Technical Note

tenos

Project:	Kooltherm K15 insulation	Date:	18 May 2015
Client:	Kingspan Insulation Ltd	Author:	Mostyn Bullock
Ref:	TS15149-N01-ISSUE 1	Checked by:	David Bostelmann
Re:	Rain-screen constructions using K15 insulation in buildings >18m		

Introduction

A workshop meeting was held on 30 March 2015 at Tenos involving Mostyn Bullock (Tenos), Ivor Meredith and Tony Milichap (Kingspan Insulation ltd) to discuss compliance with BR135 (3rd edition) and the status of testing to BS8414.

Tenos has been instructed to carry out an initial review of fire test data, certification/approvals and 3rd party assessments related to the issue of the use of K15 insulation in rain-screen cavity wall constructions for buildings in excess of 18m in height. This review also proposes further testing with the objective of establishing a field of application report for more flexible use of the product.

To facilitate this review, Kingspan Insulation Ltd has provided Tenos with the following information by email on 1 May 2015:

Reaction to fire test data:

- Classification report 2008-Efectis—R0624 Rev 1. Refers to test reports as follows:
    - Test report 2008-Efectis-R0622 (small flame ignitability test to EN ISO 11925-2:2002)
    - Test report 2008-Efectis-R0623 (SBI test to EN 13823: 2002)
- Classification report 2009-Efectis—R0251. Refers to test reports as follows:
    - Test report 2009-Efectis-R0249 (small flame ignitability test to EN ISO 11925-2:2002)
    - Test report 2009-Efectis-R0250 (SBI test to EN 13823: 2002)
- Classification report 2009-Efectis—R0253. Refers to test reports as follows:
    - Test report 2009-Efectis-R0240 (small flame ignitability test to EN ISO 11925-2:2002)
    - Test report 2009-Efectis-R0252 (SBI test to EN 13823: 2002)
- Efectis_K15_40mm_160mm.pdf
    - From the document it appears that this SBI testing was carried out by the University of Ghent.
- Exova 11-002-651(C) – ASTM E84-11A Steiner Tunnel test
- Exova Warringtonfire 315839 – BS476: Part 6. Tests carried out on foil facing only.
- Exova Warringtonfire 315844 – BS476: Part 7. Tests carried out on foil facing only

Fire Resistance test data:

- BRE 218611 – EN1634-1 non-loadbearing wall test
- Exova 323655 – BSEN1365-1 loadbearing wall test
- AFITI 8482/11 (translation of Spanish report) – small scale test to EN1363-1 furnace conditions

3rd party approvals:

- Herefordshire Council Type Approval RD165 Kingpsan Ltd (stated as expiring 2014)
- LABC Certificate EWW165 (marked as Draft)
- BBA Certificate BBA/4582
- BRE Certification 118/06 Jan 2006 (relates to fire resistance performance of external wall assembly)

3rd party assessments:

- ARUP fire engineering assessment report 218294-00
- ARUP fire engineering assessment report 232444-00
- BRE CC301393
- BRE CC302787

Test data to BS8414 and classification to BR135:

- BRE 220876 – BS8414-1 test
- BRE 297099 Issue 2 – BS8414-2 test
- BRE291642 Issue 2 – BR135 Annex B classification, Refers to an additional test as follows:
    - BRE 293940 – BS8414-2 test

Information review

The small flame ignitability and SBI tests appear to indicate an 'expected' European Class C performance (equivalent to UK Class 1) with low levels of smoke production (S1-S2) and with no droplet formation.

The Class B results appear to have been obtained with high pressure laminate facings being exposed to the test conditions that produced less heat but more smoke evolution.

Some Class D results were obtained at one of the laboratories indicating the variability/sensitivity of the SBI test methodology as there is a wide variation in some of the measurements recorded.

