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Review Of Performance Of Air Cooled Heat Exchanger

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Abstract:

A heat exchanger is a component that allows the transfer of heat from one fluid (liquid or gas) to another fluid. In a heat exchanger there is no direct contact between the two fluids. The heat is transferred from the hot fluid to the metal isolating the two fluids and then to the cooler fluid in this study the performance parameter such as air velocity ,pressure drop ,discharge of air and water , temperature of air and water , we provide heating coil in the duct for increasing the temperature of air .

Introduction

The Air-cooled heat exchanger, also known as dry cooler, air-cooler or fin-fan cooler is a device which rejects heat from a fluid or gas directly to ambient air. When cooling both fluids and gases, there are two sources readily available, with a relatively low cost, to transfer heat to…..air and water. The obvious advantage of an air cooler is that it does not require water as a cooling medium, which means that equipment require cooling need not to be near a cooling water reservoir. In addition, the problems associated with treatment and disposal of water have become more complex with government regulations and environmental .

concerns. The air-cooled heat exchanger provides a means of transferring the heat from the fluid or gas into ambient air, without environmental concerns, or without great ongoing cost.

The applications for air cooled heat exchangers cover a wide range of industries and products, however generally they are used to cool gases and liquids when the outlet temperature required is greater than the surrounding ambient air temperature. The applications include Engine cooling, Condensing of gases and steam, Oil and gas refineries, Compressor stations for gas pipelines, Subsurface gas storage facilities, Bakeries to preheat ovens and provide steam for other equipment.

Fin-and-tube heat exchangers are widely used in several life fields such as heating, ventilating, refrigeration and air conditioning systems. A fluid is considered to have made one pass if it flows through a section of the heat exchanger through its full length. If the fluid is reversed and flows through an equal or different section, it is considered to have made a second pass of equal or different size. One of the major advantages of multi passing is to increase the exchanger overall effectiveness over individual pass effectiveness. The multipass arrangements are classified according to the type of construction, for example, extende surface, or plate's exchanger. Finned surfaces are often employed where the heat transfer coefficient readily attainable with one fluid stream is much higher than that readily attained.

Types Of Finned Tube
Fins can be attached to the tubes in a number of ways:

L-Footed Tension Wound

The most common fin type utilized in the air-cooled heat exchanger design is the L-footed tension wound aluminum fin. The fin is produced by wrapping an aluminum strip, that is footed at the base, around the tube. This process is done by holding tension on the fin at all times. The ends of the fins are stapled to prohibit the aluminum fin from unraveling, and loosing the contact between the fin foot and the tube. This contact is critical to the operation of the air cooler, since the heat is transferred from the tube wall, through the fin, to the surrounding ambient air. The L-footed tension wound fin is normally used in services where the tube wall temperature does not exceed 350 degrees, and air side

corrosion is not extremely high. At the higher tube wall temperature due to the difference in material between the tube and the fin, the fin will not maintain contact with the tube, therefore loosing cooling efficiency of the air cooler. This fin is also susceptible to air side corrosion creating a film between the tube and fin, creating the same problem. Coatings to the fins, or special in material can be utilized to slow this process.

Embedded

In high temperature applications, an embedded process is employed to attach the fin to the tube wall. In this process, a groove is actually cut into the tube, the fin strip inserted, and the tube material then "plowed" back against the fin to bond it to the tube. Separation of the fin and tube due to corrosion or temperature differentials are not a factor with the fin type.

Since the fin does not employ a "foot", this leaves the tube totally exposed to airside corrosion factors. In addition, due to the groove cut into the tube, a thicker tube wall thickness must be used to avoid over-pressuring the tube.

The embedded fin is normally used for services greater than 350 degrees and less than 750 degrees F

Extruded

For applications where atmospheric corrosion is critical, the extruded fin tube provides the best protection.

The extruded fin is produced by inserting the tube into an aluminum sleeve and then extruding the fins from the aluminum sleeve. Since the tube is totally covered by the aluminum sleeve, the tube wall is protected from outside corrosion, and the bond between the fin and the tube remains tight.

