

Heat Augmentation in Solar Water Heater with Different Inserts-A Review

A.N.Mahure¹

Assistant Professor

Department of Mechanical Engg., JDIET, Yavatmal

Abstract:- Solar energy become most important due to energy crisis all over the globe. Solar energy is an important source if renewable energy. In solar water heater the temperature of water is increased by using solar thermal collector. By using different types of inserts in solar water heater heat enhancement can be improved.

Index Terms—Heat Enhancement, inserts

1. INTRODUCTION

Heat enhancement in solar water heater can achieved by using different types of inserts inside the fluid flowing tubes, which helps in increasing the turbulence. In solar water heater the heat is absorbed by the absorber and that heat is then transferred to the fluid flowing through the tube by conduction. Different inserts discussed in this paper can help in improving heat transfer rate.

1.1 Passive techniques:-This techniques mostly use of geometrical modification in the flow channel by using various shape inserts or other devices. These method do not require any external power..

- Rough surface
- Extended surface
- Additives for gases

1.2 Active Techniques:-This techniques need some external power to enhance the heat transfer rate.

- Fluid vibration
- Suction and Jet Impingement
- Using mechanical aid

The present paper contributes for the review of heat transfer in solar water heater with different inserts.

2. REVIEW WORK CARRIED OUT

Shashank S. Choudhari , et.al [1] In this paper the experimental investigation were carried out on horizontal double pipe heat exchanger with coil wire inserts with different materials are used. These different materials are copper, aluminum, and stainless steel with different pitches used. Effect of this coil wire inserts with different material on heat augmentation and friction factor were studied. He found maximum Nusselt number obtained for copper wire inserts than aluminum and stainless steel inserts. The copper, aluminium and stainless steel coil wire insert cause heat transfer enhancement up to 1.58,1.41 and 1.31 resp. compared to plain tube.

Bodius salam, et.al [2] In this paper experimental investigation was carried out for the measurement of tube side heat transfer coefficient ,friction factor, heat transfer enhancement efficiency of water for the tube fitted with

rectangular cut twisted tape inserts. The Reynolds number varied in the range of 10000-19000 with heat flux variation 14-22kw/m² for the smooth tube and 23-40kw/m² for the tube with inserts. At a comparable Reynolds number Nusselt number in tube with rectangular cut twisted tape inserts were enhanced by 2.3 to 2.9 times compared to those smooth tube with 2.6 times average enhancement. Heat transfer enhancement effectiveness were found to be in the range 1.9 to 2.3 and found to be increased with Reynolds number.

Smith Eiamsa-ard, et.al [3] In this paper experimental investigation have been conducted to study the heat transfer in a circular tube equipped with regularly spaced helical tape swirl generators. The flow rate of in the tube is considered in the range of Reynolds number between 2300 and 8800. The swirling flow devices consist of

1.Full length helical tape with and without centre rod.

2.Regularly spaced helical tube are insert in the inner tube of concentric tube heat exchanger

Found that the maximum Nusselt number may be increased by 160% for full length helical tape with centered rod,150% for full length helical tape without rod, 145% for regularly spaced helical tape.

Webb , et.al [4] Investigated heat transfer characteristics of internally helical ribbed tubes. For experimental purpose uses the liquid water as test fluid experiment were carried out in double pipe heat exchanger. Experiment were carried out in range of 20000 to 80000 Reynolds number and 5.08 to 6.29 Prantle number. Total eight tubes with wide range of variation in geometry (helix angle 25°-45°,rib height 0.327mm-0.554mm, and number of fin start 10-45) were used.

Naga S. Sarda , et.al [5] Investigated the heat augmentation of turbulent flow heat transfer in horizontal tube by means of mesh inserts with air as working fluid. Sixteen types of mesh inserts with screen diameter of 22mm,18mm,14mm and10mm for varying distance between the screens of 50mm,100mm,200mm in porosity range of 99.73 to 99.98 considered for experimentation. The Reynolds number varied in the range of 7000-14000.They found that for a constant

diameter, further enhancement in heat transfer can be attained by using porous insert with smaller porosity.

Smith Eiamsa-ard , et.al [6] Investigated the heat transfer and friction factor characteristics of fully developed turbulent air flow through tube fitted with diamond shaped turbulators in tandem arrangements. For experimental purpose Reynolds number used in the range 350 to 16500 the inclined cone angle $15^\circ, 30^\circ, 45^\circ$. The variation of Nusselt number and friction factor with Reynolds number under the effect these parameters are determined. He found that both heat transfer rate and friction factor increases with cone angle 45° . The increase in heat transfer rate with increasing the cone angle and decreasing with tail length ratio. For the tube with turbulator at 45° , the heat enhancement is found to be 67%, 57% and 46% respectively.

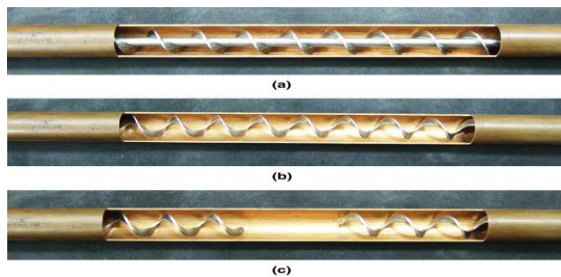


Fig. 1. The inner tube fitted with various helical geometries insert: (a) Full-length helical tape with a rod; (b) Full-length helical tape without a rod; (c) Regularly-spaced helical tape without a rod.



Fig. 2. Twisted tape insert.



Fig. 3 mesh inserts.

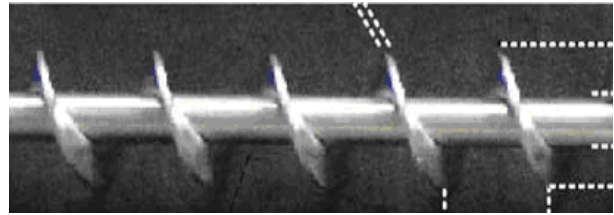


Fig. 4 Screw tape insert

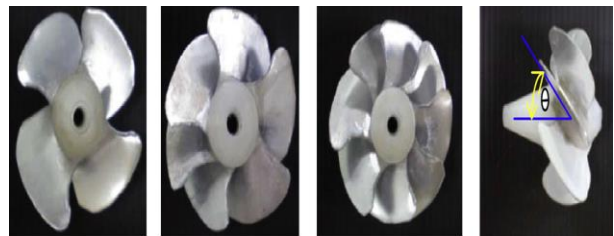


Fig.5 Propeller inserts with varying number

3. CONCLUSION.

Heat transfer enhancement in solar water heater increased as compared to plain tube or tube without any inserts. Inserts increasing heat enhancement as inserts creates turbulence in the flow path.

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