

Comparison of Non-destructive Devices to Quantify the Moisture Content of Bio-Based Insulation Materials on Construction Sites

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Abstract : Improvement of the thermal performance of buildings is a high concern for the construction industry. With the increase in environmental issues, new types of construction materials are being developed. These include bio-based insulation materials. They capture carbon dioxide, can be produced locally, and have good thermal performance. However, their behavior with respect to moisture transfer is still facing some issues. With a high porosity, the mass transfer is more important in those materials than in mineral insulation ones. Therefore, they can be more sensitive to moisture disorders such as mold growth, condensation risks or decrease of the wall energy efficiency. For this reason, the initial moisture content on the construction site is a piece of crucial knowledge. Measuring moisture content in a laboratory is a mastered task. Diverse methods exist but the easiest and the reference one is gravimetric. A material is weighed dry and wet, and its moisture content is mathematically deduced. Non-destructive methods (NDT) are promising tools to determine in an easy and fast way the moisture content in a laboratory or on construction sites. However, the quality and reliability of the measures are influenced by several factors. Classical NDT portable devices usable on-site measure the capacity or the resistivity of materials. Water's electrical properties are very different from those of construction materials, which is why the water content can be deduced from these measurements. However, most moisture meters are made to measure wooden materials, and some of them can be adapted for construction materials with calibration curves. Anyway, these devices are almost never calibrated for insulation materials. The main objective of this study is to determine the reliability of moisture meters in the measurement of biobased insulation materials. The determination of which one of the capacitive or resistive methods is the most accurate and which device gives the best result is made. Several biobased insulation materials are tested. Recycled cotton, two types of wood fibers of different densities (53 and 158 kg/m³) and a mix of linen, cotton, and hemp. It seems important to assess the behavior of a mineral material, so glass wool is also measured. An experimental campaign is performed in a laboratory. A gravimetric measurement of the materials is carried out for every level of moisture content. These levels are set using a climatic chamber and by setting the relative humidity level for a constant temperature. The mass-based moisture contents measured are considered as references values, and the results given by moisture meters are compared to them. A complete analysis of the uncertainty measurement is also done. These results are used to analyze the reliability of moisture meters depending on the materials and their water content. This makes it possible to determine whether the moisture meters are reliable, and which one is the most accurate. It will then be used for future measurements on construction sites to assess the initial hygrothermal state of insulation materials, on both new-build and renovation projects.

Keywords : capacitance method, electrical resistance method, insulation materials, moisture transfer, non-destructive testing

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