# *Review of Metal Foam Effect on Solar Parabolic Trough Collector*

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***Abstract***

*Today's world is trying to find more efficient energy storage systems for unconventional energy sources like wind energy, solar energy, etc. Porous materials which pursue increment in surface area also one of the solutions for the storage of energy received from unconventional energy sources. In solar parabolic trough collector, hollow pipe of aluminum or copper material is used as absorber which is generally used to receive the reflected rays of sun. The pipe is covered with evacuated tubes for the better absorption as well as to reduce convection. The heat is then transfer to liquid passing through that for the increase in temperature. In place of the hollow pipe absorber, porous material can be utilized which increases the heat transfer rate due to increment in surface area as well as decrement in velocity. In this review article, literature has been discussed for such absorber made of copper or aluminum metal foam which increases the efficiency of the solar parabolic trough collector.*

***Keywords: -*** *Solar Parabolic trough collector, Metal foam, Thermal efficiency, Energy storage;*

## INTRODUCTION

Now a day's energy production and conservation is the biggest challenge. By considering the pollution and pollution control laws production of energy was the biggest challenge. Unconventional energy is the best options to produce energy and is rapidly growing nowadays. As it is been used worldwide so the efficiency and development work on this energy production techniques are been practiced. As development of apparatus for unconventional energy production needs to be rapidly developed. Solar, tidal, wind, etc are the unconventional energy sources which are been targeted to produce energy without effecting environment and surrounding. By looking at the large amount of energy requirement for the country like India, the energy required should be rapidly growing. Solar energy is said to be the most reliable renewable energy. This energy do not produce any dangerous or hazardous effect on environment. This energy is the source to fulfill the need of mankind without affecting surrounding. Greenhouse effect and ozone layer depletion can be minimized by using solar

technology. As the source of this energy is sun there will be no scarcity of the source of production. Many solar apparatus are been invented and are been used globally. Apparatus like solar panel, solar disc, solar tower, solar engine, solar parabolic trough collector, etc are already in use and number of research and development works are been carried out on it to develop this method of energy production. In this review article solar parabolic trough collector is targeted for its development. As we all know about the solar parabolic trough collector. It is a device used to convert steam energy produced by heating water using solar reflector into electricity. A parabolic frame is been made and a sheet of aluminum is been placed on the frame and a pipe is been fitted at the center of the frame in such a way that the solar rays get reflected from the aluminum sheet and hits the pipe by this the water flowing in the pipe will be heated and steam will be produce.

Metal foam is the new technology which ensures the same property of material, same dimension by using less volume of material. So even after getting the same property we can reduce the use ofraw material. And due to porosity the material will be having increment in some of the mechanical and thermal properties like strength and low thermal conductivity. Due to which if modification is being made in solar parabolic trough collector by replacing metal foam it will result in increase in efficiency. Metal foam will take more time in passing water throughout which will result in more contact time and will heat more amount of water. And by this we can boost the efficiency of Solar Parabolic Trough Collector.

**LITERATURE REVIEW**

S S Sharma et al. [1] The experiment was performed in house facility to produce the aluminum metallic foam .By using blowing agent as the medium of making voids (pores) in aluminum. Pit furnace was used to melt aluminum at 700C. Stirring mechanism was used to mix blowing agent and aluminum properly. By using Blowing agent technique aluminum foam can be developed. But more efforts and research is needed. Better manufacturing techniques to be find out. Porosity resulted was 55% and volume of solid aluminum was 45%.

Mr. Mahadev et al. [2], Aluminum metal foam is having wide applications and use due to its light weight construction. There are number of metal foam manufacturing methods and techniques but still metal foam foam is having the deficiencies and non uniformity. Different manufacturing techniques have their own advantage and disadvantage. According to application manufacturing process is being selected.

Milad Tajik Jamal-Abad et al. [3] They experimented on the efficiency of a solar parabolic trough collector. They filled an absorber with copper foam for to improve the heat transfer and efficiency. It also observed that by increasing the mass flow rate, the efficiency of the collector is increased. When absorber filled with metal foam the overall loss coefficient is decreased results in the efficiency is increased.

