

Chapter 33 – Expandable Polymeric Beads

Expandable polymeric beads, also known as expandable polystyrene (EPS) (UN 2211 Polymeric Beads, Expandable), are used to produce a moulding material in the form of granules or beads of approximately 3 mm in diameter. The beads or granules may contain 5 to 8% of a volatile hydrocarbon, which is predominantly pentane.

During the moulding process, the beads are heated, causing expansion and fusion, which forms the familiar polymeric packaging material. During storage or transport, the material will release a portion of the pentane. The rate of this release increases with a rise in temperature. Pentane vapours are heavier than air, so higher concentrations can be found closer to the deck level, or at the bottom of cargo holds.

To add more complexity, pentane can ignite at relatively low concentrations, eg 1.3% by volume in the air.

The beads have been found to generate flammable concentrations of gas in enclosed spaces and have been involved in several major explosions, one incident causing severe damage to a container ship.

33.1 Packaging and Storage

Expandable beads are included in the IMDG Code (Reference 19), under Class 9 (miscellaneous dangerous substances and articles). Packaging recommended in the IMDG Code includes outer drums and inner plastic packages. Intermediate bulk containers include composite fireboard or plastic materials.

The IMDG Code (Reference 19) states that storage and segregation is Category A, on deck or under deck, but mechanical ventilation should be provided for under deck stowage to prevent the formation of a flammable atmosphere. The Code advises that, during storage, a small proportion of the pentane may be released to the atmosphere and that this proportion is increased at elevated temperatures. There is also a cautionary note relating to the opening of doors if the material is carried in containers.

The recommended storage is in a well-ventilated space and preferably below 20°C. Warehouse storage below 20°C may be a relatively simple operation. However, stowage in the holds of an ocean vessel may be more difficult and should, at least, be away from heated bunker tanks or engine room bulkheads. Temperatures in ships' holds might be of the order of 65°C in some tropical areas. Adequate hold ventilation with 'suitable equipment' should be stressed because the arcing of an electric fan motor may readily ignite a flammable concentration of pentane in air.

Under deck stowage is permitted, but good ventilation must be ensured so that any ignitable concentrations can be avoided. Use of ventilation containers must be considered with caution as the level of ventilation provided may not necessarily be sufficient to rid any build-up of pentane. When ventilated containers are used, the 'Criteria for the Selection of Ventilated Containers' provided by the Expandable Polystyrene (EPS) Transport Group of Plastics Europe in *Guidelines for Transport and Storage of Expandable Polystyrene Raw Beads* (Reference 55) must be complied with in addition to complying with other requirements of the IMDG Code for labelling, packaging and segregation. This requirement must include additional labelling for closed containers, with markings such as:

- Keep away from sources of ignition
- no smoking or welding
- no fire/flames or naked lights
- no spark producing tools
- distance maintained from hot surfaces or sources of heat.

The Code of Federal Regulations *Title 49: Transportation*, Chapter 1, Part 173 (Reference 56) describes various packaging materials but states that, except for transportation by highway and rail, the packaging must be capable of containing any evolving gases from the contents during normal conditions of transport.

33.2 Shipment

Transportation on ships in closed, non-ventilated containers is permitted, but the consignees must be advised about the risks associated with any accumulated pentane in high concentrations, including additional requirements for making an entry into the container, which should be treated as an enclosed space. This may require use of supplementary labels to warn workers of the hazards.

Deck temperatures in tropical climates can also exceed the recommended limits for safe stowage of the beads. However, if the cargo is containerised, the containers can be placed in a central area of the stow where they will be insulated from the effects of direct sunlight. This arrangement will create extra movement during loading and discharge but can assist toward safe carriage. Pentane released from containers in deck stowage will be dispersed by wind and movement of the vessel and should not create flammable or explosive conditions outside the containers.

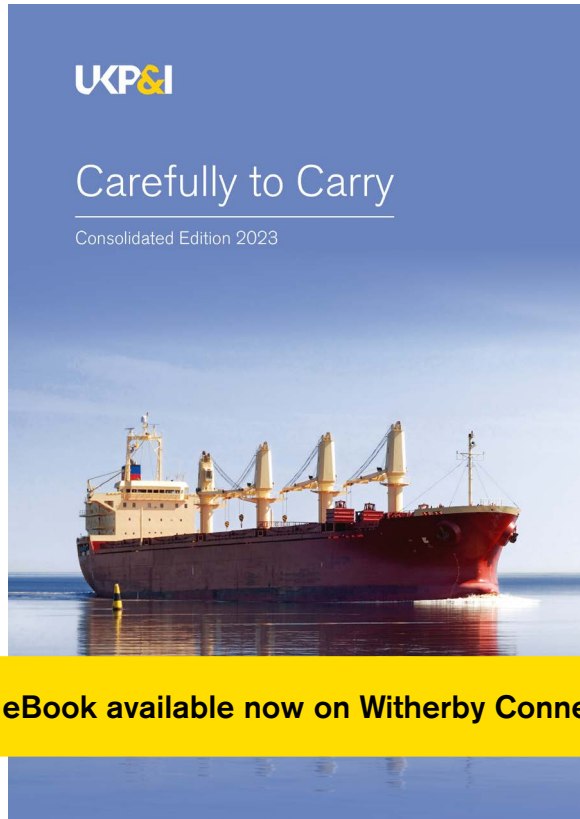
33.3 Hazards

Manufacturers are aware of the problems of release of pentane, which is heavier than air, into freight containers. Recommended ventilation periods are suggested prior to entry and unpacking the container. If opened in a container yard, containers should be sited away from drains so that pentane released when the doors are opened does not enter them, creating a potential fire hazard at some nearby location.

Manufacturers are aware of the hazards involved with storage and transportation of the beads and provide detailed lists of precautions to be observed. They also ensure packaging is provided with detailed warning labels, fixed to either the drums or the freight containers, and expressed in several different languages.



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