PU Europe FIRE HANDBOOK

IMPACT OF INSULATION ON FIRE SAFETY IN BUILDINGS

COMMON BUILDING PRACTICE

The way buildings are constructed has changed considerably over the last four decades. Shopping malls, industrial buildings or cold stores are larger. High amounts of goods are processed, stored and traded. In today's food industry, hot processing to produce ready-made meals for distribution is common. Generally the fire load of the building contents by far exceeds that of the construction products (see fire load densities of typical buildings – Table 1 – and of the insulation – Table 2). Furthermore the content is most likely to contribute first to a fire.

Finally, envelopes of all types of buildings, being residential, commercial, industrial and cold chain,

ESTIMATED FIRE LOAD	
Building category	Fire load [MJ/m²]
Library	1800
Hotel room	400
Office (standard)	500
School	350
Theatre, cinema	350
Transport building (public space)	150
Shopping centre (including corridors)	750
Residential building	950
Hospital	300

Table 1: Estimated fire load. For more details on the declared values see the report *Natural Fire Safety Concept*, drafted in the framework of the Valorisation Project (20 August 2001)

Material	Density [kg/m³]	Thermal conductivity [W/(m·K)]	Thickness [(mm) for U=0.21 W/m²K]	Calorific value [MJ/kg]	Fire load density [MJ/m²]
PIR/PUR	30	0.023	115	27	93
Stone wool (Euroclass A2)	120	0.040	200	3	72
	160	0.037	185	3	89
EPS	20	0.035	175	39.6	139
Wood insulation	100	0.040	200	16.2	324
Bituming roofing 2 layers (8 mm)	800	n.a.	n.a.	40	256

Table 2: Calorific value and fire load density for different insulation materials and bitumen roofing membrane

are becoming increasingly insulated. Cold bridges are avoided and ventilation is controlled.

These changes result in different fire risks and hazards. For example, a fire can develop faster in large premises with high amounts of combustible goods stored or in homes or rooms that are well insulated.

NEW BUILDING PRACTICE: HIGHLY ENERGY EFFICIENT BUILDINGS

In the next two decades, both existing and new buildings will need to further improve their energy efficiency.

Key elements to improve the energy efficiency of buildings include the use of more and thicker insulation in the floor, walls and roof, the installation of double or triple glazed windows and airtight building envelopes. At the same time a controlled ventilation system is needed. Solar panels may be installed to produce the remaining energy that is required. Finally, traditional heating sources, which may have been the cause of fire in the past, are less or no longer present in low energy buildings.

Media have reported that fires in highly energy-efficient buildings attain flashover more easily [1]. The higher incidence of flashovers has been correlated in the media to better insulated houses.

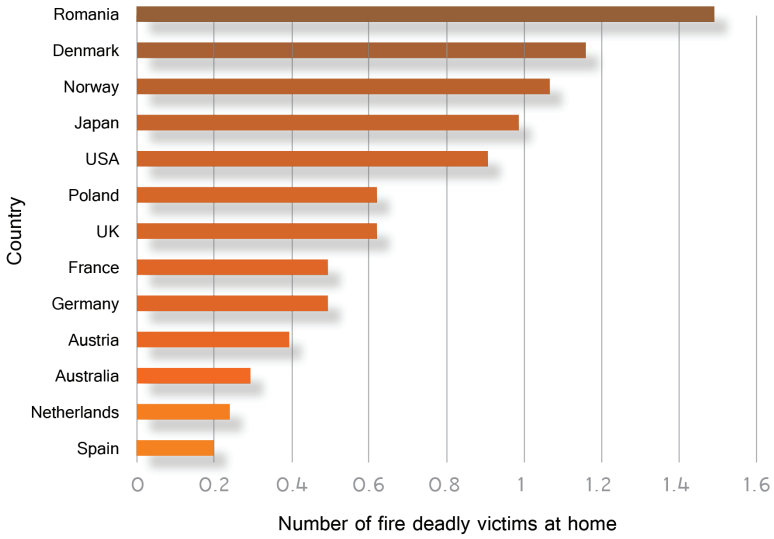
Are there more fires in highly insulated buildings? Not necessarily, but the chance that a fire grows large is higher.

The reason is however not the insulation, but must be sought in the changed building physics of an energy efficient building:

- A fire in a highly insulated building will grow faster compared to an un-insulated building because the heat is retained in the building. This happens irrespective of the type of insulation.
- Controlled ventilation and closed windows/doors may lead to

[1] The point of flashover is the temperature at which suddenly all combustibles in the premise start to burn so that the fire suddenly changes from a local to an all involving fire

Table 3: International comparison on the number of fire victims "at home" per 100 000 inhabitants of a given country (average over several years) [2]



slower fires, but these may instantaneously reach flashover when rescue teams open the door (backdraft).

- Triple glazed windows may not break or do so only at a later stage of the fire. Together with air-tightness, this leads to a quick reduction in oxygen in case of fire. When a door opens and fresh air comes in, this then causes instantaneous revival of the fire.
- In some cases, solar panels have caused problems during fire extinguishing, when they came in contact with the extinguishing water.

Generally, a recent Dutch National study on the fire safety of combustible insulation materials concluded that the current and correct application in the building envelope does neither significantly contribute to the severity of the fire nor to an increase of fire victims [3]. This conclusion is confirmed by official statistics. The market share of non-combustible mineral wool insulation in Scandinavia is as high as 85 %, whereas combustible organic insulation materials such as PU account for almost half of the insulation market in Central and Eastern Europe. Still the number of casualties per capita is significantly higher

[2] Dr. rer. nat. Georg Pleß (Institut der Feuerwehr Sachsen-Anhalt based on statistics of the World Health Organisation), Ständige Konferenz der Innenminister und -Senatoren der Länder, Forschungsbericht Nr. 145 (Teil 1)

[3] 2009-Efectis-R0824, *Brandveiligheid van isolatiematerialen*, for Ministerie VROM (February 2010)

in Scandinavian residential buildings.

More specifically, a simulation study on fire safety in passive houses, commissioned by the Hoge Raad voor Brandveiligheid (High Council for Fire Safety in Belgium), did not give rise to great concern. The conclusion was that the early phase of the fire is quite similar to traditional buildings and that a passive house does not constitute a higher risk for escape of occupants. At the later phase, the simulated fire in the passive house resulted in lower temperatures because of lower oxygen levels. The report further concludes that there may be a higher risk for backdraft when a door is opened in this phase [4].

From the above, it may be concluded that a faster fire growth is possible and that, in most cases, it is due to the different building physics and not to the choice of the insulation material.

The changes in building design due to increasing energy efficiency need to be taken into account. When the causes are understood, effective recommendations can be formulated when and where needed. Recommendations have been issued for fire men, i.e. guidelines for the safety of rescue teams, or special ways of fire extinguishing of air-tight buildings.

[4] S Brohez et al.: *Passive House and fire = Inferno?*, Final report financed by SPF Interieur, Direction générale Sécurité Intégrale, Issep, Belgium (2009-2010)