

# Flammability and Toxicity of Expandable Polystyrene

## I. FLAMMABILITY

Raw expandable polystyrene resin, expanded polystyrene pre-puff, and expanded polystyrene molded products must be considered combustible when directly exposed to fire of sufficient intensity and heat. Therefore, they should not be stored or installed near open flame or ignition sources.

The modified grades of expandable polystyrene contain flame-retardants designed to decrease flammability due to accidental ignition from a small flame source. The expanded polystyrene molded from these resins have been tested in numerous small scale fire tests and meet the requirements of the nation's building codes and applicable industrial, federal, and state requirements.

**THE RESULTS OF THESE TESTS ARE NOT INTENDED TO REFLECT HAZARDS UNDER ACTUAL FIRE CONDITIONS.**

### Flammability Characteristics

**Recommended Maximum Use Temperature:**

165°F (75°C)

**Melting Point:** As a thermoplastic, polystyrene does not exhibit a true melting point. It will begin to soften at about 212°F (100°C) and, as more heat is applied, melting occurs.

**Flash Ignition Temperature\*:** The lowest initial temperature of air passing around a molded sample of EPS at which a sufficient amount of combustible gas is evolved to be ignited (ASTM D 1929).

698°F (370°C)

**Self Ignition Temperature\*:** The lowest initial temperature of air passing around the specimen at which, in the absence of an ignition source, the self-heating properties of the EPS lead to ignition or ignition occurs of itself. (ASTM D1929)

752°F (400°C)

**Potential Heat of Building Materials\*\*** A property-type measurement of the heat that could be potentially released Grade 40 from building materials when exposed to high heat exposure of 1382°F (750°C). (NFPA –259)

17,293 BTU

17,269 BTU Grade 54

\* results as reported in Radco Test report No. RAD-2725 dated Feb. 2001

\*\* results as reported in SwRI project report No. 01.030490303 dated July 2000

## II. COMBUSTION TOXICITY

For over 30 years, the public has been concerned about the potentially hazardous effects of toxic fumes in building fires. Attention has focused on how construction materials can be reliably tested for combustion toxicity, and the meaning of those results relative to the overall hazard of the fires. There are currently two recognized tests—one developed at the University of Pittsburgh and the other at the National Bureau of Standards (NBS)—that yield consistent results and are reproducible from one laboratory to another. Both tests are based on the lethal effects of combustion gases on animals (rats or mice).

The toxicity of smoke generated by the combustion of products has been defined as "the propensity of smoke to produce adverse biochemical or physiological affects." Toxicity is the study of degrees of effects in relation of degrees of dose; it is not an absolute. The nature of the products of combustion of a material are highly dependent upon the conditions of combustion.<sup>(1)</sup>

A literature review of the combustion toxicity of expanded polystyrene by the Southwest Research Institute (SwRI) for the Society of the Plastics Industry, suggests that all the studies performed to date indicate that in laboratory tests the combustion products from expanded polystyrene are no more toxic than those from wood.<sup>(2)</sup> It should be noted that the combustion products resulting from burning any organic material produces toxic gases such as carbon monoxide and carbon dioxide. Other gases may be produced from products containing elements other than carbon and hydrogen. Expanded polystyrene is an organic compound consisting of carbon and hydrogen and, consequently, one would expect that the products of combustion would be predominantly carbon dioxide and carbon monoxide. This was aptly shown in studies in the late 1970's utilizing Military Specification M-14-G wherein the following results were obtained:

### COMPOSITION OF THE PRODUCTS OF COMBUSTION

Product	(PPM)	
	Expanded Polystyrene	Standard Wood
Hydrogen Chloride	0	0
Aldehydes as HCHO	0	0
Ammonia	0	0
Carbon Monoxide less than	10	119
Carbon Dioxide	500	13,500
Oxides of Nitrogen	4	10
Cyanides of HCN	0	0

**Degrees of Toxicity:** Degrees of toxicity are frequently reported in terms of LC<sub>50</sub>. This term refers to the "concentration" of smoke that will produce lethality of 50% of the test animals with a specified exposure, and possibly also including post exposure. In practice, the LC<sub>50</sub> for combustion toxicity experiments has often been considered to be the amount of material charged to the furnace, rather than the concentration of smoke.

### III. TOXICITY BY CONTACT OR INGESTION

Products molded from Huntsman expandable polystyrene resins are not toxic by contact or ingestion. Toxicity is a matter of degree, not an absolute, and is the ability of a substance to cause some degree of injury to a living organism. In other words, a toxic substance is one that produces some adverse physiological response that would not normally occur if that substance were not present in or on the organism. The responses may be as minor as a barely perceptible mold irritation or it may be lethal. In most cases, toxicity is markedly dose-dependent. As an example, Sax <sup>(3)</sup> lists toxicity hazard ratings for such common substances as baking powder, coffee, flour, whiskey and even ordinary table salt. These substances are not normally considered to be deadly, yet, under certain circumstances, they can cause permanent damage, even death to living organisms, including man. To present a better perspective, it is more accurate to describe materials of this sort as "hazardous under certain conditions".

As with most industrial materials, some degree of hazard exists in the use, or more particularly, in the misuse of expandable and expanded polystyrene. The degree of hazard is influenced by the physical, chemical and physiological properties of the material and the circumstances of use or misuse. Molded expanded polystyrene can be, and has been, used with no apparent harmful effects when a potential hazard is recognized, suitable precautions are taken, and good housekeeping practices are maintained.

### REFERENCES

- (1) Stacy, H.W. Evaluation of the Toxic Potency of the Combustion Products of Polystyrene Materials. SwRI Project No. 01-1374-714
- (2) Grand, A.F., H.L. Kapan, Hartzell, G.E. A Literature Review of the Combustion Toxicity of Expanded Polystyrene. SwRI Project No. 01-8818-507
- (3) N.I. Sax, "Dangerous Properties of Industrial Materials"

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