Abstract

With more than half—51% in 2020—of a household's annual energy consumption used for space heating and air conditioning, building insulation is important. However, typical building insulation materials are petrochemically derived, which has a range of adverse impacts including contributing to resource depletion, pollution, and CO_2 emissions during extraction and manufacturing. This situation motivates a need for alternative low emission materials during building construction, that can also be recycled or reused during demolition or disposal. Experimentally, this means developing and testing new materials in comparison with known samples to determine properties like thermal conductivity (k-value). For this purpose two instrumented apparatuses, a linear heat conduction module (LHCM) and radial heat conduction module (RHCM) were developed and tested.

Motivated by interest in identifying sustainable low-k materials to be used for building insulation, the present work explores the experimental determination of a range of samples, some conductive that would not be used as insulation, and some that would specifically be used as insulation. This approach is used to establish better understanding of the use of steady state techniques in determining k-values of materials ranging from as high as 10^2 down to 10^{-2} $W^{-1}mK^{-1}$, which is closer to the range of k values for building insulation materials.

One potential type of alternative material that can be used for insulation are "mycomaterials," which are materials made of fungal mycelium. These are sustainable biomaterials created by growing mycelium on an organic substrate. These materials have various benefits including having fire retardant characteristics and being biodegradable without commercial composting facilities. The present work establishes limitations on the LHCM in determining low k values and uses the RHCM to determine k-values of plastic foams, fibrous synthetic wools, and mycomaterials.