

Laboratory testing of the durability of airtightness products - Review and analysis of existing studies

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Tightvent Webinar 2020

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Durabilit'air project

- 1st task of the Durabilit'air project



Cerema



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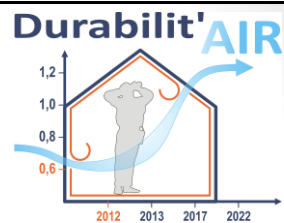
PLEIAQ CETii



- Objectives of the project:
 - State of the art of major international research findings
 - Characterizing the evolution over time in mid and long term scales by on-site measurement campaigns
 - Developing a laboratory controlled method in order to test the accelerated ageing of airtightness systems;
 - Disseminating the main results of this work to promote best practices.

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Objective of the state of the art

- Learn from previous studies
- Improve the protocol for the other tasks of the project
 - Field measurements
 - Laboratory testing

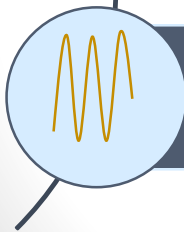


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PART II: Durability tested in laboratory



Loads on the air-barrier



Laboratory testing



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LOADS ON THE AIR BARRIER

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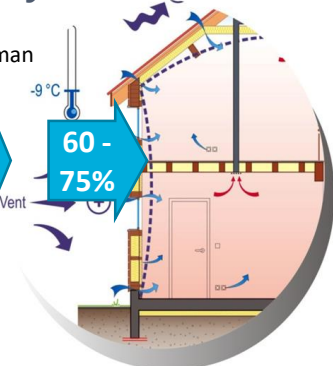


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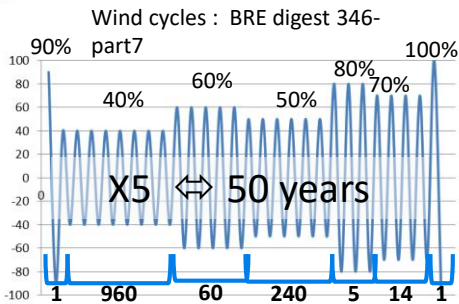
Pressure load sustained by air barrier

60m/s : maximum wind speed in France
 41m/s maximum wind speed in inhabited area

$$P_{vent} = \frac{1}{2} \rho C_p v^2$$



at météorological station



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Temperature and Humidity load

- Depends on the air barrier position
 - Inside (plaster board, etc.) or outside (plasters on masonry, some membrane) insulation
- Artificial ageing due to temperature variation: « time-temperature superposition principle »
 - Maintaining a polymer at high temperature (below glass transition temperature)
 - WLF model or Arrhenius law
 - Depends on material => **how to apply it to assembly?**
- **Heat treatment is not an ageing protocol**
 - **What predominate: physical, mechanical or chemical ageing?**

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Equivalent ageing in stove


- Inconsistent information in literature (Ackerman_2012)
- **Seems impossible to ensure an equivalence between natural and artificial ageing in the context of airtightness assembly**

Artificial aging at 65 °C / 80 % r.F. in days	Natural aging following ASTM D3611-89 [5] in years	Natural aging following SATAS [6] in years
21	10,5	3
40	20	5,7
80	40	11,4
120	60	17,1

Table 3. Correlation between artificial and natural aging





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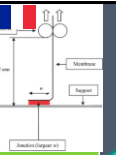






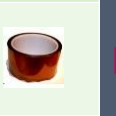


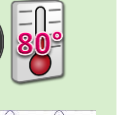
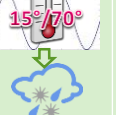
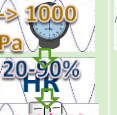








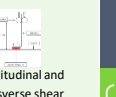
LABORATORY TESTING





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BRACKE_2014	Sherman_2004, Sherman_2003	Ylmén_2014	Langmans_2015	Michaux_2014	Antonsson_2015	Cahier 3710, CSTB_2015
						
						
						
45 à 70min	2 years	1year + 1 week at 30% RH	Test 1: 2 weeks Test 2: 12 days Test 3: 4 weeks	Few days	7 days	168h
↔?	↔30 ans	↔50 ans	↔?	↔?	↔?	↔?

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Important results

- In Swedish study
 - they observed no correlation between the ageing of the product alone (in term of peeling, etc.) and the durability of the assembly in term of airtightness
 - Due to
 - compatibility problems between film and tapes,
 - difference in the results for smaller and full scale specimens,
 - air channel appearing during the heat treatment.
- ⇒ Necessary to develop durability test of the complete airtightness systems on full-scale set-up
- ⇒ Done on a 3m*3m wall
- ⇒ They also tested the impact of implementation in cold or dusty environment
 - ⇒ Big impact

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Conclusion laboratory testing

- Results **varying from one study to another.**
- **No standardised protocol**
- General conclusions:
 - Results observed on **products alone** are not always consistent with ageing observed when they are **implemented**
 - Products' **results** with standard tests (peeling, etc.) **do not correspond to their airtightness ability**
 - Big impact of **implementation**
 - Products do not react the same way in extreme conditions and in usual conditions (temperature, humidity, pressure)
 - A standard is **missing** to characterise products and above all **assemblies in term of airtightness**
 - **Test of reproducibility are missing in studies**
 - Major limitation for scale 1:1 system: expensive and impact of implementation

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Steps to define a protocol

- Design the testing facility considering that:
 - reduced scales may not be representative,
 - tests have to be repeatable and reproducible.
- Define implementation conditions (temperature, relative humidity, dusty area, etc.).
- Specify the loads on clear bases and considering:
 - worst conditions the air barrier undergoes in the field
 - preliminary tests to evaluate of which impact between steady worst condition or cycling prevails.
- Focussing on the comparison of products, not on actual ageing.
- Implement small scale preliminary tests to evaluate the feasibility and results.
 - However product characteristics may vary depending on the sample size

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Conclusions



Standardised protocols is missing for assemblies

- Find good balance between too reduced tests (that do not characterise airtightness) and too complexes (not reproducible)



Loads on airtightness barrier

- Pressure loads defined
- Temperature/Humidity load to be defined

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Thank you for your attention!

Questions?

Source: AIVC 2017 –Nottingham:
Publication available on Airbase

<https://www.aivc.org/resource/durability-building-airtightness-review-and-analysis-existing-studies>



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