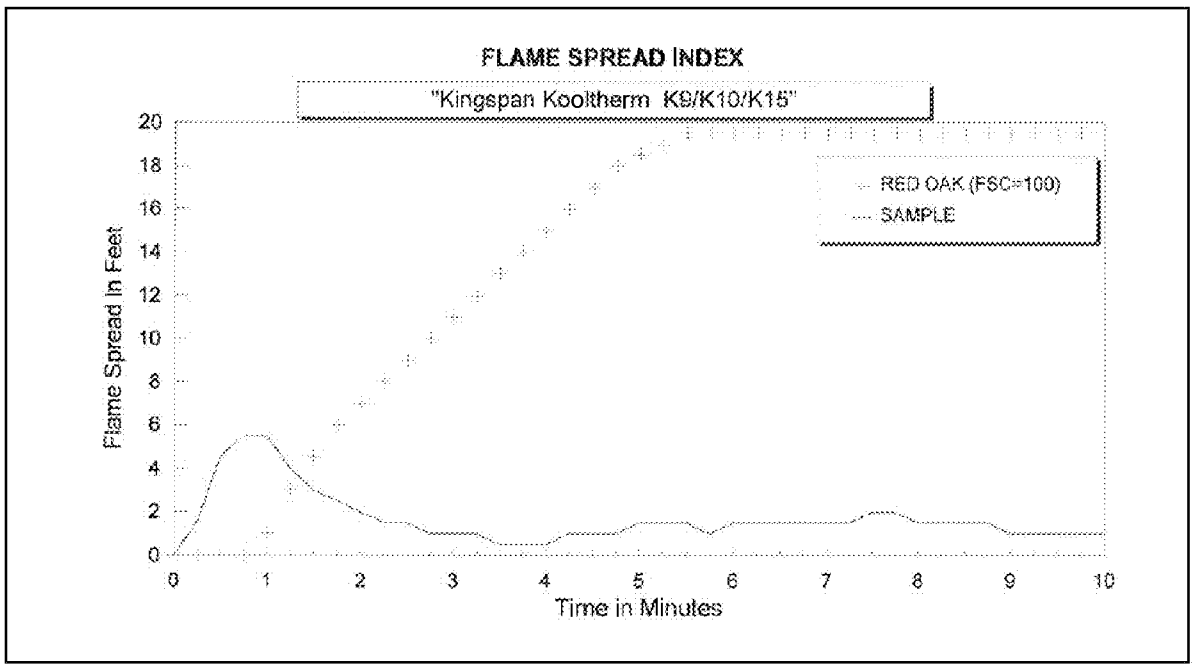
The SBI test is by its nature quite sensitive to contribution to heat release rate by facings and adhesives etc. and it is possible that different specifications and/or quantities of foil facings and their adhesives were a contributory factor in test variability. Information relating to the presence and specification of facings and adhesives is not fully reported in the test data.

When used as insulation material within a rain-screen cavity the reaction to fire performance established by SBI testing is of no direct relevance in terms of the regulatory context of BR135. This is because it is already known that the material is neither non-combustible or of limited combustibility and it is the fact that the K15 material is 'combustible' which means that a cladding design must satisfy BR135 if it is to be used in a building above 18m.

What the performance classifications from the SBI tests do demonstrate and with direct and important relevance to the performance of external cladding systems is that the K15 remains as a thermoset at fire temperatures and does not produce droplets (either through melting or decomposition of the foam).

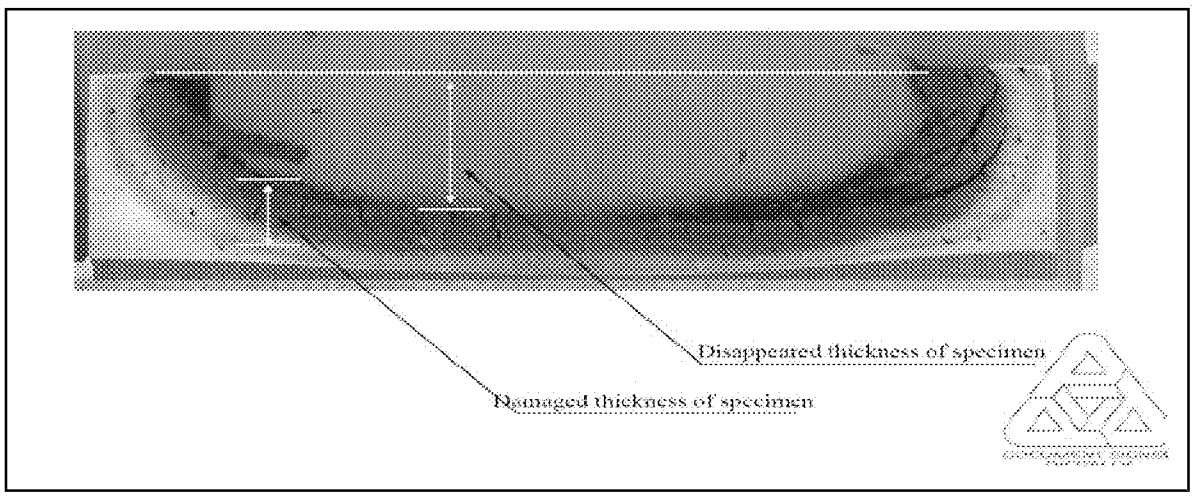
This feature of the material performance is very important in highlighting the particular relevance of the ASTM E84 testing carried out on the material. It is widely regarded that the ASTM E84 (Steiner Tunnel) test is one of the most onerous tests on combustible materials as the test specimen forms a soffit of the fire test chamber and the heat from the combustion of the material under test is effectively reflected back to the surface of the test specimen (rather than being lost to atmosphere as in the case of the SBI test which only exposes a wall to the test burner). The ASTM E84 test is therefore justifiably much more relevant in terms of demonstrating whether a combustible material presents a significant risk of propagating a fire in its own right. The fact that the K15 material does not produce droplets means that the specimen can remain dimensionally stable under fire test exposure when used as a soffit and thereby permits the applicability of the ASTM E84 test method. As illustrated in the test measurements from the report (shown in Figure 1) the K15 insulation resulted in a maximum flame front propagation of 1.6m dying back later in the test, therefore illustrating that, whilst the material is combustible, the level of heat generated from burning of the combustible gases released is not sufficient to propagate the fire to unaffected insulation away from the original fire source. The ASTM E84 test result achieved a Class A rating meaning that the K15 could be used as an exposed building lining in the most onerous of applications in the US and other jurisdictions using NFPA codes.

