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Property

Insulated Sandwich Panel

Underwriting considerations for insulated sandwich panels

Risks involving large insulated sandwich panels constitute a big challenge from a fire prevention / protection standpoint. As the frequency and severity of losses has been increasing, several countries have been conducting studies on this subject.

A typical "sandwich panel" has a metal skin containing a core of either mineral wool, foamed polystyrene (EPS), polyurethane (PUR), polyisocyanurate (PIR) or other "hybrid" materials. Polystyrene filled sandwich panels offer very economical solutions for achieving reliable temperature control and provide coated, hygienic surfaces that can be washed down frequently.

This type of construction has seen an important and rapid development in many countries for food processing plants, pharmaceutical plants, laboratories, semiconductors factories, electronic plants, aircraft / automotive engine testing rooms, ageing rooms, space launch vehicle industries etc.

The down-side is that fire will spread very rapidly in buildings containing combustible cored sandwich panels because of their heavy combustible load. In such conditions if the fire is not controlled in its early stages by automatic fire protection equipment, it will be nearly impossible to fight it manually due to the heat and toxic corrosive smoke released, coupled with the Fire Service's standing instructions not to enter an EPS environment where there is confirmed alarm activation.

Consequently after a fire, large property damage and a long business interruption period can be expected. The fire exposure of combustible insulated sandwich panels depends on the quality of the foam, the quality of manufacture (adherence between the sheeting and insulation), and moreover the quality of on site assembling. Yet, unless adequately arranged, properly protected by an automatic system and provided with approved passive protection, no insulated sandwich panel will withstand a large fire.

Foam plastic insulation, such as polyurethane, some polyisocyanurate products and polystyrene, is made from a mixture of plastic components and a blowing (foaming) agent. When involved in a fire, these materials may spread fire damage far beyond normal expectations. They may also generate large quantities of dense, toxic smoke that may contaminate machinery, equipment, products or the building, thus requiring extensive cleaning, repackaging, or scrapping of a product.

Sandwich panels containing plastic foam present severe challenges for automatic sprinkler systems. Polystyrene is 1.5 times more combustible than polyurethane and up to 10 times more combustible than polyisocyanurate*, forming a combustible liquid when it melts. Automatic sprinklers installed prior to the adoption of NZS4541:2007 may not confine the fire so that protection should be considered at either roof level, false ceiling level, or in racks, and should protect building walls and

building structures. In many cases, retrofitting or additional sprinklers should be installed to the new standard.

Good loss prevention practices obviously are crucial and should comply with Lumley's EPS Panel requirement and Work Permit schedules.

The minimum integrity of the sandwich panels should be ensured as follows:

- There is no exposed combustible foam, panel walls not covered with metal, each panel is adequately joined to another one and adequately attached to building floors and roofs at the lower and upper ends.

- There are no combustible components other than insulation material (vapour barrier, glue, inner and outer coatings).
- Special precautions also should be taken when installing electrical devices and equipment, and when conducting cutting and welding operations.

Sandwich panel insulation materials – relative fire risk factors:

1. Expanded Polystyrene – EPS (Including Polyurethane Foam – PUR.)
All EPS or PUR used in construction products in New Zealand since 1993 contain a flame retardant conforming to AS 1366, part 3 – 1992. As flame retardant EPS is heated it softens, and at about 150ºC it begins to shrink. This continues until it is reduced to its original density prior to expansion.

Continued heating will melt it to liquid and then a combustible gas will form above 200ºC and become concentrated within the steel sandwich panel. This gas can be ignited at temperatures between 360ºC and 380ºC, and will self ignite around 500ºC.

EPS not designed for construction use such as packaging, generally does not contain flame retardants and will support combustion at relatively low temperatures. However as it is not confined within a sandwich panel the flammable gasses are dispersed into the atmosphere and the result can be compared to a wood or cardboard packaging fire base. This reaction also applies to exposed PUR provided we can be satisfied that it has been treated with the approved flame retardant, if not the fire will spread rapidly at very high temperatures.

The insurance industry should discourage the future use of EPS in favour of alternative materials with greater fire resistance.

2. Polyphen and XFlam:
A relatively recent development is the Phenolic/expanded Polystyrene hybrid core material. These composite materials consisting of EPS beads and other polymer products encapsulated in a Phenolic matrix combining the fire performance and relatively low smoke production properties of Phenolic core materials with the thermal insulation properties of EPS, i.e. the polystyrene beads are separated by a fire resistant phenolic material recently tested to British and Factory Mutual standards.

