Technical Information Sheet – TIS 11

Behaviour of Azote® Foams in Fires

Zotefoams plc has carried out extensive testing of the fire behaviour of Plastazote® and Evazote® including studies by an independent testing authority: RAPRA Technology, Shawbury, England. It is considered the results will apply generally to all Azote® products produced by Zotefoams. The following notes summarise the results of the tests. Attention is drawn to the list of publications at the end of this information sheet in which are contained the relevant UK legal requirements.

INTRODUCTION

The behaviour of foam materials in fires is important to all who transport, store or use them, and to the emergency and safety authorities with responsibility for dealing with them. The following notes describe the behaviour of Plastazote® foam and Evazote® foam in a fire with good air circulation, conditions which are commonly found in warehouses or outside bulk storage. Such fires are considered likely to present the greatest hazard.

Stores of finished products containing Plastazote® foam and Evazote® foam are unlikely to involve as large quantities of foam as stores of the raw materials and are not covered by these notes. Furthermore, the presence of other materials such as other plastics, textiles, etc. may substantially alter the ignitability, smoke and toxic gas production, and suppliers of these types of materials should be contacted for information.

BURNING AND GROWTH

Burning is a reaction between gaseous products and oxygen in the air. Plastics burn when they are caused to emit gaseous decomposition products which subsequently ignite. Considerable heat is required to cause plastics to decompose in this way. In most cases of fires involving plastics the heat and ignition source comes from fires initiated in some manner unrelated to the plastics, for example, an overloaded electrical circuit, or a cigarette stub.

There is a temperature, which varies according to the type of plastics material, at which the gaseous decomposition products will spontaneously ignite. It is not necessary for sparks or flames to be present to start a plastics fire. The temperature at which the gaseous decomposition products of LD Polyethylene will auto-ignite is approximately 340 °C while flash ignition temperature is some 10 °C lower. Plastazote® foam contains LD Polyethylene and can be expected to exhibit the above behaviour.
It is essential that all plastics materials including Plastazote® foam and Evazote® foam are stored away from the sources of heat and that adequate controls are exercised over the introduction of possible sources of ignition to the storage area.

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TEST FIRES

Currently there is no standard set of test conditions that can adequately measure the fire hazard of materials. Ad hoc tests can be devised and the results interpreted to give general advice on the hazards. The tests below were carried out with this aim and are not claimed to be exhaustive.

All of the tests were carried out on sheet materials, each approximately 30mm thick. Offcuts of sheets around which air would flow more easily would burn more quickly than entire sheets. By analogy, wood shavings burn more quickly than planks.

The materials used for the tests were natural, i.e. unpigmented grades of Plastazote® foam and Evazote® foam. No tests in this series of studies were carried out on grades of Azote® foam that contain flame-retardant additives such as LD45FR. Test fires involving single stacks of sheets were studied. Typically the stack dimensions were 1 m x 0.95 m x 1.75 m. Analyses of the combustion gases were carried out also, by RAPRA. The RAPRA tests were held in a specially constructed test room where the foam occupied approximately 3% of the room volume. This room was connected via an open door to a corridor which led to a smoke extraction system.

The progress of the fires was monitored and recorded and the information given below is based on the results obtained.

TEST FIRE RESULTS

Both Plastazote® foam and Evazote® foam burnt. During burning molten polymer ran down the surface of the stacks and burnt on the ground as a liquid pool. In the tests using comparatively small ignition sources it was found that the main growth of the fire occurred after 10-15 minutes for a Plastazote® foam and after 20-25 minutes for Evazote® foam, by which time the burning pool of polymer was a contributor to the fire. Up to this point in the fire growth, smoke emission was relatively low, and would not have reduced visibility to a hazardous extent.

In this respect Plastazote® foam and Evazote® foam are unlike some other types of plastic foams, which even in well-ventilated fire conditions and in the early stages of fire development produce copious quantities of dark smoke. Smoke emission by Plastazote® foam and Evazote® foam fires would probably be greater in conditions where the oxygen supply is restricted, for example a fully developed fire with limited ventilation. Similarly the addition of pigments, particularly carbon black in the black and grey foam grades, can alter the amount of smoke produced in a fire.

When organic materials burn, carbon dioxide and carbon monoxide are produced as combustion products. Gases sampled from the test fires contained these gases as well as a wide range of gaseous hydrocarbons. While these gases would be irritating to respiratory systems their individual concentrations were such that it would need

several hours exposure to them to be lethal. No hydrogen cyanide, a combustion product of polyurethane-type foams, was found in the test fire gases.

Quantities of gases and smoke generated were higher in the fully developed fire conditions. In the cases of Evazote® foam, an ethylene vinyl acetate copolymer, acetic acid was found in the combustion products. in the fully developed fire condition the heat, smoke, gas and molten polymer would be a serious hazard in inside storage; outside, the hazard would be much less.

CONCLUSIONS

The main atmospheric contaminants were:

1. Increased levels of carbon monoxide and carbon dioxide.
2. A wide range of hydrocarbon gases which would be irritant but which require long exposure periods to be lethal.
3. Smoke at levels significantly lower than is experienced by many other plastic foams.
4. No highly toxic gases such as hydrogen cyanide were detected.
5. The formation of pools of burning molten polymer was a hazard.

RECOMMENDATIONS FOR STORAGE

From the work reported above and other studies carried out the following recommendations are made for the storage of Zotefoams products:

1. The normal precautions that are observed for the storage of combustible materials should be observed for Zotefoams products.
2. Bulk storage areas should be separated from working areas and partitions should have adequate fire resistance.
3. Sources of ignition such as open flames and smoking should be prohibited.
4. Engineering operations which involve heat, flames or sparks such as welding or grinding should be carried out only after adequate precautions against fire have been taken.
5. A 'permit to work' system is recommended whereby only authorised people and operations are permitted in storage areas.
6. Fire extinguishers should be mandatory. (Note: for a fire in its initial stages small hand-held water or power extinguishers have been found to be effective. Sprinkler systems and/or hose reel water supplies are necessary to control larger fires.)
7. Loose combustible material such as waste foam, packaging cartons, etc should not be allowed to accumulate in storage areas.
8. Storage of foam in compact stacks that minimise the air spaces within stacks is advised.
9. The width and length of each stack should be the minimum consistent with convenient access and practical working conditions. The stack height should not exceed twice the width of gangways between stacks, except in sprinklered installations when the advice of the insurers should be sought.
10. Measures to restrict the spread of molten polymer are advisable, especially for storage above ground level when molten polymer dripping through upper

floors or down stairways can create particular hazards and contribute to the fire spread.

11. All stockists should ensure that local regulations are complied with.

OTHER INFORMATION SOURCES

Details of the UK legal requirements can be found in:

The Building Regulations 2010
Building (Scotland) Act 2003
Health and Safety at Work Act 1974
Management of Health and Safety at Work Act 1999
Regulatory Reform (Fire Safety) Order 2005
and reference should be made to these documents.

Guidance on safe working practises can be obtained from the Health and Safety Executive http://www.hse.gov.uk/fireandexplosion/workplace.htm

A publication which puts fire and plastics into a broad perspective is:
Flammability Handbook of Plastics, Fifth Edition: Ed CJ Hilado. CRC Press, ISBN 9781566766517

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