A29: Degradation of mineral wool: the effect of elevated temperature and moisture content on the hygrothermal properties

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About the conference
The following abstract is from the 3rd International Conference on Moisture in Buildings (https://ukcmb.org/icmb25) held in UM Guimarães, Portugal, on the 23-24 Oct 2025. All abstracts published here underwent single blind review by the Conference Scientific Committee.

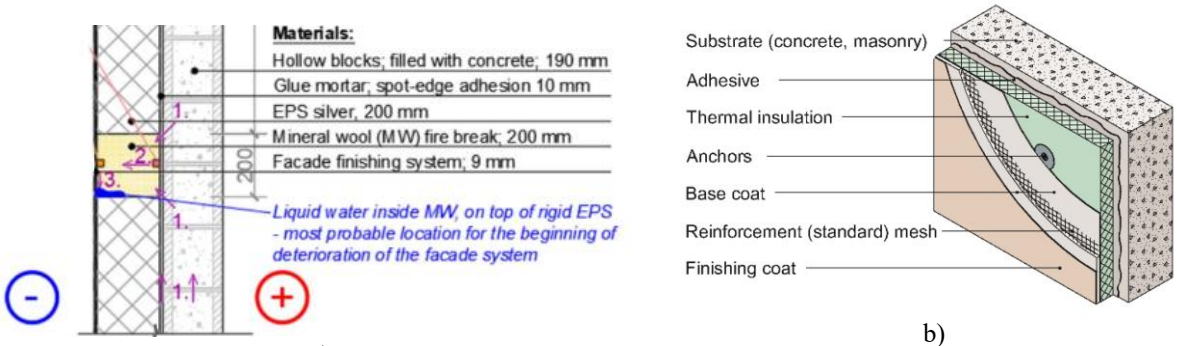
Abstract

Mineral wool is commonly used as an insulation material on buildings as the main insulation material or as fire breaks in buildings insulated with EPS. In ETICS facades, problems have occurred at the mineral wool fire break, where water has accumulated between the fire break and EPS insulation, and the water has been absorbed into the mineral wool and can lead to horizontal cracks along the façade. As the facade can heat up to 70˚C, which will transfer the heat to the mineral wool, creating a warm and moist environment which can have an effect on the mineral wool's properties. Mineral wool samples were aged in water at a elevated temperature and then, compressive strength and moisture retention curves determined. Results showed a significant loss of strength and higher water retention due to the aging process, which could lead to the deterioration of the façade.
Peer-review under the responsibility of the organizing committee of the ICMB25.
Keywords: moisture; mineral wool; ETICS; hygrothermal preformance

1. Method

In Europe ETICS is a very common façade system for new and renovated buildings. It is manly used on cast concrete or concrete (light concrete) block buildings (small apartment buildings, single family homes). ETICS consists of insulation material (usually EPS or mineral wool), which is glued of mechanically fastened to the structure. On the insulation, plaster is installed in two layers to make the façade weather resistant (Fig. 1). In Estonia fire safety regulations require fire breaks in the façade, if the main insulation that is used is flammable, commonly EPS as the main insulation and mineral wool fire breaks at each floor level (1). This has resulted in water accumulating behind the plaster on the interface of mineral wool and EPS (2). This can result in horizontal cracks forming along the façade at each floor level. (3). As the mineral wool is subjected to warm and moist

conditions behind the plaster, we wanted to investigate if these conditions could have an effect on the material properties of the mineral wool.



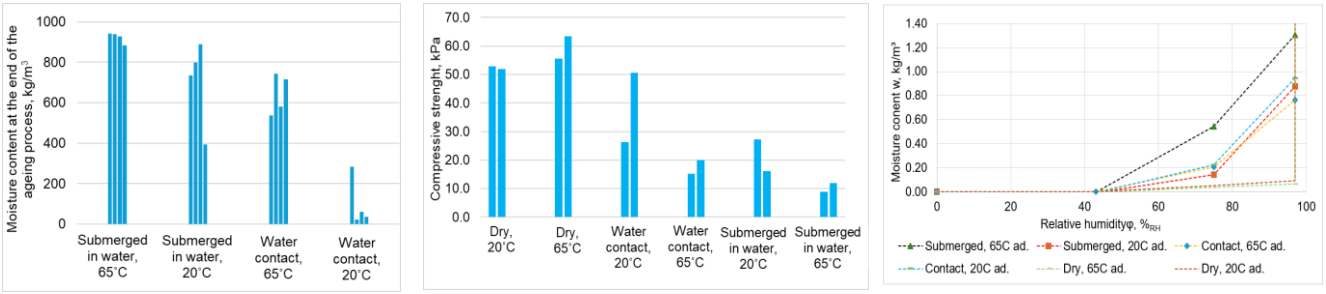
a) b)

Figure 1 (a) Water accumulation inside ETICS façade (3) . (b) Cross-section of ETICS wall (4).

For this preliminary study, 6 batches of 4 mineral wool cubes, approximately 5x5x5 cm, were used. The batches were used to test three different conditions at two different temperatures: mineral wool completely submerged in water at 65 ˚C and 20 ˚C, mineral wool in contact with water at 65 ˚C and 20 ˚C, and mineral wool in dry conditions at 65 ˚C and 20 ˚C. Two temperature points were used, to see if higher temperature affects the absorption of water. The mineral wool samples were aged for two weeks and then dried at 65˚C. After aging, moisture retention curve and compressive strength of the mineral wool cubes were measured.

2. Results and discussion

Conditions in which the mineral wool was aged played a pivotal role in moisture content at the end of aging (Fig. 1). Samples that were aged by being completely submerged and at 65°C absorbed the most water, average of 922kg/m^3 Samples aged at 20˚C submerged, had 24% lower moisture content compared to the ones at 65˚C. Temperature had a larger effect on the samples which were in contact with the water but not submerged in it. At 65˚C the average moisture content was 643 kg/m^3 and at 20˚C the average was 100 kg/m^3. This shows that, at elevated temperatures in contact with water, mineral wool is able to absorb more than at lower temperatures.



a) b) c)

Figure 2 (a) Water absorbed during the ageing process. (b) Dry compressive strength of the test samples. (c) Water retention curve for adsorption

Adsorption curve results show, that the ageing process has an effect on the amount of moisture the mineral wool can store (Fig. 2). Samples that were aged by being submerged at 65˚C had the highest adsorption curve. Rest of the aged samples results were within a few per cent of each other. Aging at 65 °C without water contact had the least effect on adsorption curve as the measurement results were almost identical to the unaged samples.

A compressive strength test was performed after the adsorption curve was determined on half of the test samples with the other half to be used for further aging and testing which was not able to be done for this paper (Fig. 2). The samples that absorbed more water during the ageing had a lower compressive strength (at 10% deformation) than the samples that absorbed less water or were not aged in the water at all. Submerged at 65˚C samples had the lowest compressive strength at 8.81 kPa and 12.0 kPa, while the samples that were in water contact at 20˚C had a compressive strength of 26.2 kPa and 50.5 kPa which is still lower compared to the dry ageing samples. This

shows that the structure of the mineral wool has changed but it is not clear in which way and thus requires further investigation.

3. Conclusion

These preliminary tests show that the aging of mineral wool while submerged or in contact with water at elevated temperatures influences the material properties. Mineral wool that had been completely saturated at 65˚C was able to retain more moisture and became significantly weaker compared to other samples. This suggests that during the ETICS façade's life cycle, the properties of the mineral wool fire breaks are subject to change, as similar conditions form behind the plaster, e.g., direct contact with liquid water and temperatures up to 70˚C (5). The effects of these changes on the façade require further investigation.

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