Figure 1 – Flame spread result from ASTM E84 test indicating resistance to fire propagation



The full scale fire resistance tests add nothing of particular relevance for the consideration of the BR135 performance issue as the test results are more a function of the performance boards than the insulation material.. The test which is most relevant is actually the test at AFITI where small scale specimens of insulation in isolation were subjected to the standard temperature-time conditions of the fire resistance tests and both the 60mm thick and 100mm thick specimens resisted burn-through (i.e. maintained integrity) for at least 30 minutes (the test was terminated without integrity failure at 30 minutes). The test results demonstrated that the insulation material retains it thermoset properties under fire-resistance test furnace exposure (i.e. does not melt or decompose into liquid droplets) and that the char which is formed when the material pyrolyses protects the unaffected material from the fire.

Figure 2 – Picture of residual material section from small scale fire resistance burn-through test



So, taken together, the fact that the reaction to fire testing shows no burning droplets, low smoke emission and resistance to self-sustaining fire propagation should help inform the assessment of how

a built-up rain-screen cladding system including K15 performs in a BS8414-1 or BS8414-2 cladding test including subsequent assessment of the results in terms of generating a certified field of application.

In terms of the existing assessment reports, the BRE assessment follows the traditional approach for assessment of variations to tested details in that the impact of the variations are considered specifically against the conditions of the test to provide an opinion of how the test result and subsequent BR135 classification would have been affected by the variations. The ARUP assessments take a different approach and assess the proposed cladding construction in terms of the actual functional fire safety engineering objectives for the building project in question. The ARUP report for Carillion makes the statement in Figure 3 which is relevant to the performance criteria in the BR135 classification and reflects what has been demonstrated by the key tests discussed above which is that the insulation does not significantly propagate fire in its own right.

Figure 3 – key statement in ARUP fire engineering assessment report

> The propagation of fire within the façade to more floors than those exposed directly to external flaming is expected to be limited based on test information (including BS 8414, Class C-s1,d0 tested performance for 80 mm K15 material and the limited rates of fire spread

The existing certification documents do not provide a statement of field of application wider that the rain-screen constructions that have been tested in the tests referenced by the certification documents. As such, the current certification documents only establish that the K15 insulation has been successfully tested and classified by BR135 so that it can potentially be used in rain-screen constrictions for buildings greater than 18m in height.

In relation to the BS8414 tests themselves, the test to BS8414-1 (220876 in 2005) utilised a masonry substrate with a UAC cement bonded particle board (product specification not stated) rain-screen cladding and an intumescent-coated perforated cavity barrier fixed directly to the substrate (no product name stated). The test thereby used a non-combustible substrate and (as currently stated on the UAC website for their cement bonded particle boards) a Class 0 rain-screen. It passed the test criteria.

