ANALYSIS THE THERMAL CONDUCTIVITY BETWEEN COMPOSITE WALL AND POWDER MATERIALS

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Abstract

Experiments were conducted with asbestos, wood and brick to test the thermal performance of composite powder and wall insulation materials. Also, the thermal performance of composite powder insulation and wall insulation were examined for comparison with composite powder and wall insulation. The found effective thermal insulation the composite wall and powder apparatus is fitted to varying the voltage and current is different so I found the thermal conductivity of the material as followed asbestos-0.08W/m-k, wood-1.804670W/m-k, brick-0.72W/m-K, according to the result.

Keywords: composite powder insulation; composite wall insulation; composite multilayer insulation; effective thermal insulation; thermal performance prediction.

1.Introduction

Many engineering applications of practical utility involve heat transfer through a medium composed of two or more materials of different thermal conductivities Arranged in series or parallel [2]. Consider for example the walls of a refrigerator, hot cases, Cold storage plants hot water tanks etc., which always have some kind of insulating Materials between the inner and the outer wall [1]. A hot fluid flow inside the tube covered with a layer of thermal insulation is an example of composite system because in this case the thermal conductivities of tube metal insulation are different [4]. The problem of heat Transfer through the composite system can be solved by the application of thermal Resistance concept. The procedure for solving one dimensional, steady state heat conduction Problems for composite system comprising parallel plates, co-axial cylinders or concentric spheres are dealt here.

Thermal conductivity is one of the important properties of the material and its knowledge is required for analyzing heat conduction problems. Physical meaning of Thermal conductivity is how quickly heat passes through a given material. Thus the Determination of this property is of considerable engineering significance [6]. There are various methods of determination of thermal conductivity suitable for different material. The present apparatus is suitable for finding out thermal Conductivity of the material in the powdered form. It is desirable to reduce the heat loss to the surroundings in many heat exchange equipment's. Insulating materials have a very low value of thermal conductivity and are used in different shapes, sizes and forms [4]. Insulating powder and multilayer material such as asbestos, brick, wood, because of their ease of taking any complex shape between the confining surfaces and their having large air space in between particles are in great demand these days. The thermal conductivity of an insulating powder will depend upon the geometry of the surface, particle thermal conductivity, size and number of contained air spaces and the modes of the heat transfer in different situations of the application [7]. The thermal conductivity of composite wall depends upon the geometry of the surface, thickness of the layer and air gap.

2.Experimental Procedure

2.1 Experimental Concept of composite Powder

The power supply to the heating coil by using a dimmer stat and is measured by voltmeter and ammeter. Thermocouples are used to measure the temperatures. Thermocouples 1 to 3 are embedded on inner hollow tube and 4 to 6 are embedded on the outer iron tube. Temperature readings in turn enable to find out the thermal Conductivity of the insulating powder packed between the two hollow tubes. We assume the insulating powder as an isotropic material and the value of Thermal conductivity to be constant. The apparatus assumes one-dimensional radial heat conduction across the powder and thermal conductivity can be determined.

2.2 Experimental Concept of Composite Wall

The power supply to the heating coil by using a dimmer stat and is measured By Voltmeter and Ammeter. Thermocouples are used to measure the temperatures. Thermocouple 1, 3, 5, and 7 are embedded to heating coil top side layers And thermocouple 2, 4, 6, and 8 are embedded to heading coil bottom side layers. Temperature readings in turn enable to find out the thermal conductivity of the composite wall and composite powder material. We assume the insulating material an isotropic material and the value of thermal conductivity to be constant. The apparatus assumes one-dimensional radial heat conduction across the powder and thermal conductivity can be determined.

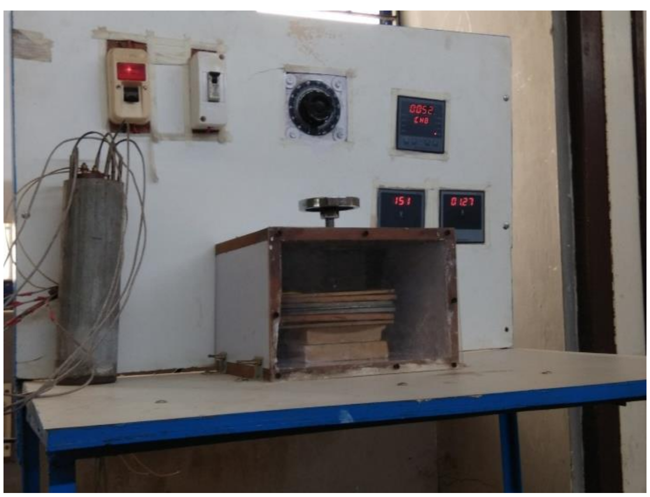


Fig 2.1 Experimental Setup

3. Result and Discussions

By changing the, input current temperature has been varied. The temperature tabulated based on various power input.

