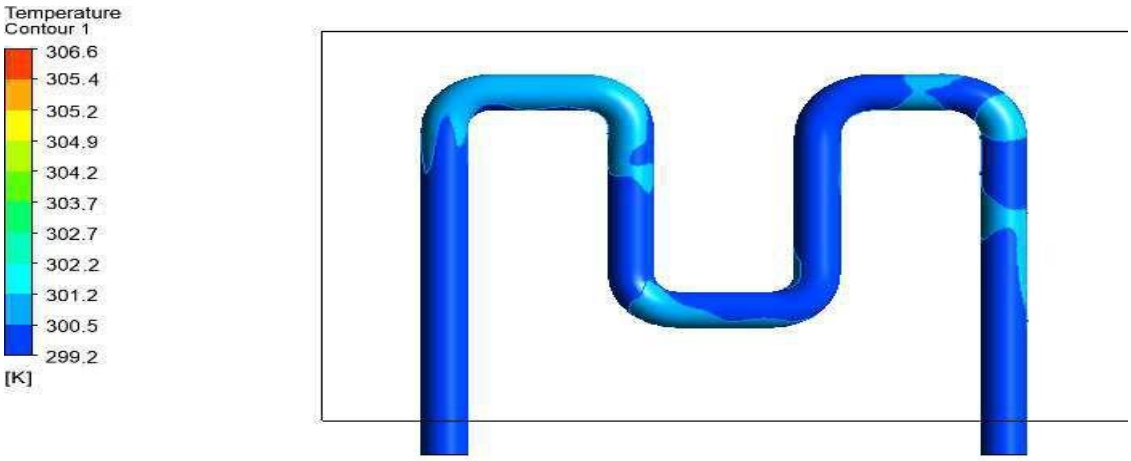

Fig. 6 Total temperature of the water pond without with PCM max temperature 306.6K

III. CONCLUSIONS

When sunlight heats a pond, the lowest layer absorbs the heat and stores it until needed. We may discover the following gaps in the existing body of research as a result of this analysis of the existing literature. Two of the primary objectives of the study—designing a solar pond with three levels and examining how high-conductivity materials alter the heat-transfer properties of pure PCM—were met. Latent heat thermal energy storage was the preferred method due to its high energy storage density and reliable temperature storage up to the phase transition temperature of PCM.

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