

Recommended Safety, Health, and Environmental Guidelines for EPS and RMER II®

I. GENERAL

Huntsman expandable polystyrene is shipped in the form of small polystyrene beads which contain a low percent of a volatile, flammable blowing agent. Polystyrene itself is flammable, although more difficult to ignite than the vapors of the blowing agent. The blowing agent vapors are flammable only when mixed with air within the range of 1.5 to 7.8 percent by volume. As this range is relatively broad, such mixtures can frequently occur under ordinary handling conditions. Not only the beads, but also the pre-expanded foam particles (prepuff) and the molded or extruded foam pieces can, until much of the residual blowing agent dissipates, supply enough vapor to form a flammable mixture. The mixture, when unconfined, is not "explosive". The mixture is explosive only when confined and, upon ignition, its rate of flame propagation is very high, and the flame appears to move in a flash but without explosion.

In view of these characteristics, attention must be given to certain safety provisions and practices specific to the safe handling of Huntsman expandable polystyrene and to the production and storage of foamed polystyrene, including regrinding and storing of scrap. If reasonable safeguards are provided and proper precautions are practiced, these materials can be handled and stored safely.

II. CONSTRUCTION AND EQUIPMENT

1. Building should be of substantial, fire resistant construction.
2. Areas for various services such as raw material storage, production, finished product storage, and grinding and storage of scrap should be separated by fire walls. Fire doors should be either self closing or kept closed.
3. Sprinklers capable of delivering adequate water density from a water supply of adequate volume, as determined by the local fire and insurance authorities, are recommended. The number and type of sprinklers will vary with the height of the building, its construction, its area, and its location.
4. An adequate number of hand fire extinguishers, preferably carbon dioxide and hand water supply hoses should be strategically located for quick use. (Weigh carbon dioxide extinguishers at least every three months and mark weight and date on tag)
5. Adequate ventilation at floor level, preferably forced, should provide for at least six changes of air per hour to keep blowing agent vapor concentration below 1000 parts per million, i.e. 10% of the lower flammability limit and below the 8 hour time weighted OSHA permissible exposure limit.
6. Exhaust fans with ducts to outdoors or emission control systems should be provided at critical locations such as scrap grinders, cutting tables, and pre-expanders.
7. Electrical equipment such as motors, stop-art push-buttons, disconnect switches, and wiring should conform to local building code requirements.

8. Good electrical bonds and grounding of all metal equipment, as well as transfer lines, storage bins, and scrap grinders are essential.
9. An adequate number of conveniently located and properly sized waste and trash boxes should be provided. They should be equipped with gravity closing lids and should preferably be made of non-combustible material. Vents to outdoors or emission control systems are desirable for blowing agent vapor dissipation.
10. Pre-expanded particles (prepuff) should not be passed directly through the impeller of an air flow. Any blockage of flow down-stream from the blower causes accumulation in the blower. The revolving impeller may generate enough frictional heat in the accumulation to start a fire which can spread to storage bins. Such a fire is particularly difficult to detect early and to extinguish.

III. GENERAL HOUSEKEEPING AND SAFE PRACTICES

1. Establish and maintain aisles of adequate width.
2. Keep all floor areas clean of litter.
3. Practice housekeeping at the level that the plant can be shown with pride to any unannounced visitor.
4. Establish and enforce a "NO SMOKING-NO MATCHES-NO LIGHTERS-NO WELDING" rule without fail. This restriction may appear to be unnecessary in certain areas, but as blowing agent vapors are about 2½ times heavier than air, they fall to the ground and in quiet air can crawl along the floor and convey fire from one area to another.
5. Have several persons stand by with extinguishing equipment in hand if such spark-producing operations as welding or cutting must be carried out. Never let a welder work alone. Be sure area is clean and vapor crawl is absent.
6. Avoid open flame such as lanterns. Lift truck exhausts should be directed upward.
7. All grounds should be tested periodically. Bonding and ground connection failure can produce sparks.
8. Tools such as scoops and shovels should be of materials such as wood or non-conductive plastic to eliminate the possibility of sparks.
9. Clothing should be non-static-accumulative and shoes should have conductive soles. Avoid fabrics of synthetic fibers.
10. Fire drills can be an invaluable aid. Trained personnel are less likely to panic if an emergency should occur.
11. Periodic checks of various locations in the plant under full operating conditions with an "explosimeter" are recommended.

