International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 05 | May - 2022 Impact Factor: 7.185 ISSN: 2582-3930

High-Temperature Cooling Water Jacket for Camera

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Abstract*— *The utility model discloses a high-temperature cooling water jacket for a camera in a furnace. The high-temperature cooling water jacket comprises a water jacket body (1), a water inlet pipe (2), a water outlet pipe (3) and a compressed air joint (4). A flow-guiding cavity (13) used for separating a water cavity into an upper layer and a lower layer and provided with flow-guiding ports is arranged in the water jacket body (1). The water outlet pipe (3) and the water inlet pipe (2) are respectively arranged at the upper layer and the lower layer of the water cavity. The compressed air joint (4) is connected with an inner cavity of the water jacket body (1). The high-temperature cooling water jacket for the camera in the furnace has following beneficial effects: by the flow-guiding cavity, the water cavity is separated into two layers and therefore water enters from the lower layer and flows out from the upper layer so that water fully flow in the jacket, with the result that a cooling effect is obviously improved; compressed air is used for sweeping in place of nitrogen gas in the prior art so that problems arising from assembly of the camera in the heating furnace such as short service time and high operation cost are well solved; and the high-temperature cooling water jacket is simple in structure, convenient in installation, stable and reliable in operation and is capable of substantially reducing cooling cost.

I. Introduction

Heat exchangers have wide applications in modern industries. Heat exchangers are devices that facilitate the exchange of heat between two fluids with high effectiveness and low investment and low maintenance cost. Optimizing the performance of the heat exchanger results in efficient utilization of energy with reduction in total volume and the weight of the heat exchanger. Thus, heat exchanger has always been one of the main research topics in thermodynamics. Generally, the performance of a heat exchanger is measured by its effectiveness, but effectiveness does not provide any information about the efficiency of heat exchange that takes place in a heat exchanger, and the measure of irreversibility is entropy generation. In order to take into account, the irreversibility, the concept of heat exchanger efficiency based on the second law of thermodynamics has been introduced and the relation between effectiveness and efficiency has been derived. The main objective of this work is to determine the heat capacity rate ratio accounting for both efficiency and effectiveness of the heat exchanger.

There have been reported cases of heat exchanger failure in service due to the extreme service conditions, such failure may have occurred due to poor material selection. Design is the process of translating a new idea or a market need into the detailed information from which a product can be manufactured, in addition, each state of design requires decision about the material of which the product is to be manufactured and the process involved in making it; normally, the choice of material is dictated by the design.
The performance of an engineering component is therefore limited by the properties of the material of which it is made.

Under some circumstances a material can be selected satisfactorily by specifying ranges for individual properties. More often, however, performance depends on a combination of properties, and then the best material is selected by maximizing one or more performance indices.

A key element in the heat exchanger analysed in this study is the tube wall that separates two fluid streams (hot and cold) which travel in the same direction. The two streams enter at one end and leave at the other end [2]. Ali and Shaban [3] designed a heat exchanger to pasteurize milk by steam in a dairy plant and they did their calculation processes manually to specify the tube length and the number of tubes, and the pump for the heat exchanger

Experimentally investigated the effect of fluid flow rate on the performance of a parallel flow heat exchanger. Also, Sivakumar and Rajan [5] undertook performance analysis of heat transfer and effectiveness on laminar flow with effect of various flow rates, the final point of their experimental assessment was validation with the numerical values. Abayomi et al. [6] designed and developed a small heat exchanger as auxiliary cooling system for domestic and industrial applications. T'Joena et al., reviewed polymer heat exchangers for HVAC&R applications and concluded that a successful application polymers or polymer matrix composites are based on careful material selection and modification of the design to fully exploit the material properties

Recently, the use of Computational Fluid Dynamics (CFD) to solve and analyze fluid flow has been advocated by researchers, Hesham [8] conducted experimental and CFD analysis of turbulent flow heat transfer in tubular exchanger. Ranjbar and Seyyedvalilu

