

Phase-Change-Material-Impregnated Wood for Potential Energy-Saving Building Materials

ABSTRACT

PCMs (phase change materials) are ideal for thermal management solutions in buildings. This is because they release and store thermal energy during melting and freezing. When this material freezes, it releases a lot of energy in the form of latent heat of fusion or crystallization energy. Conversely, when the material melts, it absorbs the same amount of energy from its surroundings as it changes from a solid to a liquid state. In this study, Oriental spruce (*Picea orientalis* L.) sapwood was impregnated with three different commercial PCMs. The biological properties and the hygroscopic and thermal performance of the PCM-impregnated wood were studied. The morphology of PCM-impregnated wood was characterized through the use of scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FT-IR), thermogravimetric analysis (TGA), and differential scanning calorimetry (DSC). PCM-impregnated wood demonstrated low performance in terms of storing and releasing heat during phase change processes, as confirmed by DSC. The results show that PCMs possess excellent thermal stability at working temperatures, and the most satisfying sample is PCM1W, with a phase change enthalpy of 40.34 J/g and a phase change temperature of 21.49 °C. This study revealed that PCMs are resistant to wood-destroying fungi. After the 96 h water absorption test, the water absorption of the wood samples decreased by 28%, and the tangential swelling decreased by 75%. In addition, it has been proven on a laboratory scale that the PCM material used is highly resistant to biological attacks. However, large-scale pilot studies are still needed.