

New Novel Thermal Insulation and Sound-Absorption Materials Extracted from Agro/medical Waste Materials: Toward Green Cities of Zero Waste

Mohamed E. Ali

King Saud University, College of Engineering
Mechanical Engineering Department
P. O. Box 800, Riyadh 11421, Saudi Arabia
mali@ksu.edu.sa, <https://fac.ksu.edu.sa/mali>
ORCID #: 0000-0001-8149-8098

Abstract

New novel biodegradable natural thermal insulation materials are manufactured from agro-waste materials of date palm trees' residuals, such as leaves or surface fibers, pineapple crown leaves, sunflower seeds (hull), watermelon seeds (husk or shells), Eucalyptus Globulus waste leaves, wheat straw fibers, and Apple of Sodom fibers. Other wastes, such as coffee and tea filters and black tea bags, can also be implemented. In addition, medical waste of personal protective equipment, such as disposable facemasks, can also be used after some health hazard treatments. The developed materials and their hybrid ones can be used in building thermal insulation. Laboratory-scale thermal insulation boards are made from a single agro material or a hybrid composite with different compositions. Different binders, such as wood adhesive and/or cornstarch or any other binders, will be used to bind the fibers/leaves. Morphology analysis of the fibers/leaves, such as scanning electron microscopy, chemical composition, Fourier transformation Infrared, and energy dispersive X-ray spectroscopy, is performed for each loose agro/medical waste raw material. Thermal characteristic (stability and decomposition) tests of the fibers/leaves of waste materials or the composite materials are determined. Such thermal tests will include thermo-gravimetric analysis and its differential. Thermal conductivity coefficients of the raw materials and their composite ones are determined in the range of 0.05 to 0.08 Watt/m.K for a temperature range between 20°C and 80°C at different densities. Sound absorption coefficients are obtained and found in the range 0.4- 0.8 in a frequency range between 500 to 6000 Hz. The developed composites have a low moisture content under the environmental conditions of Riyadh. All the earlier mentioned tests confirm using such agro/medical waste materials and their composites as novel new materials to be used for sound-absorbing and thermal insulation in buildings to reach green buildings and satisfy the 2030 strategy of the Kingdom toward a smart green city of zero agro/medical waste materials.

Keywords

New Novel Thermal Insulation, Sound-Absorption Materials, Agro/medical Waste materials, Toward Green Cities, Zero Waste.