IV. SPECIAL SAFETY PROVISIONS

1. Store and open containers, Super Sacks, or FIBC's only in a well ventilated area which is free of open flame, sparks, lighted cigarettes, or other fire hazards.
2. Care should be exercised when opening containers, Super Sacks, or FIBC's, remembering the possibility of the presence of ignitable vapors.
3. Opened containers, Super Sacks, or FIBC's should stand undisturbed for ten minutes to allow dissipation of vapor accumulation between the contents and the top of the container, Super Sacks, or FIBC's. Once opened, containers, Super Sacks, or FIBC's of raw material should be completely emptied.
4. If a partially used container, Super Sacks, or FIBC's of beads must be stored, the liner must be tightly wrapped around the remaining beads to minimize the free air space above the beads.

5. Personnel should, under no circumstances, be permitted to lean over or reach into open containers, Super Sacks, or FIBC's.
6. Storage of either beads or pre-expanded foam particles (prepuff) in partially filled drums should be avoided. The larger the free space above the solids, the larger is the volume of the blowing agent-air mixture which, if ignited, might well be expected to give a larger flash fire. Partially filled containers, Super Sacks, or FIBC's should be opened with extreme care to prevent ignition by spark or frictional origin. After opening, allow containers, Super Sacks, or FIBC's to stand to dissipate vapors before moving. Mild air currents accelerate such vapor dissipation.
7. All equipment used in handling and processing the material should be electrically grounded. This material will develop a static charge rapidly.
8. Non-metallic scoops, etc., should be used for transferring the material. (Plastic buckets with metal handles are NOT acceptable.)
9. Because the flammable vapors of the blowing agent are heavier than air, they may flow across the floor and accumulate in low places. Proper ventilation should, therefore, be extended to these places.
10. Bins or storage containers should be made of cloth or wire screen to allow constant escape of blowing agent and to prevent accumulation of large quantities of a flammable mixture above the content.
11. Scrap grinders should have a magnetic separator over which the material passes before entering the grinder. Ferrous metal pieces can cause frictional sparks which can ignite the contents not only within the grinder body but also within the scrap storage bin.
12. Waste EPS should be kept for at least 24 hours before disposal. Containment in an open mesh bin will allow dissipation of blowing agent. Only open top or well vented trucks should be used to haul waste EPS. Compactor-type waste trucks should be avoided. Compaction can cause frictional sparks and subsequent ignition of the blowing agent vapors which are being squeezed out at the same time. Fires have occurred when waste EPS has been loaded onto compactor-type trucks now commonly used for hauling all sorts of waste to disposal locations.
13. All employees should be periodically indoctrinated in all safety practices involving the processing of expandable polystyrene.

V. RECOMMENDATIONS FOR HANDLING FABRIC INTERMEDIATE BULK CONTAINERS (FIBC or Super Sack)

FIBC Do's

1. Do use lifting gear of sufficient capacity to take the suspended load
2. Do inspect fork tines for burrs and rough edges, they must be smooth
3. Do adjust fork tines to the correct width for the FIBC being handled
4. Do tilt the mast of the fork-lift truck rearwards to appropriate angle
5. Do ensure the crane hooks are of adequate size and well rounded
6. Do protect the FIBC from rain and/or prolonged sunlight
7. Do ensure that the FIBC are adequately secured in transport

FIBC Don'ts

1. Don't use FIBC for new applications without consulting the manufacturer
2. Don't start or stop suddenly during transportation
3. Don't subject FIBC to snatch lifts or sudden jerk stops
4. Don't allow personnel under suspended FIBC, including when discharging.
5. Don't tilt the mast of the fork-lift forward when moving FIBC's.
6. Don't withdraw forklift tines prior to relieving the entire load on the lifting device.

7. Don't lift on one or two lifting loops. If bag has fallen over lift it up by using a rope through ALL four loops if necessary.
8. Don't stack FIBC's unless sure of stability. If stacked FIBC's become unstable, cautiously separate the stacked layers from the top down
9. Don't use secondhand FIBC's unless recertified by the manufacturer.
10. Don't use sharp-edged forklift tines or hooks.
11. Don't hit a filled FIBC against forklift mast.
12. Don't drag a FIBC.

These recommended safety practices are by no means complete. ***Safety needs vary from facility to facility and this is only meant to point out some of the many practices that can be implemented to provide a safer work environment. Each facility should develop its own rules and guidelines regarding the safe handling of FIBC's.***

VI. HEALTH CONSIDERATIONS

1. Polystyrene is an inert plastic. There are no known incidents of health problems associated with skin or eye contact. Although an extremely unlikely route of entry, polystyrene is biologically inert when ingested. Reference is made to the Huntsman OSHA Material Safety Data Sheet for further information.
2. Expandable polystyrene contains pentane as a blowing agent. Pentane, as a volatile flammable liquid, provides a slight hydrocarbon odor to the expanded polystyrene. Recommended exposure limits for pentane vapors in the workplace are found in the Material Safety Data Sheet (MSDS).
3. During the manufacturing of molded expanded polystyrene from expandable polystyrene resin, the majority of the pentane is used and emitted. Adherence to the MSDS is recommended.

