KNOW-HOW

Low smoke density can mean the difference between life and death

armacell®

Time and time again fires in buildings claim fatalities and casualties. On average, 11 people die as a result of fires in the European Union every day.

FIRE FATALITIES ARE SMOKE FATALITIES

When fire breaks out, people usually only have 3 minutes to escape. Smoke spreads extremely rapidly, blocking escape and rescue routes. So technical insulation materials with low smoke development make a significant contribution to people's safety in buildings.

Facts at a glance

The smoke development of construction products is a significant factor in achieving the primary objective of fire protection (rescuing people and animals and allowing effective fire fighting). While technical insulation materials were previously evaluated mainly on the basis of their flame resistance, the criteria used in the European SBI test are much more complex and allow a more realistic assessment of the fire behaviour.

Armaflex Ultima is the first technical insulation material with extremely low smoke development. In comparison to a standard elastomeric product, Armaflex Ultima exhibits 10 times less smoke.

On average, 11 people die in fires in the European Union every day. That means around 4,000 deaths a year among the 505 million inhabitants of the 28 EU countries. Over half of fires occur in buildings or vehicles and 90 % of the fatalities are a result of these fires.

But only a few are killed by the flames, the majority – 95 % of fire victims! – die as a result of smoke inhalation. When fire breaks out it is crucial that fire-fighters and those trapped find escape routes quickly and that is only possible with minimal smoke development.

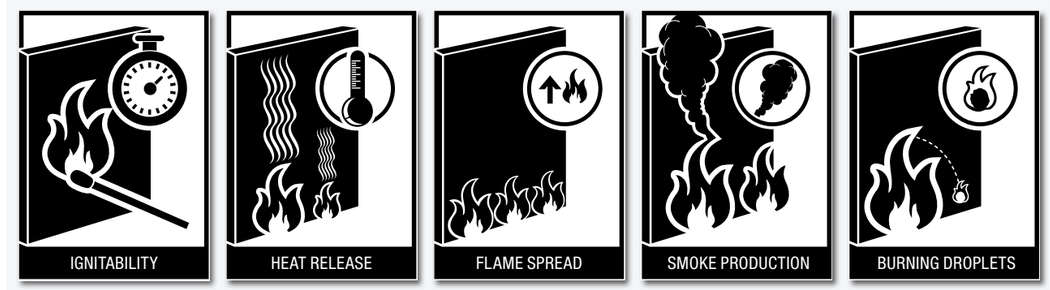

Figure 1: Characteristic parameters for the fire behaviour of construction products

Fires have disastrous consequences for industry, too: according to insurers, every third fire leads to damage to property amounting to more than 500,000 euros. All in all, fires cause 126 billion euros of property damage in Europe every year. Here too, smoke gases cause more damage than the flames. The secondary damage as a result of soot and corrosive gases accounts for over 50 % of the total costs in a major fire. Not to mention the follow-up costs due to production downtime. Avoiding damage due to soot and smoke on plant and equipment is not usually a declared protection objective in industrial buildings.

Low fire load through technical insulation

To limit the speed at which the fire spreads, the use of combustible construction products in buildings is usually restricted. But it is not possible to do without plastics, such as cables or synthetic insulation materials, completely. However, the contribution of combustible construction materials is often overestimated in relation to the building contents (e.g. the interior fittings) and only make up a very small fraction of the fire-load. Because of their low density, plastics usually only contain 2 to 3 volume per cent of combustible material and therefore only constitute a minor fire-load in comparison to compact materials [1].

Assessing the fire behaviour

The outbreak of the fire is the crucial phase for assessing the fire behaviour of synthetic insulation materials. The characteristic parameters for the fire behaviour of construction products are:

- Ignitability
- Flame spread
- Heat release (or temperature rise)
- Smoke development
- Burning droplets / particles

More realistic evaluation of the fire behaviour in the SBI test

Whereas in the national testing procedures for construction products technical insulation materials were primarily assessed according to their flame resistance, the classification criteria of the European SBI test (single burning item test) are much more complex and allow a more realistic evaluation of the fire behaviour of the various products. The classification standard DIN EN 13501-1 [2] distinguishes fire classes A1, A2, B, C, D, E, F. Table 1 shows the new Euroclasses, the target safety level.

In order to distinguish the Euroclasses for linear products (such as insulation tubes) from flat products (insulation sheets), the former are marked with a subscripted L (short for linear).

