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Technical Bulletin

Overview of expanded polystyrene fire performance in external wall insulation systems.

Building Regulations, together with supporting guidance documents and national and European standards provide design and fire performance acceptance criteria for a wide range of external cladding systems. Those defined as combustible can safetly be specified, providing they are fully compliant to these requirements.

The insulating component of Dryvit Outsulation systems (direct adhesive fix and rail) is reaction to fire Euro-classification E fire retardant grade expanded polystyrene (EPS). It is nominally of 15 kg/m³ density and in common with most organic materials is classified as combustible, although contains <1% of a fire retardant chemical, far less than other fire retardant plastics. In its uncovered form it is more difficult to ignite than standard EPS and welding sparks or a lit cigarette will not readily set it alight and it self extinguishes when the heat source is removed.

When burning and in its unprotected form EPS behaves like other hydrocarbons such as wood and paper etc, with the products of combustion being carbon monoxide, carbon dioxide a small quantity of hydrogen bromide and styrene, but no liberation of cyanide. During a fire the decomposition of styrene produces water vapour and black soot (smoke), but even so EPS is considered less toxic than many common building materials and produces around 90% less carbon monoxide compared to solid woods and 98% less than chip board. The toxicity of the released smoke fumes is also considerably less than those of similar volumes of commonly used materials, such as wood because EPS is low density and only 2% plastic by volume, the remainder being 98% air.

However, when considering the fire behaviour of any building material, it is important that the assessment is based on the finished product in end use conditions, not as single components or stand alone materials. This is reflected in the fire performance test requirements for mulitstorey buildings (BR135) and surface spread of flame classification (BS EN 13501), both of which require the full composite systems to be tested.

In Outsulation systems the EPS is fully encapsulated in a layer of glass fibre reinforced mesh coated in cementitious base coat faced by an acrylic decorative finish. All system terminations are backwrapped, that is the mesh is fixed securely to the substrate beneath the perimeter of the insulation and remains fully fixed in the event of a fire. No uncovered EPS is allowed in the correct design of the system.

Large scale fire tests such as those carried out to the methodology set out in BS 8414 and classified in accordance with BR135 or LPS 1581/1582 demonstrate the effectivness of

measures used to restrict fire movement through combustible external wall systems (EWI) and its spread over the external surface. Outsulation systems installed using EPS to thicknesses upto 300 mm have achieved compliance to BR135 and upto 250 mm for LPS Loss Prevention Certification Board (LPCB)) standards by following guideline recommendations. These include mineral wool fire break dimensions and their location together with Dryvit's own in-house system designs.

When encapsulated in base coat and finish and fully backwrapped the EPS is protected from the direct flames of the fire and contracts away from the source of the heat, but does not ignite or contribute to its propogation, so in turn smoke generation may be reduced. At around 100°C the EPS softens and becomes molten as the temperature rises with combustible gases being produced at around 370°C and self ignition at 490°C. Only if the reinforced base coat is burnt through and the molten EPS is directly exposed to the flames will it contribute to the fire and produce excessive smoke and combustion gases. During the large scale testing undertaken by Dryvit it has been observed that the fire consumes part of the molten EPS, but its contribution to the fire load is reduced by absorption into the strategically placed mineral wool fire breaks, which isolate its interactiion by effectively acting as sponges. Additionally the integrity of the base coat, and in particular the backwrap, restricts the escape of molten EPS from the system envelope which would otherwise be free to ignite.

As concluded by both The British Plastics Federation (BPF) and the European Manufacturers of EPS (EUMEPS) in their respective publications "EPS insulation in Building Fires" and "Behaviour of EPS in case of Fire", although EPS is combustible, when completely encapsulated it does not present an undue fire hazard or lead to an increased risk of smoke density if correctly installed.

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References.

1. Insulated Render and Cladding Association INCA Technical Guide 01 "Fire Protection Requirements for EWI systems".
2. BRE Trust "Fire Performance of External Thermal Insulation for Walls of Multistrorey Buildings" (BR135).
3. The British Plastics Federation (BPF) "EPS Insulation in Building Fires"
4. European Manufacturers of EPS (EUMEPS) "Behaviour of EPS in Case of Fire"