[9] reported a numerical investigation of the influence of different parameters such as coil radius, coil pitch and diameter of tube on the characteristics of heat transfer in helical double tube heat exchangers using the well-known Fluent CFD software. Reddy and Rao

designed and analysed the simulation reports of an existing heat exchanger, they utilised the material library of the Solid Works in attaining better knowledge related to properties of various materials for the heat exchanger. Marjan et al., [11] investigated heat transfer and pressure drop of a counter flow corrugated plate heat exchanger using MWCNT based nanofluids. Marjan et al., [12] investigated heat transfer performance and friction factor of a counter-flow double-pipe heat exchanger using nitrogen-doped, grapheme based nano fluids. One of the major limitations in the early heat exchangers was the poor performance of materials used in the high temperature high p r e s s u r e areas of the heat exchanger. Consequently, the need for better materials to eliminate these flaws necessitated further research in the field of alloys and manufacturing.

PROBLEM DEFINITION:

Due High environment temperature life of camera decreases, in Companies such as JSW internal shop temperature is up to 80 degrees. At this temperature the physical properties of camera change & plastic parts start melting / Expanding. This results in decrease in performance of camera image processing.

OBJECTIVE:

1. Thermal Analysis of cooling jacket.
2. Experimental Analysis of Cooling Jacket.
3. Utilization of stainless-steel material to reduce rust.
4. Maintain in temperature of jacket up to 30-35 degrees.
5. Utilization of water as cooling unit.

Utility model content:

It is a kind of simple in structure, easy for installation that the purpose of this utility model is to provide, and working stability is reliable, can significantly reduce the interior camera High-temperature cooling water jacket of stove of cooling cost.The purpose of this utility model is to realize like this, in described stove, camera High-temperature cooling water jacket comprises water jacket body, water inlet is divided into two-layer up and down, and leaves flow- guiding mouth; Described outlet pipe and water inlet pipe are separately positioned on water cavity the upper and lower; Described compressed air joint is connected to water jacket body and is provided with the inner chamber of camera.The utility model is divided into water cavity two-layer by diversion cavity is set; bottom water inlet; top water outlet; not only strengthen Inlet and outlet water flow; and water is fully flowed in cover; improve cooling effect, therefore replaced nitrogen to purge and protect the normal operation that just can guarantee camera with less compressed air. The utility model is simple in structure, easy for installation, and working stability is reliable, can significantly reduce cooling cost.

LITERATURE REVIEW:

Material Selection and Fluid Flow Analysis of Parallel Flow Heat Exchanger, 'Christian Emeka Okafor', 6(3): 1-14, 2016; Article no. ACRI.30239

Aims: To select appropriate material and undertake fluid flow analysis of parallel flow heat exchanger.

Methodology: Dynamic simulation study was performed to evaluate conditions of heat transfer of water through heat exchanger using ASPEN HYSYS. Cambridge Education Selector (CES) Granta software was used to select the suitable candidate materials for the heat exchanger. The properties of the selected materials and fluid characteristics were implemented in Computational Fluid Dynamics (CFD) to solve and analyze the fluid flow. **Results:** For inner pipe, low alloy steel having maximum thermal conductivity of 55(W/m°C) and specific heat capacity of 530 (J/kg°C) respectively was selected and used. For the outer pipe, cast iron, gray having thermal conductivity of 72 (W/m°C) and specific heat capacity of 495(J/kg°C) passed the selection criteria and was used.The total heat transfer surface area and hydraulic diameter was determined as 0.1341634m and 0.481m respectively while the velocity of flow (V) for hot and cold fluid was established as 0.00014518 m/sec and 0.000196817 m/sec respectively.

Conclusion: The material-process decision on a parallel flow heat exchanger design was reduced to trade-off between performance and cost. The data obtained from the experimental record are well matched with computational fluid dynamics simulated values at different mass flow rate.Comparative Analysis Of Parallel And Counter Flow Heat Exchangers, "Koepka Sridhar" Ssn 2319-8885 Vol.06, Issue.04 February-2017, Pages:0638-0644

Abstract: The flow pattern through a heat exchanger affects the required heat exchanger surface. A counter flow heat exchanger needs the lowest heat transfer surface area. It gives a higher value for log mean TEMPERATURE difference than either a parallel flow heat exchanger or a cross flow heat exchanger. A heat exchanger can have several different flow patterns. Counter flow, parallel flow, and cross flow are common heat exchanger types. A counter flow heat exchanger is the most efficient flow pattern of the three. It leads to the lowest required heat exchanger surface area because the log mean TEMPERATURE drop is the highest for a counter flow heat exchanger. In this thesis analysis is done to compare the heat transfer rates between the two basic flow arrangements: (i) the unidirectional parallel flow (parallel flow or co-current flow), and

(ii) bidirectional flow (counter flow or counter-current flow). CFD analysis and thermal analysis is done on the heat exchanger for different fluids, by taking hot water and refrigerants R134A, R22, R600A and different materials of heat exchangers. 3D models are done in Pro/Engineer and analysis is done in Ansys.

