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# HEAT TRANSFER IN ROUND TUBE USING CONICAL RING INSERTS: A REVIEW

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**Abstract:** This paper presents the literature review of turbulent heat transfer in round tube by inserting conical type of ring. Wide study of heat transfer augmentation has been take place which is used to increase heat transfer by considering the overall performance of system should not affected. The heat transfer techniques which increase heat transfer rate in round tube play an important role for increase the heat transfer rate by inserting conical ring type inserts for some specific type of fluid which increases heat transfer and effective surface area. In this paper literature survey of heat transfer enhancement techniques by using inserts.

**Keywords**: Conical Ring, Heat Transfer, Augmentation Techniques, Inserts Passive Method.

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**INTRODUCTION**

The rate of heat transfer can be increase by using enhancement techniques. The overall performance of the system should not affect which using heat transfer techniques. There are three main types of techniques:

1) Active method

2) Passive method

3) Compound method.

In active method, we are provided external output method by heat transfer enhancement. These techniques are more complex from design point of view. In this method various techniques like mechanical aids, surface and fluid vibration, electrostatics fluid, suction, injection.

In passive method external power input does not require. The conical ring inserts increase the heat transfer rate, this techniques cause the motion of the fluid in type of swirl and actual boundary layer of fluid disturbs creating turbulent flow and increasing effective surface area.

In compound method, more than one of the techniques is used in combinations. It is also called as hybrid method. It has limited applications because of complex design. The purpose of compound augmentation techniques is further improving the thermo-hydraulic performance of a heat exchanger.

**II) DIFFERENT TYPE OF INSERTS IN PASSIVE HEAT TRANSFER AUGMENTATION TECHNIQUES.**

Inserts creates the obstacle to fluid flow for increasing enhancement of heat transfer.

Following type of inserts are generally used

1) Twisted tape

2) wire coil

3) conical ring

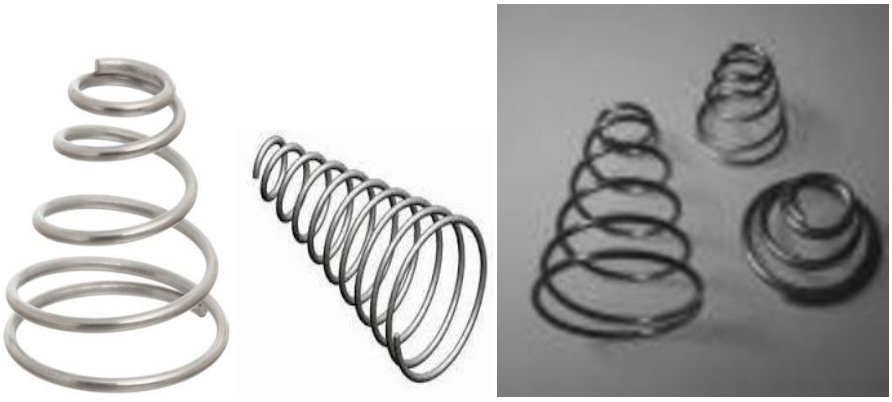
4) Baffles

5) ribs,

6) plates

7) Helical ring

**III) CONICAL SPRING INSERTS**



A conical spring inserts has been utilized as a passive enhancement techniques and used as heat transfer equipment like heat exchanger, automotive radiator etc .it is also used in thermal power plant, chemical industries, ships and refineries, industries and marine application.

It has following advantages-

1) Installation and ejection is very easy.

2) Low manufacturing cost

3) Manufacturing process is simple

4) Originality of the plain tube can be preserved

**Figure: Conical convergent-divergent spring inserts in tube**

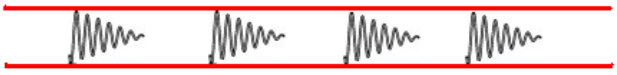


**Figure: Conical convergent spring inserts in tube**

The conical spring and arrangement of conical spring in the tube are shown above. A substantial increase in the friction factor take place by using conical spring inserts. The friction factor, heat transfer rate and turbulences of the fluid flow increase by using conical spring inserts has been carried out by experiment.

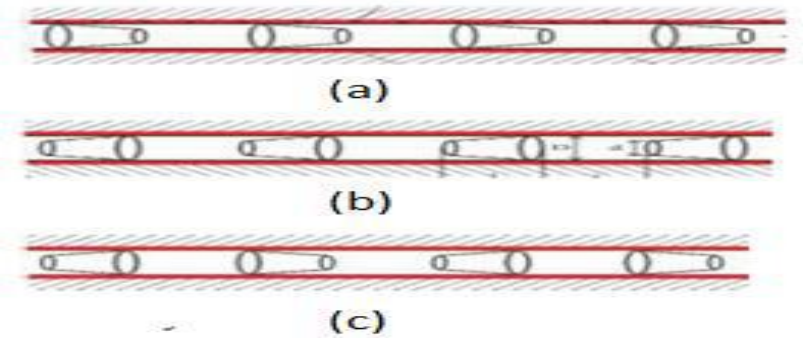
There are two type of conical spring arrangement in the tube.

