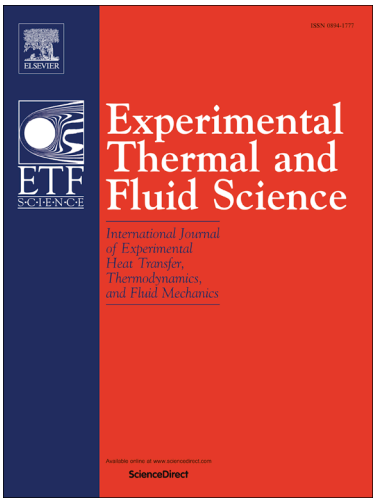

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Highlights

- THS method has good measurement accuracy for foam thermal insulation materials.
- Appropriate heating power for foam thermal insulation materials was proposed.
- Appropriate test temperature rise for foam thermal insulation materials is 6℃.
- The repeatability accuracy of THS method is better than THW method.

Abstract

Using low thermal conductivity building insulation materials is an effective way to reduce heat transfer through walls in a building therefore save building energy cost. A device based on the transient hot strip (THS) method was developed to measure thermal conductivities of organic foam thermal insulation materials. The influences of sample dimension and heating power on the calculation accuracy of the thermal conductivity were analyzed by numerical simulations and compared with experimental results. Moreover, the selection method of the appropriate heating power was proposed. The measurement results show that the device has good accuracy for measuring organic foam insulation materials and outperforms transient hot wire (THW) method.

Key words: transient hot-strip method, organic foam thermal insulation material, thermal conductivity, numerical simulation, measurement accuracy

Nomenclature

c_p	Specific heat capacity (J/kg K)	ε	Relative error of thermal conductivity
erfc	Complementary error function		
h	Convective heat transfer coefficient (W/m^2 K)	λ	Thermal conductivity (W/m K)
H	Sample height (mm)	λ_0	Standard value of thermal conductivity (W/m K)
K	Correction coefficient		
L	Sample length (mm)	ρ	Density (kg/m^3)
P_0	Heating power per unit length (W/m)	τ	Dimensionless time
q	Heat flux density (W/m^2)		
R^2	Linear fitting degree	*Subscripts*	
t	Time (s)	1	Scale division of 0.00001℃
T	Average temperature of the strip (℃)	2	Scale division of 0.1℃
T_0	Initial temperature of the strip (℃)	ex	Experimental value
ΔT	Temperature rise of the strip (℃)	hw	Transient hot-wire method
W	Sample width (mm)	id	Theoretical value
w_s	Half width of the strip (mm)	m	Sample
		max	Maximum value
Greek symbols		min	Minimum value
α	Thermal diffusivity (m^2/s)	s	Hot strip
γ	Euler constant, =0.5772...		