The most recent test 297099 (July 2014) was carried out to BS8414-2 using a Euroform cement board substrate (exact specification not stated), an ArGeTon clay tile rain-screen cladding ('Classico' profile – appears to be now known as 'Tampa') and a mineral fibre/intumescent cavity barrier. On the assumption that the Euroform material was a cement bonded particle board of the 'Versapanel' specification then the manufacturer's information indicates Class 0. By virtue of seemingly being a fired natural clay product, the clay tiles forming the rain-screen would be considered non-combustible. The assembly passed the test criteria but the report noted (as required by the test methodology) residual flaming in the zone of the insulation below Level 2 in the area behind tiles that had remained in place and where this flaming continued locally for about 19 minutes after the crib fire was extinguished before going out. The report does not attribute the residual flaming to any particular cause. However, it is noted that the construction drawings included in the test report indicate the use of 'Everbuild 600ml Foil Pack applicator gun SG00MB16'. This code reference appears to relate to the product reference of the gun only. There is no indication of the specification of the foil pack sealant that was used. Everbuild foil pack sealants for use with this applicator gun cover a broad range of material types from acrylic fire rated mastic to polyurethane sealant i.e. some contain combustible materials. It is possible that the residual flaming may have resulted from the use of a combustible foil pack sealant material.

The assessment report BRE CC301393 refers to an additional test to BS8414-2 (293940 issue 1) carried out with a Trespa 15mm tile rain-screen (Class 0) in March 2014 and otherwise similar to the 297099 test using the non-combustible clay tile rain-screen. The assessment does not stipulate the

actual Trespa panel specification used in the test to which it refers. The BBA certificate for Trespa Meteon cladding panels (99/3629) downloadable from the Trespa website indicates that the panels can be provided in either a 'standard' grade or 'FR' grade with European Class D or B respectively (equivalent to UK Class 3 or 0 respectively). The assessment report states that the test passed the test criteria.

Irrespective of the grade of Trespa panel utilised in test 293940 Issue 1, it is that test which presented the most onerous combination of materials in that it appears that it is the only test to BS8414 where neither the substrate or cladding was non-combustible (i.e. both were apparently at best Class 0 in 293940).

The BRE 291642 Issue 2 classification report for BR135 Annex B states that the performance criteria of BR135 are met but the classification relates specifically to the construction tested in 297099 using the clay tile rain-screen. Therefore, there is no field of application statement that extends the scope of the BR135 classification to include for some variation of the installed construction.

For buildings in excess of 18m in the UK it is likely that the external rain-screen cladding and the sheathing board to the SFS external wall construction forming the vertical surfaces in the cavity would both have a minimum Class 0 (European Class B) performance and where this is the case then the positive test results achieved in 297099 and 293940 ought, in our opinion, to be sufficient to justify the use of alternative sheathing boards and rain-screen claddings that have certified minimum Class 0 performance or are non-combustible or of limited combustibility subject to:

- the K15 insulation being fixed to the substrate in the same manner as in the test, and
- a cavity barrier system that has been fire resistance tested and approved for use with combustible insulations in rain-screen cavities and that is fixed back directly to the substrate and interrupts the K15 insulation in the same manner as tested, and
- the support system for the rain-screen cladding being entirely non-combustible (including all framing, sealants and fixings).

It is recommended that an approach be made to BRE to clarify the above and to establish the possibility for a BR135 classification document providing scope for some like-for-like product variation.

Planning for future testing and field of application

In terms of future testing to BS8414, it is apparent that architects designing rain-screen cladding constructions for new buildings would view the potential for cavity barriers to be fixed to/through uninterrupted K15 insulation as attractive. The manner in which K15 has performed in the tests discussed in this document in terms of its dimensional stability and burn-through resistance indicates that this may be possible in terms of achieving a positive test result to BS8414-2.

In terms of providing data to generate a more flexible BR135 classification, a BS8414-2 test using 'generic' Class 0/Euroclass B sheathing boards (substrate) and Class 0/Euroclass B cladding could potentially be designed in consultation with BRE. This could use materials that are chosen specifically on the basis of their tested and certified reaction to fire performance levels to be sufficiently onerous (i.e. 'just' achieving Class 0/Euroclass B) such that any sheathing/cladding with the same classifications can be (robustly) considered equivalent. Alternatively a test using Class 1/Euroclass C sheathing and cladding boards could be considered as, if successful, it should be clear that substitution with materials achieving Class 0/Euroclass B or better would represent a performance improvement.

The situation is akin to that which exists with fire door assemblies where it is simply not practicable to fire test every possible combination of door size, leaf type, ironmongery specification, glazing specification, intumescent and smoke edge seals etc. Because of this, the test laboratories and

certification bodies have developed assessment methodologies and associated rules that allow them to consider core test data to establish fields of application which permits reasonable flexibility for the designer to vary the as-tested detail provided that he/she stays within the boundaries of the field of application.

If BRE is not willing to engage with such a process then the option remains for Kingspan to engage another body to produce a field of application report based on the test data and specific classification statements.