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DETERMINATION OF THERMAL CONDUCTIVITY OF PLASTER OF PARIS

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ABSTRACT :

While designing a material for engineering application we should know the mechanical properties and also thermal properties like its conductivity for insulating materials. Of course we can get the values from literature and catalogs , it is important to have our own method of finding. In this paper thermal conductivity of Plaster of Paris is found with concentric spheres. POP is an engineering material used for various engineering applications in construction engineering and composite materials.

Key words : Plaster of pairs, thermal conductivity, concentric spheres method, thermal insulation

1. INTRODUCTION:

plaster of Paris is used in making the composite material, which can be used as thermal insulator and decorative interiors. The false ceiling, roofing for decoration is mostly done by POP, For installation of Air conditioning it is one the requirement to have a false ceiling. The POP is acts like a matrix and a reinforcing fiber may be used to make POP slabs. In this paper it is aimed to find the thermal conductivity of POP. It is used as a binding material.

2. Thermal conductivity

In physics, thermal conductivity, k, is the property of a material that indicates its ability to conduct heat. It appears primarily in Fourier's Law for heat conduction. Thermal conductivity is measured in watts per Kelvin per meter ($W{\cdot}K^{-1}{\cdot}m^{-1}$). Multiplied by a temperature difference (in Kelvin's, K) and an area (in square meters, m^2), and divided by a thickness (in meters, m) the thermal conductivity predicts the power loss (in watts, W) through a piece of material. The reciprocal of thermal conductivity is thermal resistively

3 . Measurement

Generally speaking, there are a number of possibilities to measure thermal conductivity, each of them suitable for a limited range of materials, depending on the thermal properties and the medium temperature. A distinction may be observed between steady-state and transient techniques. In general, steady-state techniques perform a measurement when the temperature of the material measured does not change with time. This makes the signal analysis straightforward (steady state implies constant signals).

The aim of the experiment is to find the thermal conductivity of the given insulating powder packed in between two concentric spheres.

4 Specifications

Diameter of the inner sphere (d1=75 mm)
Diameter of the outer sphere (d2=150 mm)

5 Procedure

- Desired quantity of the electrical energy is supplied to the heater by adjusting the dimmer Starter.
- The heater, which is enclosed inside the sphere ,gives off heat energy to the inner surface
- The heat flow inner surface to outer surface thought insulating powder
- The inner surface temperature(t1&t2) and outer surface temperature(t3,t4,t5,t6) are noted after steady state is reached and also voltmeter & ammeter reading are noted
- By varying the experiment power input the experiment is repeated.

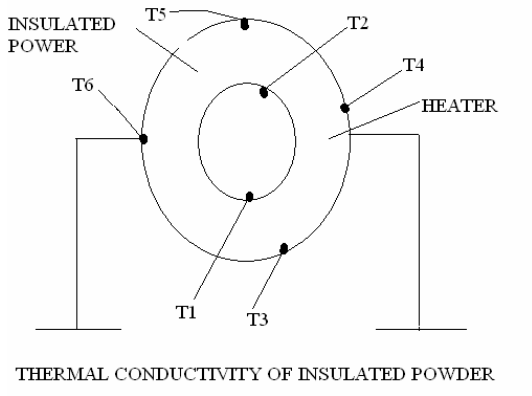

Fig: 1.1. Diagram showing two spheres experiment 1.2 Location of sensors in two spheres

6 Plaster of Paris observation table

SI.N	VOLTAGE READING V	AMMETER READING A	INTERNAL TEMPERATURE			SURFACE TEMPERATURE				
			T1	T2	T1=(T1+T2)/2	T3	T4	T5	T6	Ts=AVG OF T3,T4,T5,T6
1	0		33	33	49.5	33	33	33	33	33
2	110		33	33	49.5	32	32	32	32	32
3	110		62	67	64.5	31	32	34	34	32.75
4	110		85	91	88	31	32	38	38	34.5
5	110		99	105	102	31	32	41	41	36
6	110		119	124	121.2	34	35	46	46	44
7	110		136	140	138	36	37	49	49	42.5

7 Calculations:

Radius of the inner sphere (r_1) = 37.5 mm

Radius of the outer sphere (r_2) = 75mmm

Power input through energy meter=V*A =110*0.325 = 35.75watts

Average internal temperature (Ti) = 138 ^{0}c

Average surface temperature (Ts) =42 ^{0}c

The heat flow from the heater to outer surface of sphere is calculated using the formula

Q = (4иr$_1$, r$_2$,k(t_1-t_2))/(r_2-r_1)

Where k = Q (r_2-r_1)/4иr$_1$, r$_2$,k(t_1-t_2))/(r_2-r_1)

Sub the valves, we get

$$k = \frac{110 \text{ X } .325 \ (0.075 - 0.0375)}{4 \ \Pi \text{ X } 0.075 \text{ X} 0.0375 \ (138 - 42)}$$

= 0.397 W/mK

8 Results

Thermal conductivity of plaster of Paris is: K = 0.397 W/m K

9. Conclusions :

The results obtained are comparable with the values of other experiments conducted by Decorn, POP supplying company in Pawel , pykalo NIP 5441411315, tel 503-606-605 which gave the conductivity is 0.25 to 0.35 W/mK and also from literature this value is acceptable.

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