

FIW München

Compressive strength of vacuum insulation panels according to EN 826:

Difficulties with the measurement results for VIP and possible solutions

Project outline and cost estimate



1 Background

Results of compressive strength according to EN 826 of vacuum insulation panels without any facings (e.g. EPS, PU, etc.) are difficult to evaluate. The main reason is the absence of a linear range in the stress-strain graph, caused by warping of the panel, surface joints and the general behavior of an inhomogeneous product under load. The consequence of this is, that the values for the compressive strength for products on the market are highly depending on the skills of the testing laboratory and show a rather high range of diversity. An example, how such a graph looks like, can be seen in *figure 1*. This problem is very striking at thin panels like 10 mm or 20 mm. This small research proposal describes possible approaches to eliminate the fortuity and to increase the reproducibility for the compressive strength measurement on VIP.

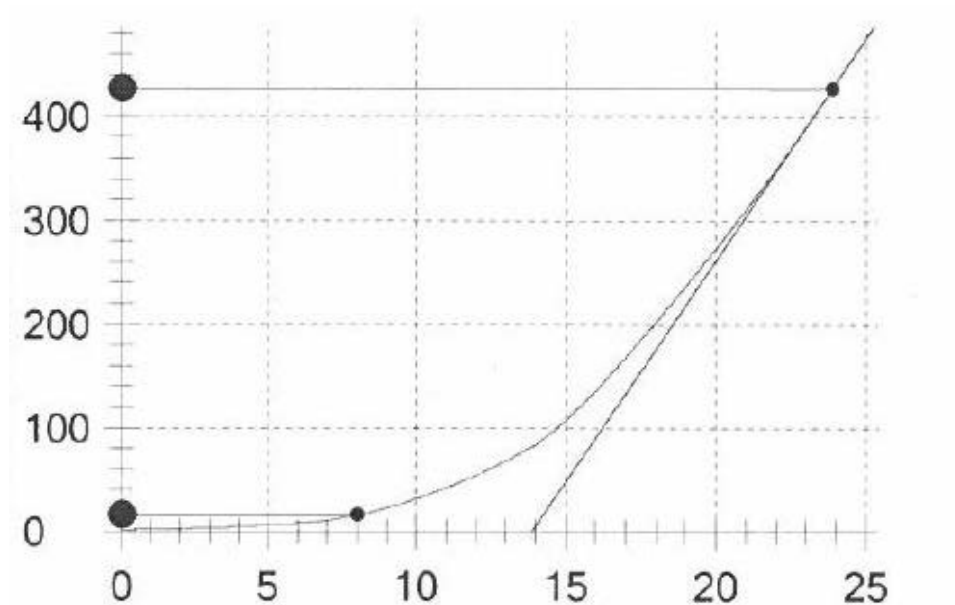


Figure 1: x-axis: compression in kPa, y-axis: strain in %; VIP thickness 20 mm; initial load 1000 Pa

2 Approach

2.1 Testing specimens without surface joints

The surface joint is one of the main reasons for the long initial range of the graph. Specimens without a surface joint (only joints on the edge) can be handled somewhat easier. To evaluate the effect of the surface joints and to get reliable results, following tests are necessary:

- Tests with different initial loads → Shortening of the initial range of the graph; evaluating the value of the initial load, depending on the thickness, the strain, the core material, the stiffness of the envelopes etc.
- Analyzing the deformation path → Starting the measurement at a certain point of the compressive behavior of the specimen (this point needs to be specified on the basis of measurements **with various boundary conditions**)
- Evaluating the influence of the geometry of the specimen → Evaluating the influence of the edges, the joints on the edges, the size of the specimen, the warping of the panels; **etc...**

This approach could lead to a shorter initial range of the graph and to a better understanding of the compressive behavior of vacuum insulation panels. It could also improve the reproducibility of the measurement results significantly.

Not finding a linear range could still remain as a problem. Additionally on the basis of the results it needs to be discussed which application is represented by the test, depending on initial load, strain, etc.

2.2 Preparation of the surface with a suitable coating

The Standard EN 826 allows to prepare the specimens with a suitable coating, if there is no other way to guarantee a plane surface. One test with gypsum on both sides - as a stiff coating for improved coupling of the initial load and for a more even distribution of this load - showed the following result:

- Good coupling of the forces
- Very low strain
- Very high measurement result compared to other materials
- Graph has a clear linear range

The test result can be seen in *figure 2*, “Probennummer 3”.