Performance Analysis Of Parallel And Counter Flow Heat Exchanger With Square Twisted Pipe, "M. Balakrishna", 2020 Jetir June 2020, Volume 7, Issue 6

ABSTRACT:

Heat exchanger is a device that used to transfer thermal energy(enthalpy) between two(or)more fluids. The transient heat transfer in double tube counter flow & parallel flow heat exchanger was carried out with corrugations on inner tube by twisting the pipe from one end, which give the more swirling motion to fluid flowing through it. The design of twisted pipe is done by using CATIA V5 software. The mass flow rate is regulated by using rotameters. Thermocouples are placed at inlet and outlet of both cold and hot fluids for measuring the required temperatures.

The experimental calculations obtained from the twisted pipe heat exchanger are compared with the normal pipe heat exchanger.

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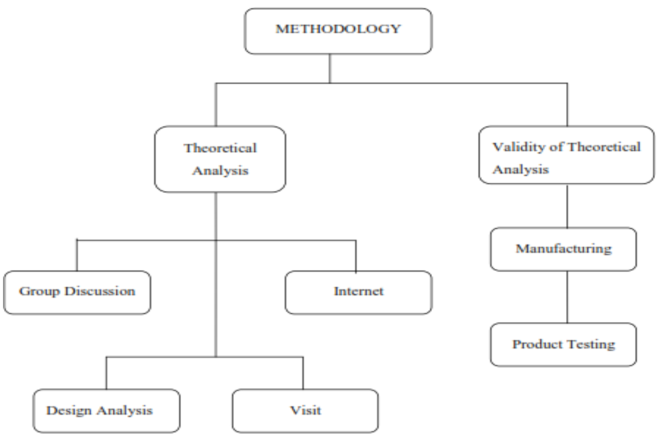
water in a spirally grooved tube with twisted tape insert. Laminar to fully turbulent ranges of Reynolds numbers was considered. The grooves are clockwise with respect to the direction of flow. Compared to smooth tube, the heat transfer enhancement due to spiral grooves is further augmented by inserting twisted pipe having twist ratios 10.15,

7.95 and 3.4. It is found that the direction of twist (clockwise and anticlockwise) influences the thermo-hydraulic characteristics. Constant pumping power comparisons with smooth tube characteristics show that in spirally grooved tube with and without twisted tape, heat transfer increases considerably in laminar and moderately in turbulent range of Reynolds numbers. Constant pumping power comparison with smooth tube shows that the spirally grooved tube without twisted tape yields maximum heat transfer enhancement of 400% in the laminar range and 140% in the turbulent range. Similar comparison for spirally grooved tube with twisted tape shows maximum enhancement of 600% in the laminar range and 140% in the turbulent range.

Pongjet Promvonge [2], studied influences of insertion of wire coils in conjunction with twisted tapes on heat transfer and turbulent flow friction characteristics in a uniform heat- flux, circular tube using air as the working medium. The wire coil used as a turbulator is placed inside the test tube while the twisted tape is inserted into the wire coil to create a continuous swirl flow along the tube wall. The effects of insertion of the two turbulators with different coil pitch and twist ratios on heat transfer and friction loss in the tube are examined for Reynolds number ranging from 3000 to 18,000. The experimental results are compared with those obtained from using wire coil and twisted tape alone, apart from the smooth tube. The results indicate that the presence of wire coils together with twisted tapes leads to a double increase in heat transfer over the use of wire coil and twisted tape alone. The combined twisted tape and wire coil with smaller twist and coil pitch ratios provides higher heat transfer rate than those with larger twist and coil pitch ratios under the same conditions. Therefore, the combined wire coil and twisted tape should be applied instead of using a single one, leading to more compact heat exchanger.

