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LIFE CYCLE ASSESSMENT OF BIO-BASED THERMAL INSULATION MATERIALS FORMED BY DIFFERENT METHODS

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Abstract

Inorganic thermal insulators are commonly used to improve energy efficiency. However, environmental and health aspects of their production until the end of life have been increasingly concerned. Agricultural wastes including rice straw, rice husk and corn cobs are abundant in Thailand and converted into value-added products such as thermal insulation materials offers a viable recycling opportunity as the ecological burden of a product has now become a widely-discussed issue. In this paper, global warming potential impact of thermal insulation materials made from agricultural wastes; rice straw, bagasse, coconut coir and oil palm fibre, were assessed by using IPCC2007, while Eco-indicator 99 was applied to evaluate the endpoint impact. Moreover, those impact of three different forming processes including (i) hot-pressing, (ii) using concentrated latex as a binder and (iii) using mixed concentrated latex-chemicals as a binder were compared. The physical properties of the insulation pads were tested to identify qualities such as density, water absorption, thickness swelling, fire resistance and thermal conductivity. The eco-efficiency of the insulation pads was also measured the performance and environmental impact and compared with commercial thermal insulators. Results revealed that thermal insulators formed by mixed concentrated latex-chemicals had the lowest thermal conductivity, while those formed by hot-pressing had the highest. Thermal conductivity of the four agricultural waste thermal insulation materials varied between 0.042–0.087 W/mK. Insulators made from rice straw caused the greatest environmental impact followed by those made from bagasse, coconut coir and oil palm fibre respectively. The result of eco-efficiency of oil palm fibre insulator, formed by mixed concentrated latex-chemical, was best presented and closed to the eco-efficiency of commercial thermal insulators.

Key words: agricultural waste, concentrated latex, hot-pressing, life cycle assessment, thermal insulation

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