In the SBI test smoke development and burning droplets are also measured. For this purpose additional classes have been developed which are marked with s (for smoke) and d (for droplets) (see Table 2).

Euroclass E is tested in accordance with EN ISO 11 925-2 [3] in the ignitability test. For classes A2 to D additional classification using the SBI test procedure in accordance with EN 13823 [4] is required.

Table 1: Euroclasses and the target safety level

Euroclass	Target safety level
A1	No contribution to fire even under fully developed fire conditions
A2	Only negligible contribution to fire even under fully developed fire conditions; no spread of fire from the area of the primary fire in the fire development phase
B	In the fire development phase, no spread of fire from the area of the primary fire and very limited contribution to the fire
C	Under the conditions of a fire in the development phase, very limited spread of fire and limited energy release and ignitability
D	Under the conditions of a fire in the development phase, limited spread of fire and acceptable energy release and ignitability
E	In the case of a very small fire (match flame) acceptable reaction to fire (ignitability, flame spread)
F	No requirements concerning the reaction to fire

Table 2: Additional assessment classes for smoke development and burning droplets / particles

Smoke development	s3 (there are no restrictions regarding smoke development)
	s2 (the fully released amount of smoke, and the rise in smoke development, are restricted)
	s1 (stricter criteria than for s2 must be fulfilled)
Burning droplets / particles	d2 (there are no restrictions)
	d1 (burning droplets not longer than the defined time)
	d0 (burning droplets/particles not permitted)

The ignitability test assesses the ignitability of a construction product by exposing it to a small flame. The SBI test assesses the potential contribution of a construction product to a developing fire in a fire scenario which simulates a single burning item in a room corner close to this construction product (see Figure 2). The test reproduces a realistic fire scenario, which can occur due to a burning waste-paper basket in a corner of the room, for example.

For flat products the limit values given in Table 1 of EN 13501-1 are to be used and for linear products the values in Table 3. The limit values for flat products are considerably lower than the classification values for linear products, i.e. more difficult to achieve.

Conflict of objectives: combustibility vs. smoke development

Like all organic products flexible elastomeric insulation materials (FEFs) are combustible. In order to ensure that the insulation material is optimally protected against fire, various flame retardants are added [5]. Flame retardants are additives which reduce the ignitability and burning rate through physical and/or chemical action, but do not prevent the materials themselves being combustible. Up to now, organic-based technical insulation materials could only achieve the best construction materials classification for combustible building products with the aid of halogenated systems. While other flame retardants are only effective at relatively low temperatures, halogenated systems act directly on the combustion process at temperatures between 600 and 800 °C. Typical components of flame retardants are chlorine and bromine. Brominated flame retardants inhibit combustion very effectively, but due to their mode of action and their effect, they lead to high smoke development, especially in the gas phase. For this reason, standard elastomeric products achieve a good fire classification in the European SBI test – the majority of premium products are classified as 'B', i.e. of low flammability – but they tend to have high smoke development and so are mainly classified as 's3'. Elastomeric insulation materials with lower smoke development ('s2' or even 's1'), on the other hand, previously only achieved fire class E or at best D.

Elastomeric insulation materials with low smoke development

The insulation manufacturer Armacell has been able to resolve this conflict of objectives: due to the

Figure 2: The SBI test – shown here with elastomeric tubes – before, during and after the test

development of completely new, intrinsically flame-resistant polymers and using ablative protective additives it is no longer necessary to add any brominated flame retardant. The Armaflex Ultima foam combines for the first time extremely high flame resistance with minimal smoke development. The blue elastomeric foam is the first flexible insulation material to achieve fire class B_L-s1,d0. The product was developed on the basis of the innovative Armaprene® technology, which is patented both in the USA (US patent no. 8,163,811) and in Europe (European patent no. 2 261 305). As Figure 3 shows, Armaflex Ultima develops 10 times less smoke than a standard elastomeric product.

New safety standard in technical insulation

With Armaflex Ultima Armacell has set a new safety standard in technical insulation. Based on the patented Armaprene technology, the new foam is the first flexible technical insulation material in the world with fire class B_L-s1,d0, thus providing unsurpassed safety in a fire. Following the launch in 2012, the market leader further improved its recipe and added further products to complete the range.

