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Perspective

Involvement of Forced Convection in Heat Transfer

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DESCRIPTION

Heat transfer augmentation can be the prime method to effectively enhance the convective mode of heat transfer by increasing the convective heat transfers co-efficient, reducing the weight and size. The various techniques that are widely used in industries to achieve high heat transfer augmentation include passive method, active method and compound method. Active method requires external power to run the system, on the contrary passive method does not require any external power. Combination of these two techniques evolved the compound method but it has limited applications. However, these methods are common in the thermal industries. The mechanical method that employs stirring of fluid either by mechanical aids or by spinning the surface has wide utility in scrapped surface and rotating tube heat exchangers. Electro hydrodynamic heat transfer enhancement is achieved by altering the electric or magnetic fields. Generally, AC or DC sources are used to produce the electro-static fields in the heat exchangers which in turn induce the bulk mixing. This method is meant exclusive for dielectric fluids.

The heated surface is subjected to a low or high frequency surface vibration in order to increase the single-phase heat transfer. Generally, acoustic waves induced in a solid wall by means of high frequency oscillation on which fluid droplets impinged causes enhanced convective heat transfer. This method involves single-phase or double-phase heat transfer process. The fluid is received from the porous heated surface in a single-phase flow whereas in double-phase flow, the nucleate and boiled vapor is discharged through a porous heated surface. This method impinges a single-phase fluid either normally to the surface or with an angle to the surface. One or more jets can be employed possibly with boiled liquids. Passive method is achieved without any external agencies, owing to self sustained mechanisms to enhance the rate of heat transfer. Examples include treated, structured, rough and extended surfaces, displaced enhancement and swirl flow devices, additives for liquids and gases, etc.

Passive techniques in which inserts are used in the flow tube enhance the heat transfer rate. This method relies upon the physics of conduction and convection to fulfill the heat transfer process. This technique easily and economically implements the geometrical and surface modification incorporated in the flow passages. Inserts are better compared to active techniques. The insert manufacturing process involved is simple and these techniques can be easily inserted in an existing heat exchanger. In the modifications of compact heat exchangers, passive techniques of heat transfer enhancement plays a vital role if a proper passive insert design can be chosen as per the heat exchanger flow and heat transfer working condition. Material and energy saving leads to more efficient and economic heat exchanger.

CONCLUSION

The passive techniques are beneficial because the inserts manufacturing process is simple and can be easily retrofitted to a used heat exchanger. In a passive technique, a helical screw, louvered rod, turbulent/swirl flow devices, twisted tapes, or a helical wire coil is inserted in a circular tube. One of the major advantages of this method is the use of turbulator devices in order to increase the heat transfer rate from the flow channel by increasing the turbulent motion. The louvered strips are induced in a fast mixing at high turbulent flows.

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