VII. ENVIRONMENTAL CONSIDERATIONS

A. Overview

"The preservation of the environment is the single most important issue facing the world today. As a manufacturer, Huntsman Corporation has a special responsibility to ensure that our production processes and the products we make are safe for our employees, the communities in which we operate, and the consumers whom we serve."

Jon Huntsman

Expanded polystyrene is made from styrene monomer and hydrocarbon blowing agents. Molecules of styrene monomer are linked together to form the polymer called polystyrene. Styrene has been produced synthetically since the 1930's from ethyl benzene, which is derived from byproducts of natural gas and petroleum processing.

Styrene also is a naturally occurring substance that has been known since the time of the ancient Greeks. It is found in many foods and beverages, such as milk, beer, coffee, strawberries, peas, tomatoes, olives, and various nuts. Styrene is approved by the Federal Food and Drug Administration (FDA) for use as a flavoring agent.

Man-made styrene is used not only to make polystyrene, but also in the manufacture of products such as automobile parts, electronic components, boats and other recreational vehicles, and synthetic rubber.

The low levels of residual styrene found in expanded polystyrene products are environmentally safe for use in packaging. Independent research shows no adverse health effects in animals exposed for their lifetimes to styrene at concentrations of up to 250,000 parts per billion, 10,000 times higher than potential exposure from food service products.

Expanded polystyrene is approved by the Federal Food and Drug Administration for use in food contact packaging. It has been shown in several studies to be more sanitary than reusable ware. Many health organizations, in fact, encourage use of polystyrene because it does not support the growth of bacteria, as reusable ware does. Expanded polystyrene's light weight, excellent thermal insulation, and sturdiness, make it easy and safe to use by persons of all ages.

Polystyrene, expandable polystyrene, and expanded polystyrene products are environmentally safe when handled properly. Raw beads, prepuff, regrind, and small molded parts can obstruct sewers and waterways. They have been found in the digestive tract of fish. Good housekeeping practices will prevent environmental concerns.

B. Biodegradability

Expanded polystyrene products are inert and safe to landfills. In fact, nothing readily degrades in landfills — not EPS, not paper, not food, or yard waste. Landfills are designed to entomb material and prevent biodegradation. Furthermore, Martin B. Hocking, Associate Professor of Chemistry at the University of Victoria, Victoria, British Columbia, reports in *Science*, 2/1/93, that when it does occur, 1000 lbs. of paper will degrade to 394 lbs. methane (a greenhouse gas) and 545 lbs. carbon dioxide. The inertness of expanded polystyrene is especially suited for building insulation and long term packaging.

C. Recyclability

The very nature of polystyrene as a thermoplastic, which allows it to be continuously melted and reformed, makes EPS a highly recyclable product. Collecting expanded polystyrene for recycling presents a challenge making consumer participation critical to recycling success.

Huntsman Corporation is committed to recycling from our plants and in community programs nationwide. Our waste reduction activities have won national recognition from organizations such as Keep America Beautiful and the U.S. Department of Interior. Huntsman maintains membership and supports the Alliance of Foam Packaging Recyclers (AFPR).

Recycling, however, is not the sole solution to responsible waste management. An integrated, balanced approach involving source reduction, recycling, and waste to energy conversion is required for effective control of waste.

D. Waste-to-Energy

Expanded polystyrene, when converted in state-of-the-art incineration systems, will yield 17,000 to 18,000 BTU of energy per pound, which is more than coal. In as much as expanded polystyrene consists solely of hydrogen and carbon, complete combustion yields only carbon dioxide and water vapor. In fact, EPS may well be the cleanest burning fuel source available.

E. Clean Air

The Environmental Protection Agency's Air Quality Control Act establishes limits of ozone concentration in the lower atmosphere. Some specified hydrocarbon compounds participate in ozone formation. Pentane is one of those compounds, called Volatile Organic Compounds (VOC), even though its role in ozone formation is extremely low. Control of pentane emissions during processing of expandable polystyrene is required in some areas of the country. Processors should review their local air quality control regulations to ensure compliance.

