

Next Step: Vacuum insulation glass




Vacuum instead of inert gases - with this technological development, glazing could take another great developmental stride. However, at 10 tonnes per square metre, the atmospheric pressure on evacuated flat glazing is immense. And for evacuated glazing, the same applies as for vacuum panels: only a lasting vacuum guarantees good thermal insulation. Now, this research project is to provide evidence that evacuated glazings with special functional layers are technically feasible for architecture.



In the foreground: Two models of vacuum insulation glass on the fair glastec06 in Düsseldorf, Germany
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Technology summary

Term of project	06/2007 - 03/2011
Technology status	 Prototype Phase
Key aspects	Facade systems, Glazing + windows

Project description

Glazing has made rapid developmental progress in the 1980s and 1990s. Triple glazings with U-values between 0.5 and 0.7 W/m²K are now possible. However, these require rare inert gases, and such glazings are several centimetres thick and quite heavy. Vacuum glass would be considerably slimmer and lighter, conceivably with thermal insulation coefficients reaching 0.4 W/m²K.

Thus, glazing with an evacuated cavity between panes, i.e. vacuum glazing, could make excellent thermal insulation properties achievable. Other advantages are that double glazing is sufficient, and that the inert gases are not required. The fact that the immense atmospheric pressure needs to be borne by numerous small support elements positioned within the cavity between panes is a disadvantage.

A Japanese company (Nippon Sheet Glass Co., Ltd. www.nsg-spacia.co.jp) and a Chinese company (Qingdao Hengda Industry Co., Ltd.) already offer vacuum glass with a modest U-value of about 1.1 W/m²K on the Asian market.

Now, a research project is to find out whether lasting vacuum-sealed glazings with U-values of around 0.4 W/m²K are technically feasible.

Focus

Evacuated glazings with functional layers (e.g. IR reflection layers) are to be developed, which have a very slim structure, and also have a U-value suitable for passive houses, i.e. approximately 0.4 W/m²K. To develop a gas-tight, thermally insulating edge seal, not only welding/brazing and adhesive methods are being tested, but also combinations thereof. Suitable spacers for bearing the atmospheric pressure must be developed, and optimised both optically and thermally.

The individual goals are:

- Evacuation to a residual gas pressure of <0.001 hPa (required for this U-value), which must be stable in a temperature range of -40°C to +60°C, and for over 20 years
- Heat transmission coefficient for the entire window of $U_w = 0.5$ W/m²K, and 0.4 W/m²K for the pane area alone
- Extremely slim structure < 10 mm
- Low weight
- Support elements which are almost invisible

Success

Firstly, numerous functional models and prototypes with different support elements and various edge seals were built and characterised. In order to subject the functional models to as realistic a loading test as possible, a device was developed for thermal load testing of glass and glass systems. In this device, the

functional models are exposed to cyclic climate change in order to test the mechanical stability and the impermeability of the edge seal.

In addition, a support material which provides sufficient mechanical stability was identified. Furthermore, the support elements are glare-free, and only perceivable in very close proximity in front of a low-contrast background.

Evaluation then showed two edge seal concepts in a positive light: metal casing, and the all-glass edge seal. Both concepts are gas-tight and mechanically stable. In addition, both approaches enable a sufficiently low manufacturing temperature for the implementation of low-E soft coatings.

The target U-value of 0.5 W/m²K has already been achieved, and it has been shown that vacuum glass can also be made with thermally pre-stressed safety glass (ESG). Furthermore, large-format vacuum glazings for all-glass facades, for example, are feasible. It is estimated that the price of evacuated glazing will be comparable to that of triple glazing today, i.e. approximately 80 euros per m².

Milestones

As of 2007, in a follow-up project, production technology for the manufacture of vacuum insulation glass is to be developed. The market launch can be expected as of 2009.

Application

Possible application areas include glazings with excellent thermal insulation properties for new buildings, especially for low-energy and passive houses or the like. Such glazings are also suitable for energy-oriented refurbishment of old buildings. Vacuum glazing could also be implemented in the area of lightweight glass construction, and in vehicle construction (trains, buses, passenger cars).

Vacuum glass with a U-value of 1.1 W/m²K is already available on the Asian market. Vacuum glass with 0.4 to 0.5 W/m²K is in development, and not yet commercially available.

 **Projektinfo by BINE Information Service**

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