

Facade Fire Test on PUR External Thermal Insulation Composite System (ETICS)

Introduction

The new harmonised system for the classification of reaction to fire in EU member states is using the SBI test (EN 13823) [1] for evaluation of the combustible building products. SBI test classification criteria have been derived from the use of a room corner test (ISO 9705) [2] as a reference scenario. Several EU member states have commented that products intended for facades cannot be classified for reaction to fire properties in a realistic way with the room corner scenario alone. Consequently, a facade testing scenario should be developed for these cases.

Several national large-scale tests currently already exist for facade products. In addition, an ISO procedure is available (ISO DIS 13875-1 and -2) [3]. The development of a harmonised CEN procedure is currently under

discussion. The draft proposal in Germany (prDIN 4102-20) [4] is already used for national certification of external thermal insulation composite systems (ETICS), if testing in large scale is necessary.

In ETICS constructions the thermal insulation boards are applied to external wall surfaces by mortar glue or by mechanical fixing and are covered by a glass-fibre mesh-reinforced rendering system. Polyurethane (PUR) rigid foam has significant advantages in ETICS applications, where higher thermal insulation values are required, for example, in low energy houses or 'passive' houses (Fig. 1). ETICS with PUR/PIR up to 100mm are fulfilling the B1 quality of DIN 4102 in Germany and it is not necessary to install a barrier of a non-combustible insulant within the façade above window or door openings.

The usage of thicker combustible insulation products in ETICS may give some concern because of fire considerations. Therefore, ISOPA has carried out a project to investigate the behaviour of a 300 mm thick PUR ETICS application in the German facade fire test. An additional objective was to generate test data for the development of a harmonised CEN facade test procedure. The test was performed by the institute MFPA in Leipzig (Germany) and the test was executed in 2002 [5].



Fig. 1 – Fixing of PUR rigid foam blocks of 300 mm thickness in an ETICS system for a passive house

Test arrangement

Test specimen

An ETICS system as described in Fig.2 was applied to the facade test facility.

A wooden window frame and a rolling shutter box were integrated into the window opening at the bottom of the facade test facility to reflect realistic application conditions (Fig. 5).

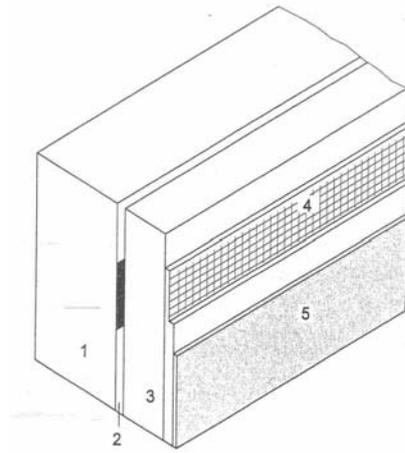


Fig. 2 – Test specimen

1. Wall of test rig
 2. Adhesive mortar
 3. 300 mm PUR rigid foam board (Purenotherm PUR 30 WDS in B2 quality)
 4. Glass-fibre mesh reinforced 3 mm rendering coat
 5. 3mm top rendering coat
- A rendering system bound with an organic resin was used

Facade test rig and test procedure

The arrangement of the test setup and the test procedure followed prDIN 4102-20 'Besonderer Nachweis für das Brandverhalten von Aussenwandbekleidungen'. The test façade was arranged in a corner configuration

with an opening (simulating a window) at the bottom. The flames from a wooden crib located in the opening attacked the cladding of the facade (Fig.3). A crib of 25 kg was used as fire load (Fig.4).

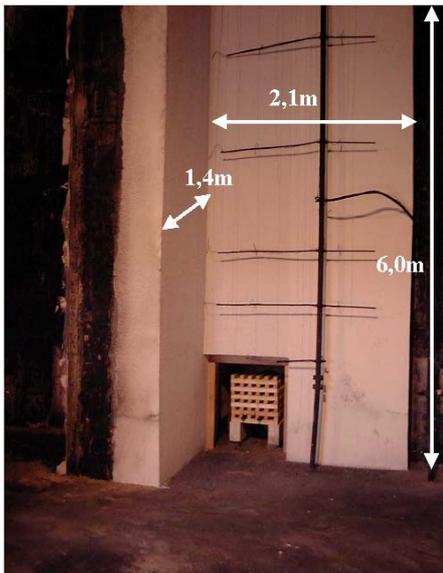


Fig. 3 – Facade test rig



Fig. 4 – Wooden crib for fire exposure

Temperature measurements were carried out at the surface and behind the rendering and within the PUR boards in different levels of height of the facade. The test and observation time was a total of 60 minutes.

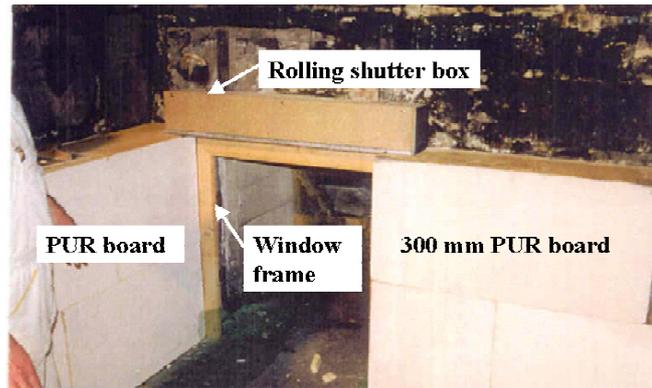


Fig. 5 – Fixing of PUR boards, wooden window frame and rolling shutter box

Test results

After ignition of the wooden crib the flames impinged on the surface of the PUR-ETICS system (Fig.6). The wooden crib was almost totally consumed after 14 minutes. However, further fire exposure was generated by the burning wooden window frame and the burning rolling shutter box (Fig. 7). After 50 minutes the fire had extinguished totally and all flaming stopped by self-extinguishment.

