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Abstract
The use of flammable foam as EPS, PUR, PIR and PF is in a strong increase in Europe for insulation of facades and roofs, and more high-rise buildings are built. The combination of flammable facades and high-rise buildings challenges fire safety. We saw this clearly at the fire in the Grenfell Tower in London in June 2017, when 79 lives were lost during a very violent fire on the building's facade covered with flammable PIR foam and aluminum composite panels. The cladding was ignited and spread to the entire building [1].

There are two predominant ways to insulate facades with foam plastic. One is called ETICS, which stands for External Thermal Insulation Composite System, and is a solution where the insulation is adhered directly to a back wall of concrete, masonry or wood. A primer is applied, in which a reinforcing mesh is laid, and finally, plastered. Today, ETICS is one of the most common methods for energy renovation [2].

The other way to perform facade systems with foam plastic is the so-called ACP, which stands for Aluminum Composite Panels [3]. In this solution, there is usually an outer casing where 2-layers aluminum covers a core of plastic for example polyethylene. Behind the outer cladding, there is typically a 50 mm air gap, and behind this a layer of insulation, which is often PIR or another foam plastic. This structure is mounted on a back wall of concrete, masonry or the like. The air gap in the ACP solution is critical, as it can contribute to extremely rapid vertical fire spread behind the outer casing. Often the aluminium melts during a fire, resulting in an increase in fire spread. An ACP solution was applied in Grenfell Tower (London).

In countries such as UK, France, China, Russia and Dubai, a number of fires have spread in similar ways in recent years. Flames spread up along facades and quickly ignite floors above the hotbed. Burning drips and facade parts fall down and ignite the floors below. Quickly, the building is ignited in a vertical burning line, from which the fire spreads to the rest. Such fires demonstrate the importance of requiring documentation of the fire properties of foam insulation and plastic-based façade solutions [4] as well as quality control of the construction technology applied. Foam plastic insulation is also widely used on roofs. Such roof fires may be impossible for the fire brigade to extinguish. Furthermore, we have seen that they can pose a serious risk to the roofers.

In some cases, foam plastic materials are produced with the addition of flame retardants in the plastic material and the use of inactive gases in the plastic bubbles. The question is how to document that the fire-retardant substances and gases remain in place despite environmental impacts such as moisture and thermal expansion when the foam is exposed to temperature fluctuations that occur in facades and roofs.

Most people who perish by fires in their homes die from smoke poisoning. For residential fires, it has been shown that foam plastics can develop toxic gases. At the University of Central Lancashire, the content of foamed plastic products has been studied, in particular carbon monoxide, but also hydrochloric acid, hydrocyanic acid, nitrogen dioxide and hydrogen bromide, depending on the material [5]. For example, PIR or PUR foam develop hydrocyanic acid, which is extremely toxic. The figures show that only 8-10 grams of PIR or PUR foam or 28 grams of EPS foam can develop up to 1 m^3 of flue gas in lethal concentration. It raises the question whether there are test procedures for the toxicity of flue gases from current facade and roof structures with foam insulation and plastic based solutions, including thermal properties and fire propagation after several years of use? With some test methods, the material is tested in arrays where the hot gases and burning drips are led away. Efforts are being made to develop new and more comprehensive test procedures for the assessment of fire properties of foam plastic insulation in facades [6], [7], but do they take into account all the conditions mentioned above?

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