



Fire and explosion risks from pentane in expandable polystyrene (EPS)

Plastics Processing Sheet No 1

Introduction

This information sheet was produced by the Health and Safety Executive in consultation with the Plastics Processors' Health and Safety Liaison Committee. The Committee comprises the Health and Safety Executive, employers and employee representatives in the plastics industry.

Raw expandable polystyrene (EPS) bead contains a flammable gas, usually pentane. Pentane is extremely flammable. Its flash point is minus 50°C and its boiling point 36°C. It is heavier than air and odourless. Some pentane is given off all the time the material is being stored and transported, and will even be released from finished products for a short while after manufacture.

EPS is normally delivered in containers designed to reduce as far as possible the amount of pentane given off. However, some pentane may leak from packaging, and the amount given off will increase when packages are opened ready for production.

The Health and Safety Executive (HSE) has investigated many factory fires caused by the ignition of pentane.

This information sheet is aimed at all those who manufacture, transport and process EPS bead and finished products.

Hazards and precautions

Here are seven essential things you should know about pentane in EPS bead, *however you handle or use it*:

- Pentane will ignite if it comes into contact with any surface with a temperature that exceeds 285°C, eg a light bulb.
- Smoking must be prohibited anywhere EPS bead is used or stored.
- Temporary heating appliances used in winter can present an ignition risk where EPS bead is stored, if they are not suitable for use in such atmospheres. Check any appliances you find.
- Temporary electrical wiring and the use of portable electric tools can ignite pentane. Avoid the first, and allow the second only under controlled conditions.
- Check that electrical switches, ventilation fans etc are suitable for use where flammable vapours of pentane can occur.

- Use of a gas monitor will enable you to identify where pentane 'hot spots' are likely to occur, and to measure concentrations.
- There is no difference in pentane risk between flame-retardant and regular EPS.

Delivery

Make sure that you follow the information on your supplier's safety data sheet about safe unloading. In particular you should:

- prohibit smoking;
- exclude other ignition sources;
- leave containers or trucks open before unloading to allow pentane to disperse (or force-ventilate);
- offload in a well-ventilated place.

Storage

Expanded polystyrene bead will emit pentane vapour in factory storerooms. So make sure that you:

- store octabins containing expandable bead in a well-ventilated area;
- store *pre-foam* in a well-ventilated area, using low-level vents. You can use this simple formula to decide how many air changes per hour are needed, and, from this, whether assisted ventilation will be needed:

$$y = \frac{2W}{V}$$

where y = air changes per hour needed;
 W = mass of material in tonnes; and
 V = volume of the storage area in cubic metres.

As a guide, if the result is six air changes per hour or less, you can probably rely on general ventilation.

Pre-expansion

At this stage, pentane vapour being given off will be mixed with steam which will reduce its flammability, but pentane/steam vapour should still be vented to outside because of the residual risk.

Maturing silos

Tests carried out by HSE have shown that explosive mixtures can be generated in the head space of maturing silos.

In *fabric* silos you should:

- use natural fabrics or conductive fabrics in earthed structures;
- provide and use a gas detector (either a permanently installed detector or a portable one for periodic sampling use, as appropriate); and
- ventilate at low levels around the silos, with the form of the ventilation based on the sampling results.

In *metal* silos you should:

- ventilate to keep levels of pentane below the lower explosive limit (LEL) - see the supplier's data sheet;
- ensure that metal silos are robust and fitted with explosion relief, venting to a safe place on the top;
- ensure that they are earthed;
- provide and use a gas detector (as described above).

Conveying ducts

The risk is higher when the beads are drier, but *in all cases* there is a real risk of fire from static electricity. So you should make sure that:

- all parts of the ducting, including flexible sections, are earth bonded and that there is earth continuity in all ducting;
- product is conveyed at the lowest speed possible.

Moulding

Steam is introduced during this process, which reduces the fire/explosion risk. However, after moulding, the blocks dry out and will release some pentane vapour. So make sure that there is sufficient general ventilation at low level, using the formula on page 1.

Cutting and shaping

Hot-wire cutting is known to cause fires (in one company there were about ten incidents a year). So make sure that you:

- cool exposed wires by forced draught ventilation;

- interlock the block transport system so that if the conveyor stops, the electrical supply to the wire cuts out;
- provide electrical fault detection to prevent wires running red hot and check it regularly;
- have carbon dioxide/dry powder extinguishers available and people trained in their use.

Finished goods

Pentane can still be given off from finished goods. So make sure that you:

- treat finished goods stores as a fire risk area;
- closely control hot work;
- keep other combustibles away;
- keep finished goods in a well-ventilated place after moulding.

Recycling of in-house waste

Flammable vapour can still be given off. So make sure that you:

- keep scrap in a well-ventilated storeroom.

Hot work

Hot work on plant, which includes grinding and cutting with power tools, can provide a source of ignition. Residual heat from such work can even cause ignition some time after the hot work has finished. So make sure that you:

- control any hot work, for example by using a permit-to-work system in areas where pentane is likely to accumulate;
- keep the area clear of anything that could catch fire.

It is also good practice to keep the area under observation for incipient fire for an hour or so after the work has finished.

Planning in advance

Despite taking these precautions, a residual risk of fire will still remain. It is good practice to think through the implications of a fire in advance, prepare an incident plan and train your staff accordingly. The further reading section includes guidance on the making of fire risk assessments under the Fire Precautions (Workplace) Regulations 1997.

Further reading

Essentials of health and safety at work HSE Books 1994
ISBN 0 7176 0716 X

Five steps to risk assessment INDG163 HSE free leaflet
1995 also available in priced packs of 10,
ISBN 0 7176 0904 9

Fire precautions in the workplace The Stationery Office
1997 ISBN 0 11 341169 3

The future availability and accuracy of the references listed in this publication cannot be guaranteed.

HSE priced and free publications are available by mail order from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 6FS. Tel: 01787 881165 Fax: 01787 313995.

HSE priced publications are also available from good booksellers.

The Stationery Office (formerly HMSO) publications are available from The Publications Centre, PO Box 276, London SW8 5DT. Tel: 0171 873 9090. They are also available from bookshops.

For other enquiries ring HSE's InfoLine
Tel: 0541 545500, or write to HSE's Information Centre,
Broad Lane, Sheffield S3 7HQ.

HSE home page on the World Wide Web:
<http://www.open.gov.uk/hse/hsehome.htm>

<p>This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.</p>

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