INTERNATIONAL ENERGY AGENCY

Energy Conservation in Buildings and Community Systems Programme

Annex 39

High Performance Thermal Insulation (HiPTI)

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1 Introduction

1.1 The Meaning of High Performance Thermal Insulation

A significant part of end energy used in western countries is for heating and hot water production. The amount of energy required depends largely on the thermal insulation.

Efficient thermal insulation is a key issue for reducing CO_2 emissions.

There are two ways of obtaining improved thermal insulation:

- Increasing the thickness of the insulation. A method which has been used for the last 20 years but which has various disadvantages, for example the cost of construction, the loss of space, the lower available space for renting
- Improving the thermal insulation properties by reducing the heat transfer coefficient of the insulation material

The second approach could allow new construction details, easier application in building retrofit and energy efficient appliances (hot water tanks, refrigerators) if the insulation thickness could effectively be reduced.

1.2 Recent developments in the construction sector

Over the last 20 years there have been important developments in the construction sector:

- The construction industry has a need for attractive, practical and feasible insulation techniques for wall, roof and floor construction. The insulation standard has shifted from 1 W/(m^{2}K) to 0.3 W/(m^{2}K), and is today moving, in progression towards 0.2 and 0.15 W/(m^{2}K). Such insulation standard became a prerequisite for sustainable housing, passive houses or advanced retrofit. With this standards an insulation thickness of more than 20 cm in thickness is needed. In new buildings this problem can be solved to a certain degree. But when renovating existing buildings it has become obvious, how unsatisfactory these 15 to 20 cm insulation layers are in terms of the lack of space.
- The U-values of glazing systems have shifted, thanks to the use of IR-reflective layers and special gas fillings from 3.0 W/(m^{2}K) to 0.4 to 0.8 W/(m^{2}K). On the one hand this has massively affected the energy consumption of the building and on the other hand it has had, mainly during the last five years, a massive influence on the architecture, where the glassed façades became an important element.

1.3 High Performance Thermal Insulation

The need for more efficient insulation and the availability of improved insulation materials has increased the interest of the construction industry for High Performance Insulation Systems (HiPTI) which are 2 to 5 times thinner than conventional insulation systems.

Definitions

HiPTI High Performance Thermal Insulations are insulation materials or systems which have mean effective λ value smaller than 15 mW/(mK) throughout their life span.

VIP Vacuum Insulation Panels are HiPTI which are evacuated to a technical vacuum in order to further improve the thermal resistance. They normally allow a λ value smaller than 5 mW/(mK)

The definition of HiPTI would allow different types of insulation materials to be looked at. During the Annex it became clear that we concentrate on VIP.

2 Annex 39

2.1 Objectives

The main aim of Annex 39 is to develop components for buildings based on HiPTI. We call them HiPTI systems (façade element, door, hot water storage, etc.). The successful developments should lead to competitive products which are available on the market.

2.2 Time frame

The Annex was started in 2001 and is expected to be closed at the end of 2004.

2.3 Participants

Country	Institutes	Contacts
Canada	NRC National Research Council	Kumar Kumaran
Germany	ZAE-Bayern Zentrum für angewandte Energiefor-schung	Ulrich Heinemann (Leader of Subtask A) L 5
	Fraunhofer Institutes (ISE, IVV)	Alexandra Raicu Werner Platzer Klaus Noller
Netherlands	University of Delft	Hans Cauberg
Sweden	KTH Royal Institute of Technology	Gudni Johannesson Thomas Thorsell
Switzerland	Dr.Eicher+Pauli AG	Markus Erb (Operating Agent)
	EMPA Federal Laboratories for Materials Testing	Hans Simmler Karim Ghazi Samuel Brunner Reto Bundi
	FHBB University of Applied Sciences Basel	Armin Binz (Leader of Subtask B/C) André Moosmann

2.4 Subtasks

This Annex is organised in three Subtasks:

2.4.1 Subtask A: Basic concepts and materials

Existing solutions (VIP) should be investigated to improve their technical, economical and ecological characteristics e.g. thermal conductivity, physical and chemical properties, longevity, reliability, production cost, recycling and grey energy content. This includes the basic materials (microporous materials, films and foils, getter materials) and the VIP-production processes (preparation and shape of microporous materials, wrapping and sealing techniques). Further questions to be dealt with in Subtask A will also arise when subtasks B and C are handled, e.g. there might arise the need for VIP with special shapes (bent panels, panels with holes). Therefore the subtasks must overlap chronologically.

Measurement standards concerning product declaration and quality monitoring procedures will be developed.

Furthermore a method has to be developed which is suitable to determine the quality of built-in VIP (on site).

New concepts for HiPTI materials and systems will be examined and evaluated. Suitable concepts will be demonstrated as prototypes.

2.4.2 Subtask B: Application and system development

The aim is to develop suitable insulation systems for the most important applications. which should be available on the market after termination of the Annex.

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The first step is to evaluate the applications in building, which would gain dis an-tages from HiPTI's in terms of energy and/or cost saving.

Co-operation between insulation materials producers, insulation system suppliers, planners and building contractors should lead to specific product profiles. These will include technical as well as economic characteristics. Special attention should be paid to the development of products, which resemble conventional solutions as closely as possible in their application. In this way they can expect to be well received on the market.

In addition new HiPTI systems for critical parts of the building shell and for technical systems should be developed as future technologies for houses with very low energy consumption (e.g. passive houses).

2.4.3 Subtask C: Demonstration and information dissemination

The aims of this part of the Annex are field testing and market introduction of the new products. In collaboration with large, innovative building contractors, architects and opinion leaders (e.g. governmental agencies) demonstration projects will be implemented.

The following objectives should be achieved by the end of the Annex:

- In the important markets for HiPTI (e.g. internal insulation, floor heating, flat roof renovation, boiler, façade cladding systems, doors and so on).
- 10 leading building contractors from the participating countries should have performed and evaluated at least one large project with HiPTI, when renovating housing stock.
- 10 recognised and leading architects should have carried out at least one renovation or new construction project with HiPTI.
- National opinion leaders should have been informed about the HiPTI products and know about the demonstration projects.
- HiPTI products and systems should be available according to market conditions in the participating countries.
- An industry association for HiPTI in Buildings should be formed, to keep international collaboration going after termination of the Annex.