Review paper on Effect of different parameters on thermal conductivity

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ABSTRACT: Thermal conductivity is important in material science, research, electronics and related fields, especially where high operating temperatures are achieved. This review paper regards with effect of different parameters on thermal conductivity like temperature influence on cellular metal, specific gravity, viscosity of fluid, porosity, particle size etc.

Keywords: Thermal conductivity, porosity, coefficient of thermal conductivity, viscosity, cellular material.

1. Introduction:

1.1 Thermal conductivity[7]:

Ameasure of the ability of a material to allow the flow of heat from its warmer surface through the material to its colder surface, determined as the heat energytransferred per unit of time and per unit of surface area divided by the temperature gradient, which is the temperature difference divided by the distance between the two surfaces.

- Thermal conductivity is a property of the material which depends mainly on structure of material in terms of chemical composition, phase of material and texture of it.
- Thermal conductivity also depends on content of moisture present in material as well as how closely atoms are packed in lattice, also with operating conditions like pressure and temperature.

Factors influencing thermal conductivity[9]

1.1.1 Free electrons

Metals are having more free electrons compared to that of liquid and gases, so metal are good conductors of heat due to migration of free electrons. Metals are having closely packed lattice compared to liquids and gases.

1.1.2 Purity of material

Thermal conductivity of pure material is higher than that of alloy materials. Alloying of metals and presence of impurities cause decrease in thermal conductivity. E.g. thermal conductivity of pure copper is 385 W/mK but copper having content of arsenic, thermal conductivity is 142 W/mK.

1.1.3 Effect of forming

Treatment of metals like heat treatment and metal forming like bending, drawing and forging decreases the thermal conductivity of material compared to material before treatment.

1.1.4 High temperature

(a)Solid [1]

At elevated temperature lattice vibration increases and free electrons movement decreases, thus thermal conductivity of metal decreases when temperature is increased.

(b) Gases[3, 4]

But for gases, thermal conductivity increases. The reason behind it at higher temperature, mean travel velocity of gas molecules and specific heat increases, because the thermal conductivity of gas is = (The mean travel velocity)X (specific heat)X(mean free path times density).

(c) Liquid[3, 4]

Thermal conductivity of liquid is also proportional to the density and at higher temperature, density of liquid decreases thus, thermal conductivity also.

1.1.5Pressure[10]

Thermal conductivity is weakly dependent on pressure of substance. Means change in pressure does not affect much in thermal conductivity

1.1.6 Density[10]

Thermal conductivity is highly dependent on density of material.increase in density increases in thermal conductivity\

2. LITURATURE REVIEW:

V. Skibina et al. [1]

Cellular metals have complex structures, which make the experimental investigation of this thermal conductivity rather complicated. Powder metallurgy produce hollow sphere and open cell structure, transient plan source technique and penal test technique were applied for measure thermal conductivity. TPS method was used up to 523k for all investigated materials. Individual material inspected with PT method up to 1073k.

S. P. Anjali Devi et al. [2]

The influence of temperature gradient on viscosity and thermal conductivity on hydro magnetic flow over stretching sheet.in this process held at high temperature like gas blowing. Considering steady, two dimensional, nonlinear, and laminar flow of incompressible, viscous fluid over stretching sheet with variable thickness in presence of magnetic field.

Sharaban thohura et al. [3, 6]

Using the basic equations are transformed to non-dimensional boundary layer equations and then solved by implicit finite method. Attention is mainly focused on the rate of heat transfer in terms of local nusselt number, velocity, and temperature profile and velocity vector field.

A.K.M. Safiqul Islam et al. [4]

The natural convection heat transfer flow of temperature dependent thermal conductivity on an electrically conducting fluid along a vertical flat plate. The transformed equation is solved by implicit finite method. Result of this solution in form of prandtl number, skin friction and local rate of heat transfer. pradult number and heat generation parameter are presented graphically.

Metin Davraz et al. [5]

The lightweight aggregates are main raw material of lightweight construction material. The usability of lightweight aggregates as core materials. The effect of loseweight, the volume of aggregate matrix, porosity and grain size on thermal conductivity. All aggregates were divided into 4 groups.

2.1 Temperature, viscosity

V. Skibina et al. [1]

Hollowsphere structures from different steel alloys and open cell structure made from FeCrAl.the pore diameter of open cell structures was varied in a special manner in order to keep the porosity constant. sensor with 6.4 mm and 12.8 mm are used to measure thermal conductivity. hollow sphere structures were investigated with TPS method up to 523k.the thermal conductivity values are distributed in such way that the lowest values of ETC are at the maximal porosity of 95% and the highest values of thermal conductivity correlate with the sample showing the lowest porosity of 90 %. Increasing of thermal conductivity of the bulk material, of the gas within the pores and their radiative heat contribution. With PT method up to 1073k and get same result both for the steel 1.4841.

S. P. Anjali Devi et al. [2]

Boundary layer flow over a stretching sheet has received a striking increase in interest because of its importance in several manufacturing process in industry which include the boundary layer along the material handling conveyors, metal extrusion, continuous casting of metals, polymer extrusion, spinning of filaments, glass blowing.by numerically get the differential equations for the boundary and it solve by runge kutta integration method. The process is repeated until the results are corrected up to accuracy of 10^{-5} level. At very high temperatures, the properties of fluid flow past such surfaces like viscosity and thermal conductivity may get vary.the magnetic field plays a vital role in heat transfer rate by controlling the fluid motion past such surfaces.

Sharaban thohura et al.[3,6]

The natural convection boundary layer flow along a vertical wavy cone with uniform heat flux and temperature dependent thermal conductivity has been considered the thermal conductivity of the fluid is taken to be a linear function of the temperature which is appropriate for the small Prandtl number or gaseous fluid.Thermal conductivity is considered linearly proportional to the temperature; it affects the surface temperature to increase significantly with increasing value of thermal conductivity variation parameter.

M. Safiqul Islam et al. [4]

Numerical results of the velocity, temperature, skin friction and heat transfer profiles obtained for different values of the thermal conductivity variation parameter, Prandtl number and heat generation parameter are presented graphically and noted that the skin friction decreases for the increasing values of *Pr*. it can be seen that the rate heat transfer increases when *Pr* increases along the positivedirection for a particular value of *Pr*. Important effect is found in skin friction for *Pr*. It is also noted that the skin friction increases for the increasing values of *heat generation parameter* On the other hand heat transfer decreases for the increasing values of heat generation parameter.

2.2 Porosity,particle size

Metin Davraz et al. [5]

Lightweight aggregates are produce by a thermal process.Different size and shape of pores are separated from each other by0.02 or0.03 mm thick glass matrix. Pores are interconnected with each other in form of channels. The thermal conductivity coefficients of aggregates were measured by laser fox 314 according to heat flow meter method.

3. SUMMARY

- The effective thermal conductivity influenced by the effects of temperature, pore diameter and porosity for cellular metal alloys. As temperature increase and decrease in porosity, effective thermal conductivity increase.
- At high temperature, induced magnetic field controls the motion of hydro magnetic flow over stretching sheet. Hence, controls the heat transfer rate because of change in viscosity with temperature.
- The estimation of thermal conductivity coefficient of lightweight aggregates is dependent on the physical properties.
- The temperature within the boundary layer increases for increasing values of heat transfer and for decreasing values of prandlt number.

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