



Developing 'Homegrown' Natural Fibre Insulation Products

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Introduction

Kraft Architecture has been working on in-house research into the processes and manufacturing of natural fibre products using home-grown & waste fibres. Following identification of prototyping facilities, waste material suppliers and having carried out market research into demand Kraft Architecture has prototyped products from various materials. Glasgow Caledonian University has assisted Kraft Architecture by measuring the thermal conductivities of the prototypes and also optimising the density of some of these to reduce their thermal conductivity thereby improving their potential for use as insulation.

Test Procedure

Thermal conductivities were measured using a Lasercomp Fox314, which is suitable for insulating materials with a maximum thickness of 102mm (Figure 1). The apparatus enables measurements to be carried out to ISO 8301:1991 (Thermal insulation - Determination of steady-state thermal resistance and related properties - Heat flow meter apparatus).

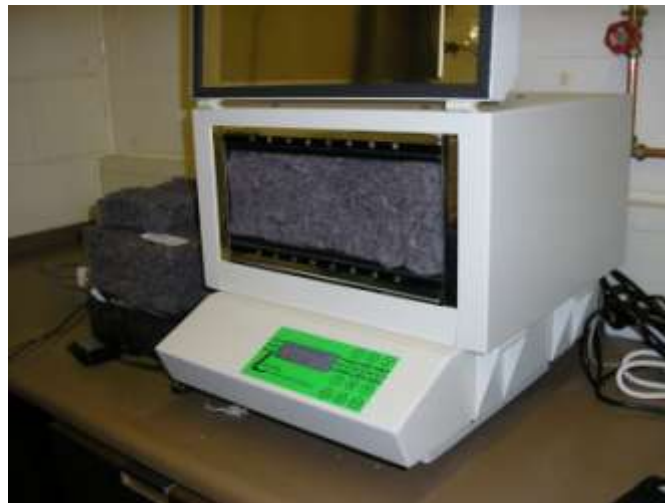


Figure 1. Lasercomp Fox314 thermal conductivity apparatus for insulating materials.

When setting up a test with fibrous insulation it is usual to program in to the apparatus the actual sample thickness, however the platens of the apparatus can be adjusted to compress the material, thereby increasing the density. Thus a range of densities can be tested.

Measurements are usually made with a mean temperature of 10°C, with a cold platen temperature of 0°C and the warm platen at 20°C.

Results & Discussion

The thermal conductivities of a range of prototype insulation materials for different densities are given in Table 1.

Table 1

Fibre/Waste Material	Density kg/m ³	Thermal
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		conductivity W/mK
Cashmere	42	0.034
Cedar Shavings	54	0.042
Cotton from Mattresses	31	0.037
	57	0.036
Denim Dust	27	0.036
	36	0.035
	53	0.035
Feathers	36	0.033
Paper#1	31	0.035
	36	0.035
	43	0.035
	51	0.035
Paper#2	36	0.035
	49	0.035
Polyester	31	0.043
	36	0.040
	43	0.039
	66	0.036
Polyester/Mixed Fibres	31	0.038
	43	0.032
	85	0.032
Re-cycled foam	40	0.036
	45	0.035
Shoddy	36	0.034
	61	0.034

The majority of these materials compare favourably with common insulation materials such as glass fibre with thermal conductivities below 0.04 W/mK. The results are compared with expanded polystyrene (EPS), glass fibre, polyisocyanurate/polyurethane (PIR/PU) and extruded polystyrene (XPS) in Figure 2.

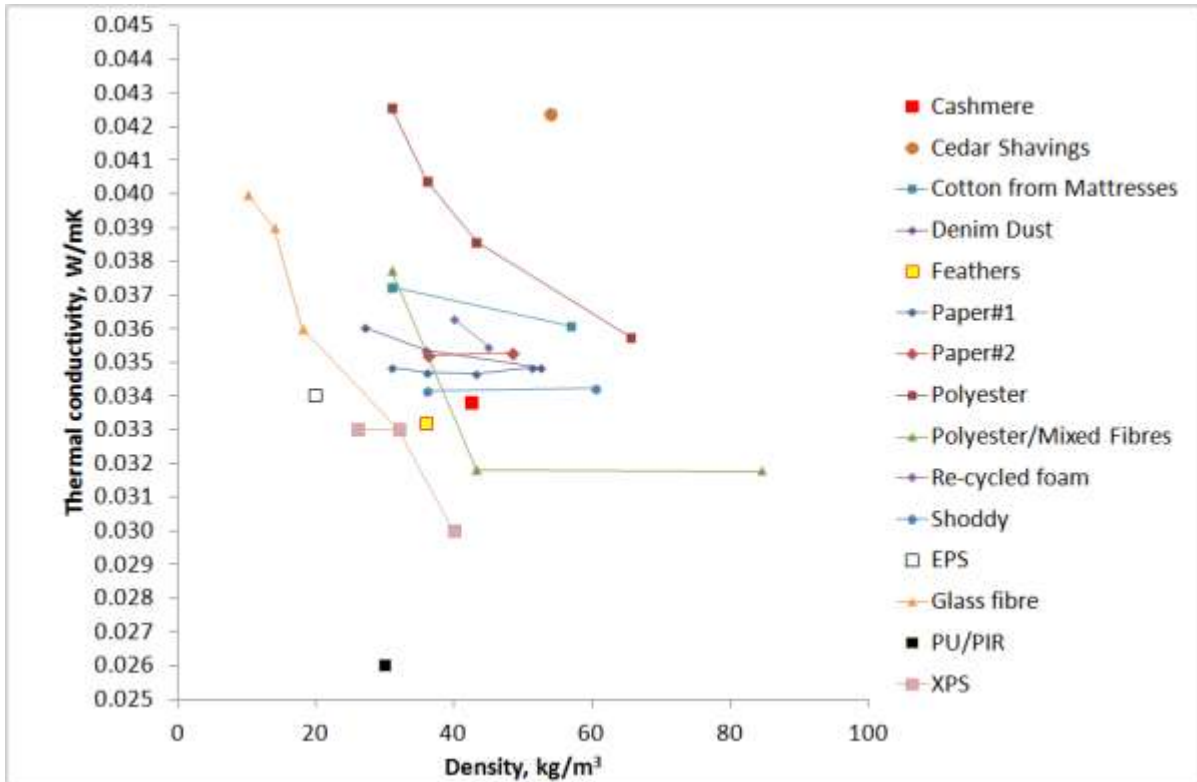


Figure 2. Comparison of prototype insulation with common insulation materials

Figure 2 shows that the minimum densities of the prototype materials required to achieve similar thermal conductivities to the range of glass fibre are higher. For example, the densities of denim dust and glass fibre with a thermal conductivity of 0.036 W/mK are 27 kg/m³ and 18 kg/m³, respectively.

Conclusions

The prototype materials show considerable potential as insulation materials with thermal conductivities between 0.032 and 0.043 W/mK if the waste streams are viable for large scale production.

The densities are higher than the range of glass fibre densities giving similar thermal conductivities. It is recommended that lower density prototypes are produced and tested.

The polyester/mixed fibre prototype gave the best result of 0.032 W/mK for densities between 43 & 85 kg/m³.

The potential of mixing fibres from different waste streams should be considered as a number of the materials tested fall in to the band of thermal conductivities 0.034-0.036 W/mK.