Effect of wood modification and weathering progress on the radiation emissivity

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ABSTRACT

The research reported here is a part of the BIO4ever project, which aims to develop numerical models simulating performance of the bio-based cladding materials in relation to the exposure time or so-called "weather dose". The amount of solar radiation absorbed, together with the surface temperature and its moisture content were identified as driving factors influencing surface weathering. The forecast and kinetics of abovementioned properties on the façade surface was simulated with support of Finite Element Method (FEM) and dedicated software (COMSOL Multiphysics V.5.3). The value of emissivity is one of the thermodynamic material constants, highly affecting heat transfer calculations. Although, the lack of reliable emissivity data for several investigated materials was discovered during model's preparation, especially in a case of samples made from modified woods and these with coated surfaces. It was especially important as the emissivity is directly related to the surface state/condition, and might change due to the weathering process. For that reason, a dedicated experimental campaign was conducted in order to determine accurate values of emissivity for all bio-materials representing categories investigated within the BIO4ever project. The thermographic (radiometric) measurements were conducted by means of thermal camera FLIR T200, covering a spectral range from 7.5 to 13 µm. Tests were carried out on samples at different stages of weathering: 0, 3, 6 and 9 months of natural exposure to South direction. The emissivity was determined at four ambient temperatures: -20, 0, +20 and +40˚C, where experimental samples were conditioned before thermography in a climatic chamber for a period of at least six hours. The emissivity parameters obtained experimentally are essential for precise numerical modelling of the solar radiation and of the moisture content changes in all investigated bio-materials. Subsequently, realistic simulation of the façade appearance and its aesthetical changes become possible by considering simultaneously time of service, geographic location, local microclimate and intrinsic material characteristic.