3.1 Composite Wall Apparatus

- Heating coil diameter = 200mm
- Heating coil thickness = 4mm
- Composite slab diameter = 200mm
- Composite slab thickness = 18mm

3.2 Composite Powder Apparatus

Copper Tube

- Inner diameter = 46mm
- Outer diameter = 51mm
- Length =22 mm

Iron Tube

- Inner diameter = 82.6 mm
- Outer diameter = 87 mm
- Length =25 mm

3.3 Formulae Used

- Heat transfer Q= ΔT/R
- Change in temperature ΔT= Ti – To
- Thermal Resistance R=L\KA
- Input Power Q = VI

Table 3.1 Thermal Conductivity of multilayer Composite Wall

S. No	Voltage	Current	Power Input	Heater Temp		Asbestos Temp		Brick Temp		Wood Temp	
	V Volts	A Amps	Q Watts	T1	T2	T3	T4	T5	T6	T7	T8
1	75	0.65	48.75	53	54	46	42	37	36	36	37
2	100	0.86	86	69	69	57	52	46	45	40	44
3	125	1.08	135	89	88	67	62	53	51	43	51

Table 3.2 Thermal Conductivity of multilayer Composite Wall

S.No	Voltage	Current	Power Input	Heater Temp	Asbestos Temp	Brick Temp	Wood temp	Thermal Conductivity
	V Volts	A Amps	Q Watts	Th	Ta	Tb	Tw	W/m-K
1	75	0.65	48.75	53.3	44	36.5	36.5	1.665
2	100	0.86	86	69	54.5	45.5	42	1.849
3	125	1.08	135	88.5	64.5	52	47	1.908

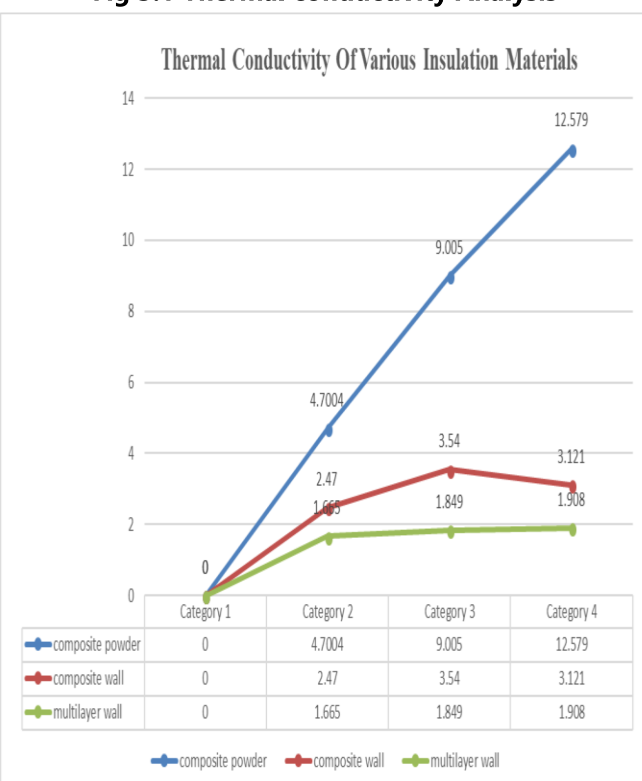
Table 3.3 Thermal conductivity of composite powder

S. No	Voltage	Current	Power Input	Inner Temperatures				Outer Temperatures				Thermal Conductivity
	V Volts	A Amps	Q Watts	T1	T2	T3	Ti	T4	T5	T6	To	W/m-K
1	75	1.25	93.75	52	49	51	50.6	50	46	48	48	4.7004
2	100	1.72	172	61	58	59	59.3	58	56	57	57	9.005
3	125	2.08	260	73	71	68	70.6	68	65	69	67.3	12.579

Table 3.4 Thermal Conductivity of Composite Wall

S.no	Voltage	Current	Power input	Inner temperature			Outer temperature			Thermal conductivity
	V Volts	A Amps	Q Watts	T1	T2	Ti	T3	T4	To	W/m-K
1	75	0.65	48.75	41	48	44.5	33	33	33	2.470
2	100	0.85	85	49	57	53	40	38	39	3.540
3	125	1.07	133.75	58	75	66.5	43	40	41.5	3.121

Fig 3.1 Thermal conductivity Analysis



The thermal performance of composite wall insulation material thermal conductivity higher then composite powder insulation and thermal conductivity of composite powder insulation material low thermal conductivity composite material.

4. Conclusion

Experiments were conducted with asbestos, brick and wood to test the thermal performance of composite powder insulation and wall insulation materials. Also, the thermal performance of composite powder insulation and wall insulation were examined in the same experimental apparatus for comparison with powder insulation. The effective thermal conductivity of powders with various specifications was calculated by the effective thermal conductivity calculation model presented in this research. Then, the deformation factor of the powder in the area-contact model was obtained by comparison the experimental data and the calculation model. An empirical correlation of the deformation factor in the area-contact model was presented as a function of bulk density, which is available to predict the effective thermal conductivity of expanded asbestos, brick and wood materials. However, the deformation factors of powder insulation materials other than expanded asbestos, brick and wood composite are necessary to predict their effective thermal conductivity.

According to analysis the most experimental researches gives the result that the thermal conductivity of composite powder insulation is lower composite wall insulation. So we can use the composite powder insulation as insulating applications which is used as in manufacturing of boilers

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