Impact of dust build-up on building airtightness durability: preliminary results of the Durabilitair2 project

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CONTEXT:

The DURABILITAIR project, conducted from 2016 to 2019, aimed to assess the durability of air sealing products used in building envelopes. Key findings were presented at the AIVC conferences in 2017 (Nottingham, UK) and 2019 (Ghent, Belgium). This research enhanced understanding of the in-situ characterization of air tightness evolution in homes over time and contributed to developing accelerated aging test protocols under controlled laboratory conditions.

Built on the previous project, DURABILITAIR2 seeks to deepen knowledge of air tightness evolution, particularly focusing on the implementation and early use of air sealing in newly built single-family homes. This project addresses the French Ministry of Construction's request to further investigate the energy performance of buildings over time.

OBJECTIVES AND PROTOCOL:

The DURABILITAIR2 research and development project has the following major objectives:

- To identify factors that degrade the air tightness of building envelopes during the first year of occupancy.
- To provide concrete recommendations to mitigate or eliminate these factors, especially those related to the implementation conditions of air sealing products.
- To quantify the impact of poor implementation conditions on the durability of airtightness.

Various bibliographic and metrological studies are currently being conducted both on-site and in laboratories in order to:

1) characterize the factors degrading airtightness within the first year of occupancy through a field measurement campaign on construction sites of individual houses
2) establish a protocol for accelerated aging of air sealing product assemblies under controlled laboratory conditions in an environmental chamber.

International standards require surfaces to be clean, stable, dry, and free of grease and dust to guarantee optimal performance. It appears to us that no company is ready to guarantee the adhesion of its products on dusty surfaces. In fact, we have identified as the limit of guaranteed adhesion the criteria of temperature, humidity and dust. This study investigates the physical-chemical cleanliness, specifically dust, which may impair adhesion surfaces and degrade the performance of air sealing over time. Hence, this article focuses on assessing the feasibility of an experimental method to quantify dust contamination on surfaces where air sealing products are applied.

Different methods of dust quantification have been examined, among them:

- Light Diffraction: Using laser granulometry to measure particles on a transparent surface.
- Visual Contrast: Assessing dust on a standardized color surface, as per NF X 50-792.
- Weight Measurement: Measuring dust mass collected between adhesive tapes, the method chosen for this study.

We defined an operational procedure for on-site sampling based on weight measurement but also visually using an evaluation grid. Dust samples were collected using adhesive tapes before air sealing application, at the dustiest stages of construction. Samples were weighed using a high-precision balance to quantify dust from various construction sites.

RESULTS AND INTERPRETATION:

Seventeen dust samples from different sites were weighed. The weight difference between dusted and reference samples was used to calculate dust mass. Uncertainty calculations confirmed the reliability of the measurements.

Differences were observed between floor and vertical surface samples. Floor samples had significantly higher dust masses, while uncertainties in vertical surface samples often exceeded the measured values, indicating insufficient dust quantity for significant evaluation.

CONCLUSION AND FUTURE PERSPECTIVES:

The weight measurement method appears to be suitable for quantifying floor dust but less effective for vertical surfaces due to higher uncertainties. To improve reliability, increasing the adhesive tape area or reducing sample size might help. Consideration of various uncertainties, such as adhesive characteristics and environmental factors, appears to be essential.

In summary, while the weighing method effectively quantifies floor dust, further refinement and exploration of alternative methods are necessary to improve the overall reliability of dust quantification in construction sites. Such a method may help to better understand the mechanism of degradation of airtightness performance over time due to dusty surfaces.

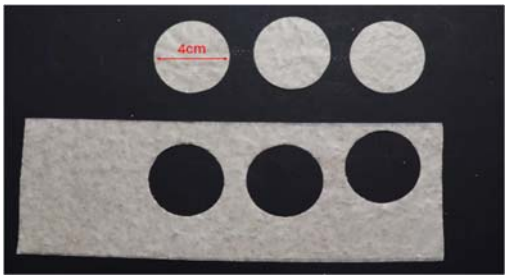

Figure 1: Preparation of samples taken on site


Figure 2: Balance Precisa BALA1055

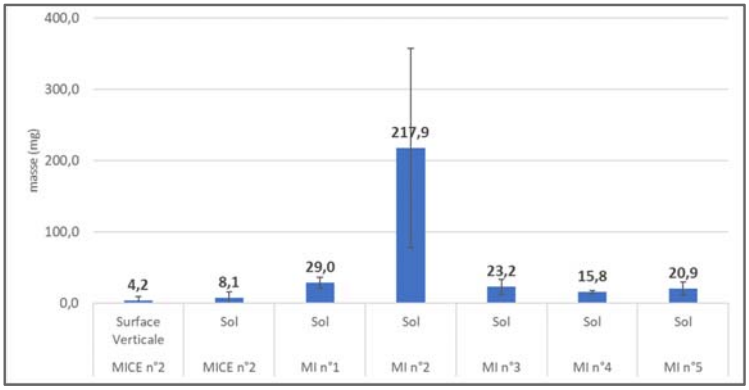

Figure 3: Average mass and associated uncertainties of samples per site