1) Conical convergent spring insert

2) Conical convergent-divergent spring inserts.

**IV) REVIEW OF THE WORK CARRIED OUT**

**P. Promvonge et al. [1]** in this paper experiment on heat transfer in a round tube with the conical ring inserts by passive method carried out. The friction factor and heat transfer rate can be investigated. The three types of arrays i.e. conical ring array (CR), convergent-divergent ring array (CDR), divergent array (DR) is used. Around 197-333%,138-234%, and 91—175% heat transfer rate are found with the 0.5,0.6,0.7 diameter ratio .the maximum enhancement efficiency are found to be 1.8,1.15,1.76, and 1.13 and 1.73 and 1.12 for DR and CR.




**Fig; test tube fitted with conical ring inserts (a) DR array (b) CR array (c) CDR array.**

**Er. Pardeep Kumar et al. [2]** in this paper experimental study on five wire coil in different pitch insert in tube. The friction factor and heat transfer can be calculated in this paper .in round tube for turbulent Re=2000-10,000 and pr=0.7.the pressure drop will be increase with the use of coil wire. And with decreasing pitch and enhancement efficiency increase. The heat transfer rate and pressure drop depend on spring pitch and wire thickness. This result is used for compact heat exchanger.

**M.A.Rashid sarkar et al. [3]** in this experimental study on three conical ring in different pitches ratios (PR=p/D=0.7, 7.5, 0.9). The diameter ratio is 0.5 for conical ring. In this experiment thermal performance factor and PR can be investigated. Thermal performance factor=1.7, PR=7.5.Re=$2\times10^4$ to $6\times10^4$.numerical investigation using finite element analysis method illustrate wall temp and air velocity distribution for both smooth tube and tube with conical ring inserts.

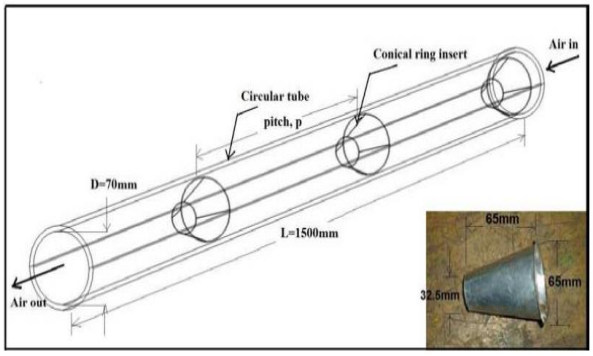



**Fig: Converging arrangement of three conical rings inside the test section of tube**

**Mr. kumbhar D.G et.al.[4]** in this paper experiment on heat transfer, friction factor and enhancement efficiency characteristics in the work two heat transfer enhancement device are applied i.e. conical coil insert and other is wire coil insert with the air as the working fluid. The result shows that nusult number values of 5 % to 12 % and enhancement efficiency of 0.78 to 0.98.

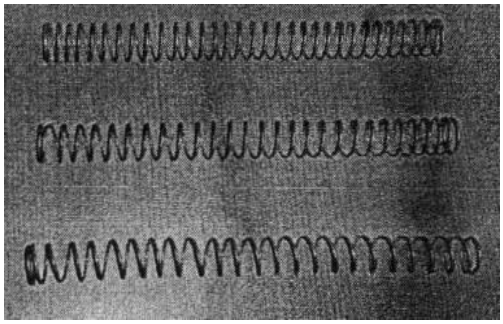


**Fig: wire coil with different pitches.**

**Monis Abdul Manah Abdullah et.al. [5]** in this paper studied the heat transfer enhancement for the inserts having the conical geometry containing filaments with holes. The convergent and divergent cross section on the filament with hole. The straight hole filament compare with the newly designed filament insert and observed that the new passive technique which shows

increase in substantially and heat transfer rate and turbulence of the fluid in the tube over the plane tube the pressure drop with filament having convergent, divergent hole. The 20% heat transfer rate increase with straight hole and 40 % plane tube.

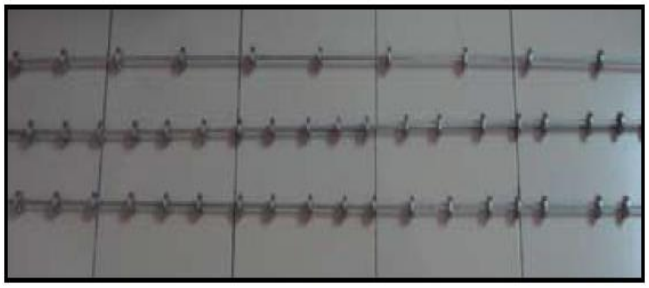


**Fig: Actual filament inserts assembly**

**S.S.Giri et al. [6]** in this paper studied the different ways of heat transfer enhancement by using various types of inserts in the tube.