P. Promvonge and S. Eiamsa-ard. [3], they have experimentally investigated the heat transfer, friction factor and enhancement efficiency of circular tube fitted with conical ring tabulator and a twisted tape swirl generator. Air is used as a testing fluid for a Reynolds number range from 6000 to 26000 maximum heat transfer rate of 367% is obtained by using the conical ring tabulators. They have also observed that the maximum heat transfer rate is obtained at lower twist ratio for all the given range of Reynolds number value, The average increase in heat transfer rate obtained by using the conical ring tabulator and twisted tape at twist ratio of 3.75 and 7.5 are 367% and 350% over the plain tube.

METHODOLOGY:



Design Of Machine: -

In our attempt to design a special purpose machine we have adopted a very careful approach; the total design work has been divided into two parts mainly:

1. System Design

2. Mechanical Design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; weight of m/c from ground etc.

In Mechanical design the component in two categories.

Design parts

Parts to be purchased.

For design parts detail design is done and dimensions thus obtained are compared to next highest dimension which are readily available in market this simplifies the assembly as well as post production servicing work.

Mechanical design phase is very important from the view of designer as whole success of the project depends on the correct deign analysis of the problem.

Many preliminary alternatives are eliminated during this phase. Designer should have adequate knowledge above physical properties of material, loads stresses, deformation, and failure. Theories and wear analysis, He should identify the external and internal forces acting on the machine parts

These forces may be classified as;

a) **Dead weight forces**

b) **Friction forces**

c) **Inertia forces**

d) **Centrifugal forces**

e) **Forces generated during power transmission etc**

Material Selection

The proper selection of material for the different part of a machine is the main objective. In the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials.

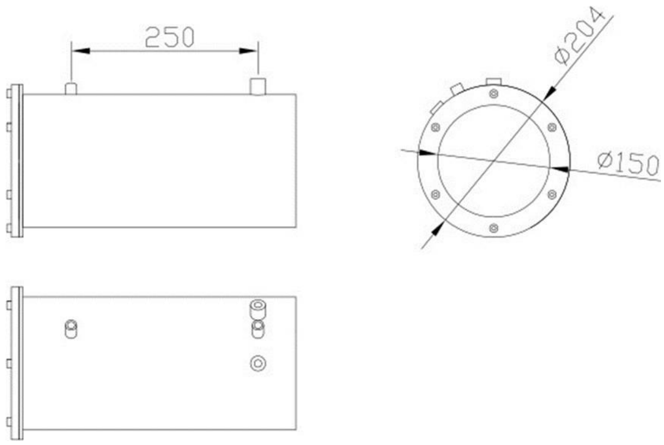
The Choice of material for engineering purposes depends upon the following factors:

1. **Availability of the materials.**
2. **Suitability of materials for the working condition in service.**
3. **The cost of materials.**
4. **Physical and chemical properties of material.**
5. **Mechanical properties of material.**

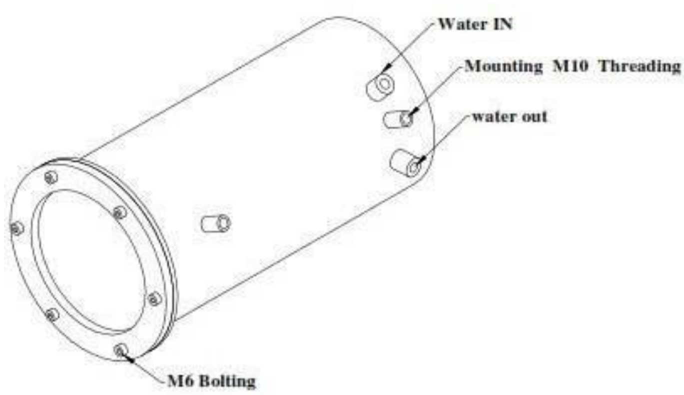
Considering all these, stainless steel was finalized for prototype in parallel with following properties.

Strength	Elasticity
Stress	Plasticity
Stress	Ductility
Brittleness	Malleability

2-D Design



WORKING OF EXPERIMENTAL SETUP:



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