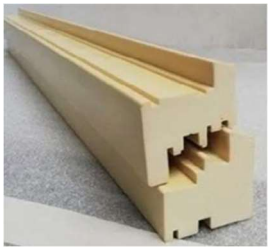
Mechanical, Durability, Acoustic tests and Thermal simulations of Indresmat window frame

MEZEROE
Measuring Envelope systems for Zero Energy buildings

INDRESMAT

Product: KLIMA-PUR window frame

INDRESMAT is a company founded in 2017 and located in Barcelona (Spain) & Geleen (The Netherlands) that is redefining the thermal envelope of buildings with materials such as biobased Polyurethane window frames and insulation foams.



Pilot Measurement & Verification Line 7

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PM&VL7

Mechanical, durability, vibroacoustic, thermal, and microclimate comfort tests of envelope products and their connectors. Mechanical, vibroacoustic, thermal, and structural (scanning and optical microscope, spectrometer) tests are used for ageing diagnosis.

SAFETY HEALTH EFFICIENCY INTERACTION

Which is the need covered by this service?

The completed program of mechanical, durability and vibroacoustic tests as well as thermal simulations were based on the certification requirements for window frames with appropriate modifications taking into account the biopolyurethane raw material used to produce the frames and the designed solutions for their connections. The obtained results indicate a path for further research and product development and may also be used during product certification.

Design of Experiments

1. Low temperature cracking according to EN 12697-46 with modifications.
2. Durability:
   - Resistance to artificial ageing by exposure to freeze-thaw according to EN 13165 with modification.
   - Resistance to accelerated ageing by exposure to temperature in accordance with the requirements of EN 13165.

   Diagnostics of durability due to ageing included features not defined in the standard:
   Mechanical test before and after artificial ageing - Strength of corners according to EN 514.
3. Direction-averaged junction velocity level difference for connector or for connection model according to our own procedure based on EN ISO 12354-1 and EN ISO 12354-2.
4. Internal surface temperature according to EN ISO 13788.

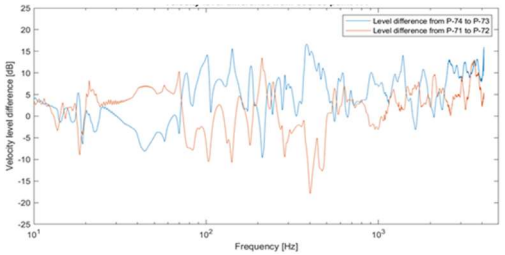
Strength of corner

Low temperature cracking

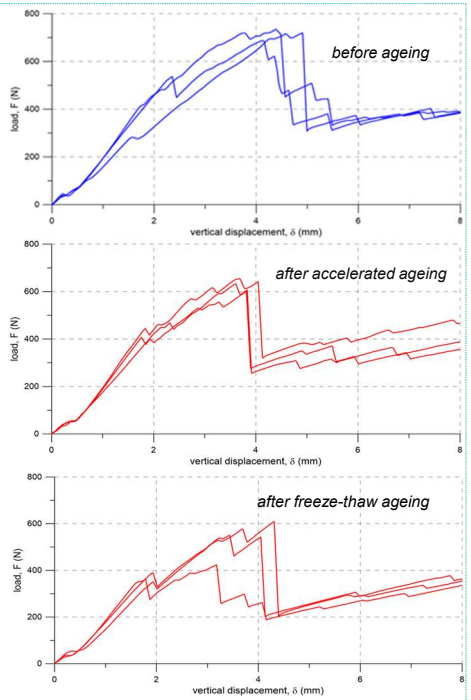
Velocity level difference

Results

1. Strength of the tested window frame corners is 3.3 N/mm², 2.5 N/mm² and 2.9 N/mm² for reference specimens, specimens after freeze-thaw ageing and specimens after accelerated ageing, respectively. Relationships between load and vertical displacement of corners before and after ageing.
2. In the low temperature cracking test, the average value of maximum cryogenic stress was equal to 1.36 MPa.
3. Foamed (bio)polyurethane frame connections found to be acoustically stiff. Average transmission of vibration velocity in frequency domain is below 6 dB.

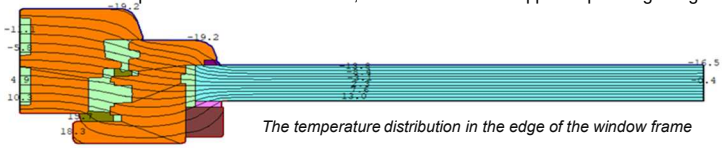


Velocity level difference from source point W1



Relationships between load and vertical displacement of corners

4. The purpose of the test was to check whether condensation and mold may occur on the inner surface of the window frame. The temperature distribution in the edge and middle element of the window frame was calculated as a 2D task. As a result of the analysis, it was found that in typical residential and office spaces with a moderate level of relative air humidity, condensation of water vapor will not occur. However, an influence of the applied specific glazing should also be checked.



The temperature distribution in the edge of the window frame

Conclusions

Both types of the used ageing procedure caused reduction in strength of the tested window frame corners.
In the low temperature cracking test, the specimens met the required evaluation criterion.
Biopolyurethane frame connections found to be acoustically stiff.

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