Experimental and Modelling Characterization of Building Integrated Phase Change Materials for Cold Climate Locations

Bio:

Calene Baylis is a PhD Candidate in Mechanical Engineering at the Carleton University Centre for Advanced Building Envelope Research (CU-CABER). Her research is focused on the integration of novel phase change materials into traditional building materials, via experimental and modelling methods, to decrease cold climate space heating and cooling loads and increase occupant comfort. Her long-time passion for sustainable buildings led her to Carleton to pursue her Master's in Sustainable Energy Engineering with thesis research on solar thermal collectors coupled with heat pump water heaters as a means for reducing residential energy consumption and emissions across Canada. She is presently the graduate student representative of the Carleton University Advisory Committee on Sustainability, Energy Efficiency and Climate Change, and has received Natural Sciences and Engineering Council of Canada (NSERC) scholarships at both the MASc and PhD levels. In addition, she was awarded the Gold Medallion in Mechanical Engineering for graduating with the highest grade-point average in her undergraduate program at University of Manitoba.

Abstract

Over 40% of energy within Canada is consumed by buildings, two thirds of which is attributed to space cooling and natural gas-dominant space heating. As such, greenhouse gas emissions could be significantly reduced by decreasing space conditioning loads. One method for achieving these reductions is through the use of phase change materials (PCMs) which employ latent thermal storage to store solar energy in the middle of the day through melting and release it at night through solidification. In doing so, PCMs can decrease cooling loads in the summer and heating loads in the winter, thus reducing both space conditioning loads simultaneously. In this project, PCM-integrated building materials for cold climate buildings have been evaluated experimentally and via simulation. PCM-integrated drywall, as well as novel plant-based PCMs were analyzed to determine their thermophysical properties and simulations were conducted to determine PCM strategies for reducing space conditioning loads and emissions. Finally, full-scale experimental analyses which are presently underway at the Centre for Advanced Building Envelope Research (CABER) are being conducted on PCM-integrated drywall. The outcomes of this project suggest that PCM-integrated homes in cold climate locations, both Canadian and international, may realize reductions in total annual conditioning loads of over 20%.