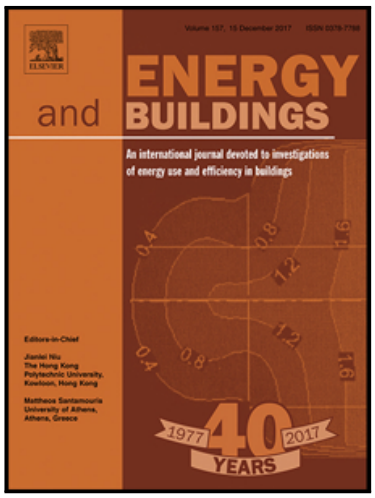

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PII: S0378-7788(17)33829-X
DOI: https://doi.org/10.1016/j.enbuild.2018.08.006
Reference: ENB 8742

To appear in: *Energy & Buildings*

Received date: 23 November 2017
Revised date: 26 July 2018
Accepted date: 5 August 2018

Please cite this article as: A. BATARD, T. DUFORESTEL, L. FLANDIN, B. YRIEIX, Prediction method of the long-term thermal performance of Vacuum Insulation Panels installed in building thermal insulation applications, *Energy & Buildings* (2018), doi: https://doi.org/10.1016/j.enbuild.2018.08.006

Prediction method of the long-term thermal performance of Vacuum Insulation Panels installed in building thermal insulation applications

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Abstract

Vacuum Insulation Panels (VIPs) are super-insulating products that can be used for different applications. When they are used for building thermal insulation, they have to maintain a very high thermal performance in long-term. The initial thermal conductivity of VIPs is around 4 $mW.m^{-1}.K^{-1}$. This very low value will increase in time, depending on the nanoporous property of the core material and on the barrier envelope efficiency which prevents the increase of moisture and internal pressure. To estimate the long-term thermal performance of VIPs, modelling is required. Simulations have shown the very great importance of the core material characteristics, and the external temperature and humidity conditions. That is why it is necessary to study the VIPs behaviour with realistic solicitations in service life for each VIP configuration. This paper proposes a methodology for determining the long-term thermal performance of VIPs when they are installed in envelope components for various building thermal insulation applications. All the methodology including the climate conditions, the building modelling and the insulation systems, is described. Severity criteria and performance indicators are proposed in order to estimate the thermal efficiency of VIPs in various applications and climates.

Keywords: Vacuum insulation panels, core material behaviour, building insulation, modelling, real solicitations

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1. Introduction

Vacuum Insulation Panels (VIPs) have been used for thermal building insulation applications for around 15 years [1], but have still not become widespread in the marketplace. Different types of VIPs exist. They can have different envelopes and core materials [2–6]. One type of VIPs doesn't have the same thermal behaviour when it is subjected to different solicitations. Different types of VIPs don't have the same thermal behaviour when they are subjected to the same solicitations [7, 8].

For commercial and technical reasons, it is necessary to estimate the long-term performance of VIPs. Short-term tests are commonly carried out and used to evaluate the VIPS conductivity evolution. But some authors have shown that a simple evaluation through a linear extension of VIP short-term evolution doesn't represent correctly its real long-term behaviour [7, 8]. It appears that more detailed modelling approaches are required to study the long-term thermal behaviour of VIPs and their ageing over 50 years. Simulations in constant conditions have been carried out for understanding the influence of the core material characteristics on the panels' thermal conductivity evolution [6–14]. These simulations have shown the very great importance of external temperature and humidity conditions. That is why it appears necessary to study the VIPs behaviour with the real solicitations that are met