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Assessing Water Resistance and Surface Properties of ETICS

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1 Introduction

External Thermal Insulation Composite Systems (ETICS)can significantly improve the thermal performance and energetic efficiency of buildings masonry. However, ETICS are constantly exposed to weathering agents (*e.g.* wind, rain, sun light, etc.) and anthropic factors (*e.g.* vandalism, environmental pollutants) which can lead to an alteration of physical-chemical, aesthetical and mechanical properties of ETICS.

In this paper, the moisture transport properties (water capillary absorption, drying kinetics, water vapour permeability) and superficial properties (colour, brightness, surface roughness) of several commercially available ETICS were studied. The main aim was the identification of the possible connection between these properties and, ultimately, a deeper comprehension of the dynamics behind the durability of ETICS surface coatings in urban environment.

2 Materials and Methods

Several ETICS from 3 producers were considered. These systems differ for their thermal insulation (EPS, MW, ICB), base coating (with cementiceous or lime-based binder, with organic or mineral additives) and finishing coating (based on acrylic, siloxane or silicate). Capillary absorption and drying tests were carried out on the ETICS specimens, as well as water vapour permeability (WVP) tests. Furthermore, some optical (colour, brightness) and physical (surface roughness) properties of the ETICS were studied.

3 Results and Discussion

Results show that all systems have capillarity coefficient values < 1kg/m^2, thus meeting the requirements of ETAG 004 for the technical approval of ETICS. Systems 1, 2, 3, 9 and 11 have capillary absorption < 0,5 kg/m^2, and, thus, according to ETAG 004, those systems are resistant to freeze-thaw cycles. Additionally, system 9, with silicate-based finishing coat, has lower capillary absorption, when compared to system 10, which differs only for its acrylic-based finishing coat. The capillary absorption of system 8 and 12 (with MW as thermal insulation material) indicate that liquid water probably reaches the insulation layer. When observing the drying kinetics, it can be concluded that the systems that absorbed more water by capillarity, are those with faster drying, which allows for some compensation and a possible adequate global behaviour.

Concering the water vapour permeability, the diffusion-equivalent air-layer thickness (S_d) of the base and finishing coat of the systems is < 2m in all cases (< 1m for MW systems) (Tab. 1).

Results presented in Fig. 1a indicate a low chroma for all systems. ETICS 9 (finished with a silicate-based coating) has higher colour coordinates (closer to an ideal white colour) compared to acrylate-based finishing coating. ETICS 9, which is finished with a silicate-based coat, has also remarkably lower surface roughness, comparable to that of systems 1 and 4.

Table 1. Results of the capillary water absorption, drying and water vapour permeability test.

Systems	Capillary absorption		Drying			WVP		
	Capillary absorption 1h (kg/m^2)	Cc ($kg/m^2.min^{0.5}$)	DR1 ($kg/m^2.min^{0.5}$)	DR2 ($kg/m^2.min^{0.5}$)	DI	μ ETICS	μ Thermal Insulation	Sd finishing (m)
1	0.10	0.027	0.000053	0.0027711	1.05	65.75	42.45	1.12
2	0.06	0.019	0.000050	0.0025406	1.05	65.22		1.15
3	0.12	0.034	0.000113	0.0051086	1.02	44.27		0.29
4	0.92	0.193	0.000287	0.0154256	1.02	16.28	8.86	0.54
5	0.96	0.184	0.000252	0.0127771	1.01	16.78		0.54
6	0.67	0.115	0.000283	0.0141846	0.98	32.63	35.81	-
7	0.77	0.172	0.000403	0.019722	0.94	42.20		0.58
8	0.64	0.160	0.000280	0.0146646	0.98	6.73	1.90	0.31
9	0.13	0.034	0.000110	0.0051607	1.03	12.06	14.07	-
10	0.23	0.081	0.000158	0.0079991	1.00	25.49		0.54
11	0.15	0.049	0.000086	0.0043290	1.00	48.94	39.83	0.59
12	0.42	0.151	0.000186	0.0099738	0.98	24.43	2.74	0.99

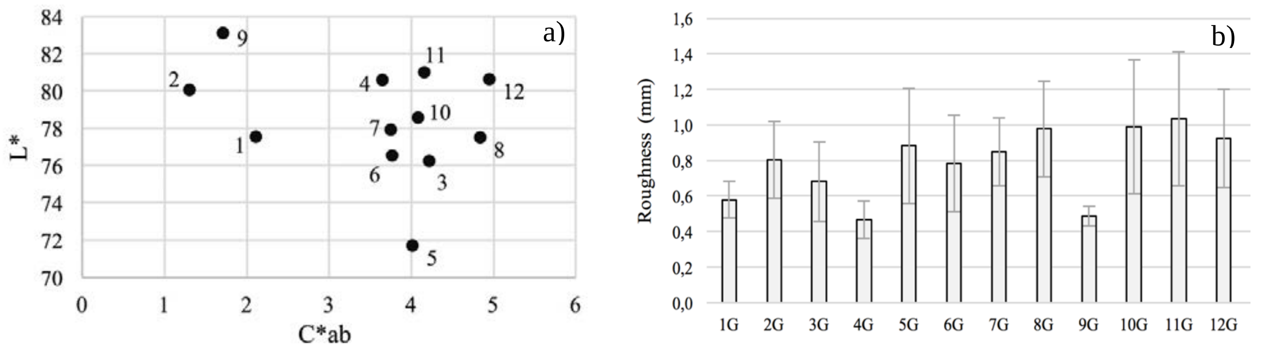

Figure 1. a) Comparision of the colour coordinates (CieLAB) and b) of the surface roughness of the ETICS.

4 Conclusions

Results showed that all systems respected the hygric requirements of ETAG for the technical approval of ETICS, *i.e.* all have capillary absorption lower than $1kg/m^2$ at 1h and a suitable water vapour permeability (diffusion-equivalent air-layer thickness < 2m). It was observed that, generally, systems that absorb more water are those that have higher dry rates and higher water vapour permeability, and vice versa. In general, a significant difference in the moisture transport properties is given mostly by the composition of the finishing render (base and finishing coats), rather than the surface properties (*e.g.* roughness). When observing results of the optical surface tests, it can be seen that the systems with acrylate-based finishing coat are generally less whitish and less bright, when compared to systems finished with silicate-based or lime-based systems.

Ultimately, it was observed that systems 1, 4 and 9 (one of each producer), the ones with the highest colour and brightness values, have also the lowest roughness values. The higher values of the other systems are attributed to the addition of mineral loads (aggregate) in the finishing coat.

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Reference

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