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Foam glass can provide an effective protection against fires

Fire Protection and Risks in Industrial settings

Foam glass can provide very effective fire protection in bunded areas and corresponding areas in which there is a risk of a spill fire in flammable liquids. This was demonstrated very clearly by fire tests that were carried out at a seminar arranged in Borås by SP Fire Technology on 25th March 2010.
The seminar was arranged within the framework of a project financed by the Swedish Fire Research Board (Brandforsk project 602-091), and attracted about 30 participants from industry, fire and rescue services, public authorities etc.

Spill fires can create serious consequences

Handling and storage of flammable liquids involve a significant risk of fire. Based on many years' experience, the petrochemical industry has developed appropriate fire protection methods and procedures, with the result that the number of fire incidents today is relatively low. However, incidents with spill do happen, which present a significant risk of ignition. If ignition does occur, it can quickly lead to a major fire with serious consequences.

A spill fire almost instantly produces a very high heat exposure towards surrounding objects which, in turn, can result in further leaks and spills, explosions and/or fully developed tank fires. Regulations require that means for fire fighting must be provided, but in practice there can be a significant delay before the fire fighting operation is started. Such delay presents a considerable risk that the fire will have already started to escalate by the time that fire fighting personnel arrive, which further increases the need for fire fighting resources, etc.

The progress of the fire, and the risk for escalation, depend to some extent on the properties of the product concerned. Petrol, for example, has a high vapour pressure and a low flash point, and an open spill very rapidly produces large quantities of flammable vapours, presenting a significant risk of ignition. Products such as ethanol and ethanol fuels can present an even more serious problem in the event of a fire, as the gas mixture in a tank or system is often within the flammable range, thus increasing the risk of an explosion in a tank exposed to fire. If ignition occurs, ethanol can also produce a considerably higher heat flux than, for example, petrol, which in turn requires more cooling of nearby objects and at the same time makes conditions more difficult for fire-fighting personnel due to the higher heat flux levels. As a further complication, a fire in water-soluble products is considerably more difficult to extinguish, which therefore further increases the risk of escalation.

What is foam glass?

Foam glass is produced by adding a foaming agent to molten glass, which decomposes to form a gas which in turn forms bubbles to reduce the overall density. Applications for foam glass include insulation materials where, in addition to good thermal insulation properties, the material presents the benefit of being entirely inert, not absorbing water and withstanding high temperatures. The offshore industry provides a major application for this type of insulation. Another important application area is as a lightweight filling material in such structures as building foundations and roads, where it can be used as an alternative to expanded plastic and similar materials. In this case, the foam glass is manufactured from recycled glass, to produce an end product similar to macadam, but with considerably lower density and better thermal insulation performance.

The benefits of using foam glass as fire protection

In the form of granules or cubes, foam glass can provide a very simple, cheap and reliable form of passive fire protection to minimise the effects of a spill fire. A layer of foam glass can be applied in a bunded area where, in the event of a spill, it will float on top of the fuel to produce a 'solid foam layer'. This reduces the risk of fire in three ways:

1. Evaporation from the fuel is considerably reduced, thus reducing the risk of producing a flammable gas mixture.
2. If the fuel does ignite, the fire intensity is considerably less than if the fuel was burning from an exposed surface, thus reducing the thermal exposure towards neighbouring objects and thereby reducing the risk of escalation.
3. The reduced intensity of the fire provides more time for fire fighting, and also exposes the fire fighters to considerably less thermal radiation.

This gives several potential advantages in comparison with conventional means of fire protection:

- A spill fire is automatically controlled already from ignition and burns more slowly.
- The foam glass does not reduce the volume of the bund to any greater extent.
- Rainwater can be drained away through existing systems.
- The cost is probably very low in comparison with e.g., a fixed water sprinkler system or a fixed foam system.
- In principle, foam glass needs no maintenance.
- Foam glass has good load-bearing capacity, which means that personnel can still walk around in the bunded area, possibly after minor measures.
- Foam glass withstands high temperatures, and probably does not age.
- Foam glass has closed cells, which prevents the absorption of water or flammable liquids.
- Foam glass has a low weight, and is easy to install and remove if necessary.

The principle of reducing the intensity of a liquid fire by means of some form of covering of the burning surface is not new. The most common method is to use fire-fighting foam, which also extinguishes fires of this type. Ordinary macadam has a fire suppression effect as long as it covers the surface of the liquid. There are also various types of explosion protection systems consisting of aluminium strips that can be used to cover the surface of burning fuel and thus reduce the fire intensity.

The idea of using foam glass as a means of protecting against fire was evaluated by Shell Research at the beginning of the 1980s, with the aim of controlling spill fires of LNG. The results were very promising, reducing radiation levels by up to 95 %, but for some reason most oil companies decided to use high expansion foam. However, recently, a manufacturer of foam glass (Pittsburgh Corning) has developed a protection concept using foam glass, FOAMGLAS® PFS, which has shown excellent results in fire tests.

Presentations and fire tests at the seminar
The objective of the feasibility study and the seminar has been to increase awareness of foam glass and what it is, to demonstrate how it can be used today and to show its potential for fire protection purposes. Peter Sundberg from the Glass Research Institute took part in the seminar, describing the properties, manufacturing processes etc. of foam glass. Öistein Lillelien from Pittsburgh Corning Scandinavia (www.foamglass.com) described the product, FOAMGLAS® PFS, and the tests that had been recently conducted in the USA on LNG spills. Stefan Nordahl from Hasopor Hammar AB (www.hasopor.com) which manufactures foam glass from recycled glass, described the use of the material in lightweight fill applications. Henry Persson, who has been the project leader of the Brandforsk project, described the ideas and principles of the use of foam glass for fire protection, and experience to date. The demonstrations that were carried out in the fire laboratory gave the participants a feeling for the fire protection potentials of the material, as shown in the photographs.

Further investigations would be valuable
The seminar was concluded with a discussion of interest in the potential application, and the need for further knowledge if foam glass is to be used as an alternative for other methods of fire protection. The conclusion from the discussions can be briefly summarised by saying that all participants were convinced of the potential of the material to reduce the intensity of a fire. However, a number of aspects require further investigation before practical application. The most fundamental question from a design point of view is to determine the optimum thickness of the layer of foam glass. Other potential question areas that were discussed included water absorption resulting from long exposure outdoors, the need to package the expanded glass, ageing properties, access to protected areas, the effect of low temperatures and other problems during the winter, the effect on the net bunded volume, and to what extent the size and shape of the expanded glass particles could be changed to provide the best coverage of the surface of a fuel. Hopefully, these questions can be investigated in a continuation project.

Report
The results of the feasibility study has been published in SP report 2010:40 with the title “Cellular glass as a fire protection measure in petrochemical industry”. The report is in Swedish but includes informative diagram’s and photos. The report can be downloaded from www.brandforsk.nu, project number 602-091.

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