(1) Twisted type inserts enhance the heat transfer rate in turbulence of flow and the pressure drop.

(2) With the mesh inserts, increasing the ratio of porous material enhances the pressure drop and higher the heat transfer rate with respect to plain tube.

(3) With the baffle inserts, with Reynolds number for transient flow condition, the rate of pressure drop increases.

(4) With the conical ring inserts heat transfer rate enhances than that of plain surface tube which also the enhances than that of plain surface tube which also enhances the friction factor.

(5) With the wire coil inserts, heat transfer coefficient is higher as compared to smooth tube and also friction factor will be increased in full laminar region.

**Manish sanserwal et al. [7]** had studied the various types of turbulators designs i.e. nozzle turbulator, conical wire coil, perforated conical ring, non perforated conical ring by considering the slight variations in the parameters. With the help of graph 1) friction factor vs. reynold 2) Nussle number vs. Reynolds number

As in the first graph the friction factor decreases with increase in Reynolds number.

As in the second graph, the increase in reynold number and convective heat transfer leads to increase in nusselt number.

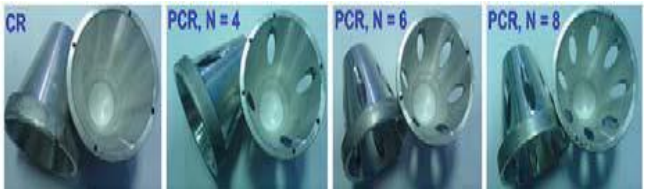



**Fig: perforated conical ring**

**Shivlingaswamy B.P et al[8]** in this paper, by using the ANSYS software fluent version 14.0 is used for explaining the CFD modeling for the heat-transfer augmentation in a circular tube with turbulent flow conditions fitted with and without rod circular inserts. The experimental results shows that 57-195% heat transfer rate compared to that in plain tube by considering the operating conditions and the Reynolds number range 4000-20000 has been taken for the experiment.

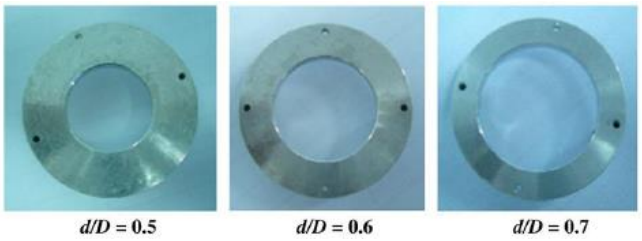



**Fig: test section with circular-ring tabulators**

**Alberto Garcia et al. [9]** their aim was to investigated experimentally determined the heat transfer rate and frictional characteristics of the helical wire coil inserts in transient flow at different prandtl number. They used water and propylene glycol mixture at different concentration and they take the values of the Reynolds number 100 to 90,000 and prandtl number from 2.8 to 200.the result found the pressure drop increased up to 6 times and 4 times heat transfer rate compared to the plain tube.

**Promod s purandare et al.[10]** their aim was to investigated experimentally determined heat transfer rate and pressure drop of conical coil heat exchanger with parameters tube diameter, fluid flow rate and cone angle. In this Paper the cone angle tube diameter and the fluid flow rate are considered. In experiment hot and cold water of the flow rate 10-100lph and 30-90 lph are taken and temperature and pressure drop recorded at different mass flow rate for both hot and cold fluid. Nu is reduces with increasing cone angle and tube diameter.

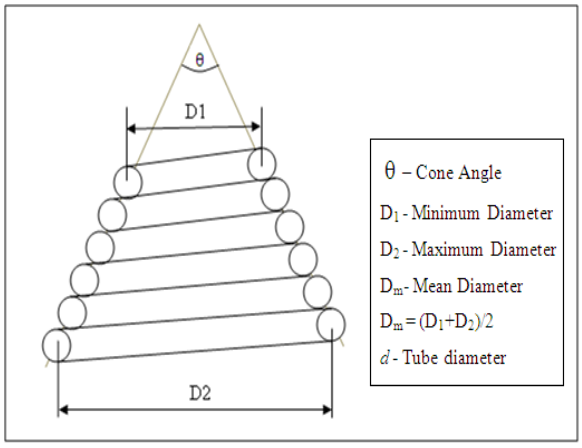



**Fig: Conical coil used in Heat exchanger.**

## VI. CONCLUSION

In this paper, the experimentation and results of the various type of inserts are observed and also the parameter required for enhancing the heat transfer rate.in conical spring type of inserts heat transfer rate increased in a tube because this type of an insert increases the turbulance of the flow and increases and heat transfer coefficient and pressure drop. In a wire inserts the friction factor increases in laminar flow region.

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