XFlam will also be produced with the EPS filler replaced by other polymeric and natural materials, however these products are not yet available commercially.

Fire rating/fire resistance specifications vary depending on thickness and whether the panel is designed for internal partitions or external walls. The usual structures we are dealing with have internal walls or linings constructed with 100mm sandwich panel. XFlam and Polyphen for this class have a rating of -/30/30, i.e. 30 minutes fire resistance and 30 minutes thermal insulation. There is no structural integrity rating and a height limitation of less than 5m applies. However to achieve a full FM4880 Class 1 rating a thickness of 250mm is used.

3. Polyisocyanurate – PIR*:
PIR is a thermo set plastic foam manufactured from an aromatic polyester polyol, a polymeric isocyanate and a blowing agent. PIR foam insulation offers many advantages such as:

1. High R-value (thermal efficiency) per unit thickness
2. Excellent fire resistance
3. Excellent moisture resistance and water repelling characteristics
4. Desirable dimensional stability, and
5. Resistance to solvents commonly found in construction adhesives.

*At present only Kingspan PIR panels carry the FM Class 1 approval rating in New Zealand and it should be noted that some PIR cores have fire performances little better than PUR.

Currently an ultra violet torch is required to establish the presence of Kingspan PIR and this can result in the Fire Service treating all insulated sandwich panel structures as EPS resulting in a 100% EML irrespective of the insulated core material in use.

For 100mm thick Kingspan PIR internal walls the fire rating and fire resistance figures are the same as Polyphen but the panels achieve the FM Class 1 rating at a thickness of 100mm and there is no height limitation.

The insurance industry should encourage manufacturers to clearly specify the insulation core on each panel to enable accurate assessment of the fire risk by our surveyors and the Fire Service.

Occupational considerations – relative risk factors:

(A) Generally unacceptable EPS risks:

1. Occupations within EPS structures involving welding, metal grinding or use of corrosive chemicals such as galvanising baths etc.
2. Workers in wood, fibreglass industries, boat builders, caravan and camper van manufacturers. (Most caravans and camper vans are constructed with EPS panels).
3. Automotive industries – mechanical engineering, panel beating and tyre manufacture assembly etc.

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4. Industries requiring high electrical power usage, soldering or testing.
5. Any EPS structure with exposed polystyrene irrespective of occupation.
6. Medium or high temperature timber drying kilns.
7. Any drying kilns with incomplete separation from boilers.
8. Pack houses and attached cool stores with no external sprinklers and no storage of wood bins or battery charging adjoining.
9. Exposed, sprayed on polyurethane foam insulation without flame retardant properties. (Generally pre 1992.)

(B) Generally acceptable EPS risks if protected. – Preferably sprinkler protected (mandatory over a combined MD/BI sum insured of $10m) or possibly with dual "rate of rise" monitored temperature probes as installed in most modern cold stores and monitored smoke detection elsewhere provided all other factors are positive following a survey:

1. Purpose built cold stores with no external storage within 10m and adequately controlled battery charging facilities.
2. Automotive spray booths and paint rooms complying with AS/NZS 4114.
3. Walk in chillers and freezers comprising less than 15% of the building floor area.
4. Vegetable processing – no cooking other than boiling or steaming with an external, adequately separated heat source.
5. Meat works – no smoke house or cooking. (i.e. "Wet risks" with no external combustible storage within 10m).
6. Fish processing – no cooking or other heat source.
7. Controlled atmosphere (CA) cool stores (Full CO2 gas flooding internally) with external sprinklers if combustible materials are adjacent.
8. Pack houses and cold stores adequately sprinkler protected.
9. Polystyrene in bulk or as packaging provided it is not contained within a sandwich panel. (Polystyrene sheets have about the same fire rating as any other plastic provided they are open to the atmosphere.)

(C) Generally acceptable as a minimal extra hazard provided the occupation is compatible with the structure:

Buildings using Kingspan PIR, Polyphen, XFlam, cork, Rockwool, fibreglass (wool or compressed sheets), steel wool as insulation materials or EPS cold stores constructed after 1993 sprinkler protected to the standard of NZS4541:2007.

If you have any questions, please call Lumley Property on **09 308 1100** to speak to one of our Property experts.

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Note: Some reference material used in this article was extracted from papers by Didier Schutz, Risk Control Practice Leader SCOR.