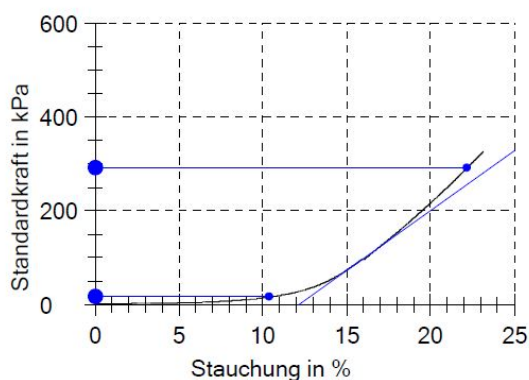
Further test are necessary to clear the following points:

- Test method suitable for all kind of panels → Evaluating the influence of the different joints (surface and edge), core materials, thicknesses,...
- Influence of the initial load and magnitude of the initial load
- Clarification of the boundary conditions concerning product surveillance and product type determination (PTD)

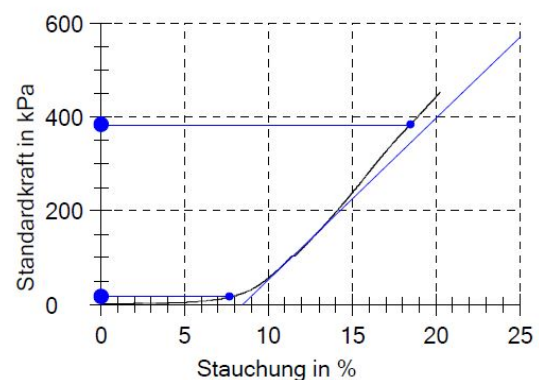
On the basis of the results it needs to be discussed:

- Which applications are represented by this test method (floating floor,...)?
- how to deal with the results for not comparable applications?
- What impact has a result with such a high result on the market?

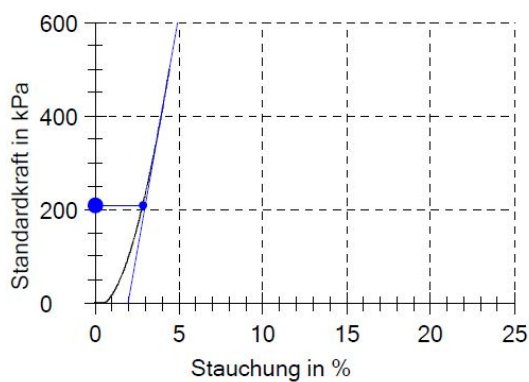
Probennummer : 1



Probennummer : 2



Probennummer : 3



Probennummer : 4

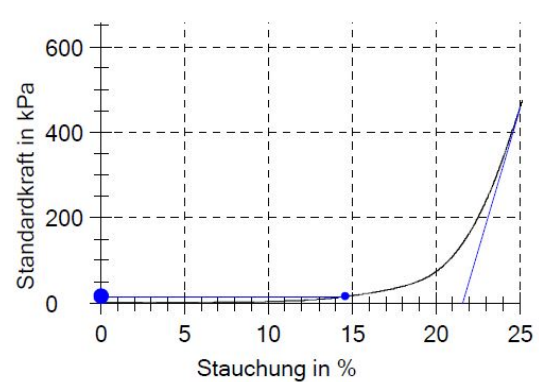


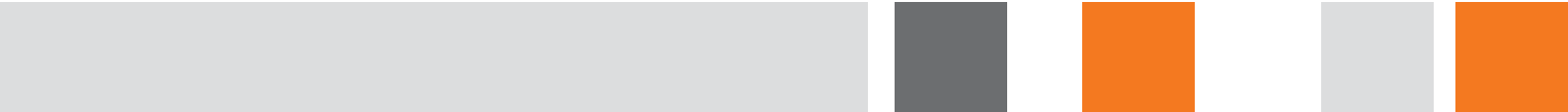
Figure 2: x-axis: compression in kPa, y-axis: strain in %; VIP thickness 10 mm.

Probennummer 1: Initial Load 1000 Pa;

Probennummer 2: Repetition test of Probennummer 1, same specimen, initial load 1000 Pa;

Probennummer 3: Both side with a gypsum coating, initial load 250 Pa;

Probennummer 4: Specimen under load of 2 kPa for 48 h before testing, initial load 250 kPa



3 Discussion and outcome

It should be discussed which applications under load exist and how these applications can be represented by a useful test method. Afterwards a guideline for special precautions on testing compressive strength needs to be developed and validated by further tests.

Tests should be carried out for different thicknesses and on panels of different producers.

Depending on the test results and the way forward, following services can be provided:

- Report and presentations for VIPA and European and International standardization committees.
- Input for different symposia and presentations for conferences
- Scientific articles in various journals
- Other...

4 Cost estimation and time schedule

In order to be able to carry out the investigation properly, an amount of approximately

15000.- Euro

will be necessary for the above mentioned program. Of course we are flexible for reduced programs and for initial investigations to be discussed. The investigations can be carried out in the second half of the year 2015.

FIW Munich
Thursday, 07.May.2015

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