For insulating pipes with large outer diameters (> 89 mm ⩽ 300 mm) Armacell provides "open tubes" – non-covered, slit tubes which achieve fire class B_L-s1,d0. News additions to the range are tubes and sheets in an insulation thickness of 32 mm. Apart from standard and self-adhesive tubes and sheets, Armacell provides an Ultima version of the tried-and-tested Armafix pipe support. The system solution for hanging pipes in cold applications is now manufactured with a load-bearing segment made of recycled PET.

Good fire behaviour is, however, just one of the key requirements for technical insulation materials. The products must also have low thermal conductivity and high resistance to water-vapour transmission. They should be closed cell and easy to install reliably even under difficult conditions on the building site.

Safety first! Fire protection is the top priority

Many European countries have already tightened the requirements regarding the smoke development of construction products in their building regulations. In Sweden, for example, only technical insulation materials that achieve at least fire class B_L-s1,d0 may be used in so-called Br1 buildings – these are buildings requiring special fire protection such as hotels or hospitals. With its Armaflex Ultima range, Armacell is the first manufacturer to offer a flexible, closed-cell product with fire classification B_L -s1,d0 to fulfil these requirements. Whether it is a case of building new or renovating existing residential and office buildings, schools, hospitals, hotels or industrial and commercial buildings, preventive fire protection must be the highest priority.

Although it is never possible to completely rule out a fire occurring, the consequences of a blaze can be significantly reduced.

The smoke development of Armaflex Ultima in comparison to a standard elastomeric product

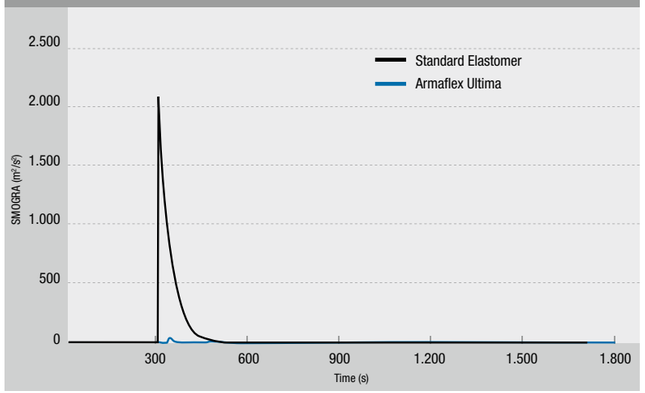

Figure 3

Table 3: Legal requirements regarding the smoke development of technical insulation materials in various European countries

Country	Specific smoke density requirements	Requirement mandatory for following applications
Belgium	non-combustible	escape routes, hospitals
Finland	B-s1, d0	residential, accommodation, assembly and commercial premises, offices, garages
Germany	A1 or A2-s1, d0*	escape routes
Italy	B-s1/s2, d0	escape routes
Latvia	B-s1, d0	escape routes
The Netherlands	B-s2, d0	residential and commercial buildings
Norway	B_L-s1, d0	Escape routes: exception for single pipes max Ø200mm or pipes in shafts or above ceilings = C_L-s1,d0
Portugal	B_L-s2, d0	residential and non-residential buildings
Spain	B_L-s1, d0	residential and non-residential buildings – car parks, risk areas and specially protected staircases and corridors
Sweden	B_L-s1, d0	residential and commercial buildings – all escape routes and Br1-buildings (ceilings) require a B-s1, d0 classification

* Low flammability products equipped with a metal cladding can be installed if this has been provided for in the fire protection concept or approved by the building control authorities

References

[1] Jürgen Troitzsch: Plastics Flammability Handbook - Principles, Regulations, Testing and Approval, 3rd Edition, Carl Hanser Verlag München 2004.

[2] DIN EN 13501-1, Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests

[3] EN ISO 11925-2 "Reaction to fire tests – Ignitability of building products subjected to direct impingement of flame – Part 2: Single-flame source test (ISO 11925-2:2010)"

[4] EN 13823 "Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item"

[5] Dipl. Ing. Michaela Störkmann: Fire performance of elastomeric insulation materials (article in German), In: Isoliertechnik 5/2000, pp. 48 - 55.

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TIP: ARMACELL'S INFORMATION CAMPAIGN

The importance of low-smoke insulation materials for people's safety in buildings is also the subject of an information campaign at www.armacell.eu.

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