Pentane is a paraffin hydrocarbon and is not considered a hazardous substance by the U.S. Department of Labor for Safety and Health Administration (OSHA). Expandable polystyrene typically contains between 3-7% by weight of pentane. Consequently, the manufacturing of 1000 pounds of expanded polystyrene could emit 30 to 70 pounds of pentane. Since the EPA classifies pentane as a volatile organic carbon (VOC) manufacturers collect and destroy it in accordance with applicable local regulations. If released to the atmosphere, pentane tends to cause a net increase in the ground level ozone layer. However, its contribution to the ozone as a "greenhouse" gas is believed to be significantly less than that of the methane generated from paper products in landfills.

Expanded polystyrene products manufactured from Huntsman expandable polystyrene do not contain nor are they manufactured with Class I or Class II chlorofluorocarbons. (CFC's)

F. Heavy Metals

In 1989, the Coalition of Northeastern Governors adopted model legislation to ban the sale or distribution of any package, packaging material, or product in packaging that contains inks, dyes, pigments, adhesives, stabilizers, additives, or other components to which lead, cadmium, chromium has been intentionally added during the manufacturing process. This was based on the availability of scientific and medical evidence that these elements posed a potentially significant public health hazard if present in emissions of ash when packaging is incinerated or in leachate when packaging is landfilled. By May of 1992, 11 Northeastern states had enacted legislation based upon the model legislation of CONEG. Many other states nationally have followed suit.

Huntsman Corporation certifies that lead, mercury, cadmium, and hexavalent chromium are not part of the intended composition of Huntsman expandable polystyrene and an analysis of the product would be expected to show none detected.

G. Risk Management Program(RMP)

EPA Clean Air Act Section 112r, 40 CFR, Parts 9 and 68

On January 31, 1994, the Environmental Protection Agency promulgated a final rule commonly referred to as the RMP rule (Risk Management Programs). This rule is in response to the Clean Air Act Amendments of 1990 and has substantial requirements for hazard assessment, accidental release prevention, community awareness and more. Part of the RMP is a list of regulated substances and thresholds for accidental release prevention. Pentane is on this list as a regulated flammable substance.

In 40 CFR, Section 68, 115 (b) (2), the EPA specifies how to determine the threshold quantity for a regulated flammable substance that is contained in a mixture (expandable polystyrene is a mixture of polystyrene and pentane):

“If a regulated substance is present in a mixture and the concentration of the substance is below one percent by weight of the mixture, the mixture need not be considered when determining whether more than a threshold quantity (10,000 lbs.) of the regulated substance is present at the stationary source. If the concentration of the regulated substance in the mixture is one percent or greater by weight, then, for purposes of determining whether more than a threshold quantity is present at the stationary source, the entire weight of the mixture shall be treated as the regulated substance unless the owner or operator can demonstrate that the mixture itself does not meet the criteria for flammability of flash point below 73°F (22.8°C) and boiling point below 100°F (37.8°C). The owner or operator shall document these flash point and boiling point measurements or estimates.”

The apparent meaning of the foregoing regulation is that a flammable substance, such as pentane, which is present in a mixture at greater than one percent by weight, will be subject to the Chemical Accidental Release Prevention Program if the quantity of the mixture exceeds 10,000 lbs. unless the owner or operator of the facility “documents” that the mixture is not flammable under this specified criteria. Further guidance is provided in the January 31, 1994, rule making:

“EPA agrees that a mixture containing a listed flammable substance should only be considered in a threshold determination if the mixture itself meets the criteria for a NFPA flammability rating of 4, i.e., flash point below 22.8°C (73°F) and boiling point below 37.8°C (100°F).”

Pentane meets the criteria for a NFPA flammability rating of 4 with a flash point of -49°C (-56.2°F) and a boiling point of 36.1°C (96°F). Polystyrene is considered non-flammable for the purposes of this regulation with a flash point (self-ignition temperature) of 470°C (880°F). Polymeric materials do not exhibit “boiling points”. Polystyrene begins to soften at about 90°C (194°F) and will begin to boil off above that temperature.

A mixture of polystyrene containing 3-7% pentane exhibits entirely different behavior in flash point characteristics. The flash point of expandable polystyrene manufactured by Huntsman has been tested in accordance with recommended procedures of NFPA via ASTM D-56 (tag closed cup). The flash point is reported to be 40°C (120°F). The boiling point or softening point of polystyrene is constant at greater than 90°C (194°F).

In order for this rule to apply to expandable polystyrene, the mixture must have flash point less than 73°F and a boiling point less than 100°F. Since Expandable Polystyrene does not meet these criteria, it is concluded that EPS does not have a NFPA flammability classification of 4 and, consequently, is exempt from compliance with the Clean Air Act RMP rule.

REFERENCES

- National Fire Protection Association, Standard NFPA-704, Identification of Fire Hazards of Materials
- NFPA Standard 231, Standard for General Storage

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