The temperatures reached 1000°C in the opening and even 800-600°C between 1m to 3m above the opening. At the 4-5 m level the



Fig. 6 – Fire after 10 minutes



Fig. 7 – Fire after 14 minutes with burning window frame and burning rolling shutter box

temperatures decreased to 200°C, which corresponded to the maximum observed flame height which reached almost to the top of the facade at 5m level (Fig.8). However, the measured temperatures within the PUR foam (75 mm to 150 mm from the outside surface) remained quite low and did not exceed 25°C to 60°C compared to the temperatures at the outside surface of 600°C to 800°C.

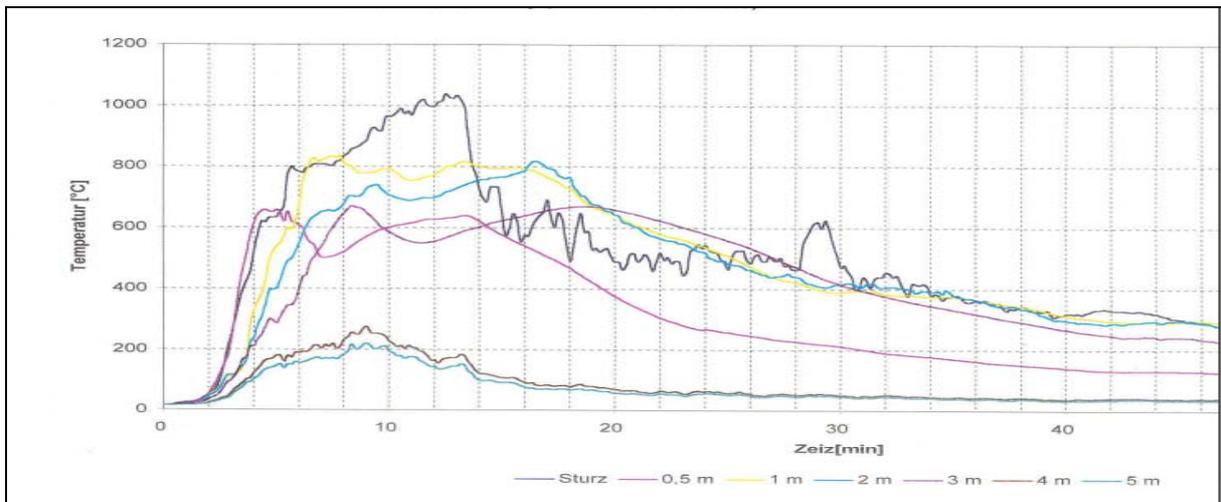
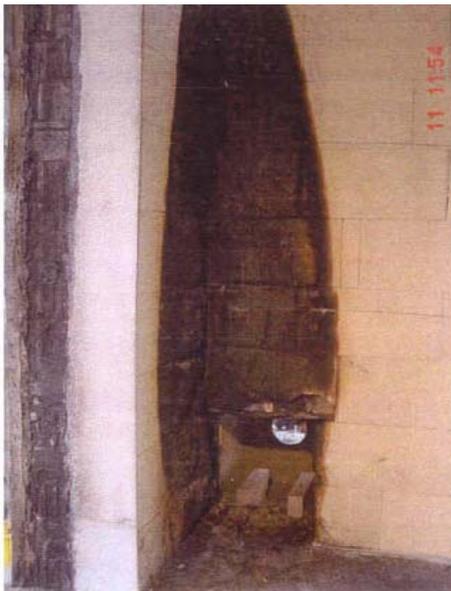


Fig. 8 – Measured temperatures at the facade surface at different vertical levels



After the test the rendering was removed from the PUR. No breaking of the rendering had occurred. The foam was only discoloured and partially destroyed within the surface layer and in a limited area, where the temperature from the fire exposure exceeded 200°C. There was no spread of fire within the PUR itself or outside the region of direct flame exposure (Fig. 9).

Fig. 9 – Limited area of foam destroyed after the fire test (rendering removed)

Conclusion

The fire exposure was increased by the installation of a wooden window frame and a combustible rolling shutter box. Despite this increased fire loading the PUR-ETICS facade showed very limited response to the fire

exposure and then only where a high enough flame temperature occurred. No further flame spread was initiated by the PUR rigid foam itself. All the flaming stopped by self-extinguishment.

References

- [1] EN 13823 Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item (SBI test)
- [2] ISO 9705-1 Fire tests – Full scale room test for surface products
- [3] ISO DIS 13875-1 and-2 – Reaction to fire tests for facades – intermediate and large scale tests
- [4] prDIN 4102-20 Besonderer Nachweis für das Brandverhalten von Aussenwandbekleidungen
- [5] Untersuchungsbericht vom 22.05.2002 der MFPA Leipzig GmbH



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