Mohammed A. Nina et al. [4] Copper foam is used to check thermal energy (heat) transfer characteristics. When foam blocks are inserted in solar plates the flow rate efficiency is been effected. Meanwhile the heating efficiency is boosted. They conducted an experiment to find the

effect of adding metal foam blocks into solar water collector risers. They have inserted copper foam blocks inside the risers and observed that the thermal efficiency and thermal power could be increased especially for lower water mass flow rate and high solar intensity radiation. That mainly occurred due to reduction in mean absorber plate temperature around 8.2°C.

M. W. Kareem et al. [5] they investigated on an enhanced forced convective MPSAHC system aided with granite pebble bed. They have eliminated the transport pipe which used for movement of heated air around the system. They have achieved a maximum thermal collector efficiency of 72.59%, daily average collector efficiency of 36.38%, and energy efficiency 83% and 67% when they applied 0.0169kg /s mass flow rate of air. In the porous media the sensible energy storage is observed so that the thermal delivery of the system is also increased.

H. Javaniyan Jouybari et al. [6] Flat plate solar collector (FPSC) is been fully filled with porous material. And other is filled with Nano particles. The analysis shows that the efficiency of Nano particles is more than porous material. They investigated the thermal performance of a nano fluid which was flow through a flat plate solar collector with the metal foam filled with channel. For higher heat transfer and pressure drop into condensation they have used evaluation criterion for nano fluid and porous media. It is also found that the effect of the nano fluid concentration was greater than the flow rate on the collector efficiency and also observed that the efficiency is decreased with diminishing the nano particle sizing.

Francisco Garcia-Moreno et al. [7] Now adays metal foam technology is finding its place in market. The number and volume of its application is rapidly growing. Research and development in the field of homogeneity and development of new alloys are been targeted. The superior industries like aeronautics, aerospace, automobile, weapon and armor industries have been working on the development of this metal foam.

A.O.Dissa et al. [8] they designed and experimented a solar collector with a composite absorber. They simulated the collector temperature in unsteady state according to both time of the day and position of the collector. Unsteady state simulation curves are found to be closer to the experimental and proved that the modal of simulation made it possible to suitably predict the collector temperature. They observed that the temperature of glass cover, non porous absorber, porous absorber and air stream are increased so that the collector could be used for agricultural application to ensure the drying of the agricultural products.

Po-Chuan Huang et al. [9] By placing metal foam blocks at the inner wall of absorber and subject to pulsating is an effective method for enhancing heat transfer.

Zhenqian Chen et al. [10] they analysed the process of melting of paraffin with aluminium foams by using two temperature models. They observed that the using of aluminium foams in the paraffin has greater effect on the heat transfer and melting rate of paraffin. The temperature distribution is also too high in the paraffin with aluminium foams rather than the paraffin without aluminium foams. A two medium approach is used

for to solve the two temperature distribution of paraffin saturated in aluminium foams.

Francisco Garcia-Moreno et al. [11] they presented a foaming method based on the powder metallurgical foaming route but without a blowing agent. They determined pore distributions, maximum and end expansions, mean ferret diameters, 2D porosities and pore roundness a function of the melting pressure by quantitatively. It was found that as a melting pressure is increased, the foam expansion and gas losses are also increased after foaming. Work and production is been started on foam metal but step by step and by research and case study. Automobile body and armors can also be developed from metal foam. Less material use and same or more requirements can be full filled.

Biljana Matijasevic et al. [12] Metal foam can be produced by using titanium hydride (TiH2).They produced aluminium foams by melting powder compacts could be contained a blowing agent. The main reason behind the use of a proper blowing agent was to release gas at the right temperature to ensure high expansion and the formation of a uniform porosity. Because of the pre treatment the delay could be up to 45 second and temperature difference around 45K. They observed that the expansion of the foam is increased and uniformity of emerging foam is also improved.

## CONCLUSION

A total review on the production of aluminum foam and copper foam by using different blowing agent and other manufacturing techniques can be described. To produce metal foam different methods like powder metal process, powder metallurgy blowing agents and casting are described. By using metal foam in Solar Parabolic Trough Collector we can reduce the flow of fluid flowing inside the collector pipe. As the surface area increased the flow rate of fluid is been decreased. As the flow of fluid is been baffeled by the porous structure of the metal foam it takes the maximum contact time.

Hence the fluid will be more heated and give increased efficiency of Solar Parabolic Trough Collector.

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