The extruded fin tube is good for tube wall temperature up to 650 degrees F. This is the most expensive fin tube to produce.

Others

There are several other types of fin that are similar to the above fin types:

Double L-Footed Fin

This fin is similar to L-tension in that it is produced in much the same manner. In this process, a foot is formed on both sides of the upright portion of the fin, providing an overlapping of the fin. This provides a higher protection for the tube against atmospheric corrosion. This fin type is also referred to as an overlapped fin.

Knurled L-Footed Fin

Again, this process is very similar to the L-footed tension wound fin, but utilizes knurling wheels that actually knurl the fin foot into the tube. This allows for a tighter bond between the tube and the fin, and reduces the likelihood of a corrosion film between the two.

L-Footed Fins With Slits Cut Into The Fin

By cutting a slit into the fin, more air turbulence can be created, due to the interruption of the air boundary layer. This in turn increases the airside heat transfer coefficient with a modest increase in the airside pressure drop and the fan horsepower.

Theoretical Analysis

The first step in the thermal and hydraulic design of the heat exchanger is to calculate the overall heat transfer coefficient (Uo) which will be based on the air- side area. The overall.

Relation Used In Calculation

1/u=
For the heat balance,
$q = m_h (T_{h1} - T_{h2})$ = Heat given
$q = m_c (T_{c1} - T_{c2})$ =Heat taken
$Q = A_1 V_1$= discharge of air
LMTD (log mean temperature difference), $\Delta T = (\Delta T_2 - \Delta T_1) / \log((\Delta T_2) / \Delta T_1)$ (°F)

Nomenclature
$\Delta T_1 = T_{h1} - T_{c1}$ $\Delta T_2 = T_{h2} - T_{c2}$
T_{h1} =water inlet T_{c1} = air inlet
T_{h2} = water outlet T_{c2} = air outlet
A_1= area of duct V_1= velocity of air

Experimental Work

The constructed test rig. It consists of a test section which is a model of a crimped finned tube heat exchanger, water heater, natural flow of water system, control panel and measuring instrumentation. The rig is made of steel structure on which the testing component is fixed.

There are two type of test section. The first type is made of crimped finned tube heat exchanger, having dimensions of (40cm) overall length, which contains (32) copper tube of (16mm) outer diameter(14mm) inner diameter(14) with fin pitch (10 fin/in), fin outer diameter(34.5mm) and fins thickness (0.1mm).. and the tubes material ad braas. Fin type crimp root soldered.

The second type is made of crimped finned tube heat exchanger, having dimensions of (40cm) overall length, which contains (32) copper tube of (16mm) outer diameter(14mm) inner diameter with fin pitch (11 fin/in), fin outer diameter(38mm) and fins thickness (0.1mm). and the tubes material ad brass. Fin type crimp root soldered.

Conclusion

The air cooled cross flow heat exchangers tested in the present work revealed that:

The overall heat transfer coefficient of the plate finned tube bank is controlled by the air side heat transfer coefficient. The latter was ranged between (34) and (50) W/m2 K for the whole range of variables used in the tests for the large tube bank. The corresponding values of the small heat exchanger were (42) and (53) W/m2 K.

A theoretical analysis on the heat transfer enhancement with the application of cooling to an air-cooled finned heat exchanger is presented in this work. A model on the heat and mass transfer process in a finned channel is developed . Based on this model, the characteristics of the heat and mass transfer are investigated in a fin heat exchanger . temperature difference between the air inlet the water . In a typical finned heat exchanger incorporating cooling, the cooling enhancement is usually less than the maximum value, and depends on the ratio of the thermal conductance between the fin and the air to the conductive conductance through the fin. From the practical point of view, this ratio is mostly dependent on the fin thickness and thus the cooling enchancement also becomes dependent on this parameter. As the velocity of air increase the over all heat transfer coefficient will also increases due to turbolance of air .

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