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**Evaluation of Foamed Cellular Plastics
as a Method of Thermally Insulating Exterior Walls**

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I. Background

Foamed Cellular Plastics have been commercially available in the United States since the early 50's. When they were originally promoted to the Construction Industry they were called urea-formaldehyde based foams. The National Bureau of Standards performed an evaluation of Foamed Cellular Plastics in 1977. They were assisted in this evaluation by several national and international agencies as well as the principle supplier of urea-formaldehyde foam plastic to the construction industry, namely the Borden Chemical Company. In addition to evaluation performed in 1977 the Bureau of Standards conducted research again in 1980, 1983 and 1985.

This publication summarizes the results of the research compiled on Foamed Cellular Plastics from the period 1977 to present. A complete listing of all research data is included for reference.

II. Discussion

Based on the research, the following specific areas should be taken into consideration when using this material.

Shrinkage:

When Foamed Cellular Plastic cures, it can undergo linear shrinkage in all three dimensions. As shrinkage occurs within walls the foam plastic may split or crack resulting in lower insulating properties. Ambient temperature conditions can attribute to foam shrinkage with less shrinkage occurring in cold climates. Tests performed by the Bureau of Standards showed under lab conditions shrinkage of upwards to 7% can occur during the first 20 months. Tests performed in 1996 by Holometrix Labs of Bedford, Massachusetts showed Foamed Cellular Plastics showed a continuation of significant shrinkage.

Temperature and Humidity:

Based on tests performed by both the Bureau of Standards and Holometrix, foam specimens disintegrated after 14 weeks when exposed to a temperature of 104 F degrees and 92% relative humidity and, as a result of these tests, the Bureau considered temperature and humidity as the most serious design concern Foamed Cellular Plastics faced.

The Borden Chemical Company, one of the original manufacturers of foam, stated in their promotional literature for their foam product Insulspray, "it was not to be used in a cavity where water or water vapor formed."

Thermal Efficiency

Both foam shrinkage and moisture content reduce the thermal efficiency on Foams. The Bureau of Standards concluded for each 1 percent shrinkage there is a reduction in thermal resistance of the insulation by about 5 percent. If moisture is also present in the wall section this will further reduce the thermal resistance. In the case of grouted reinforced masonry, a substantial reduction in thermal efficiency occurs when the loss of foam in grouted cores is taken into consideration. Not only is the insulation eliminated but thermal bridging is increased.

Toxicity:

Although Foamed Cellular Plastic Insulation has been considered a generic material, there are differences in composition and properties of the various foams which are available due to additives, fillers, extenders and plasticizers added in an attempt to alter certain properties.

Foamed Cellular Plastics are the end result of a chemical reaction. Because this reaction is dependent on several key factors including the age of raw materials, quality, mixing and temperature at which foaming takes place, the end result can vary. In the early 70's, vague guidelines and health hazard problems resulted in the banning of Urea Formaldehyde by certain States. These bans still exist in some states. Exposure to small concentrations of formaldehyde gas can cause allergic reactions. When the concentrations from several sources within a building combine, the end result could become severe. Tests for Urea-Formaldehyde should be taken when the foam is first applied. Improper results occur if foam is allowed to off gas to an open area for a long period of time before testing. Exposure to small amounts of Formaldehyde over long periods of time have produced chronic distress.

III. Conclusions

When Foamed Cellular Plastics are used to insulate walls, particularly masonry walls, the water absorption characteristic of the Foam can collect water within the wall. This water can be the result of leakage or water vapor transmission through the wall. The Bureau of Standards evaluation of this type of insulation showed concern as to the moisture, shrinkage and breakdown under certain temperature and humidity conditions which in turn all affect the thermal efficiency of the foam. All of the above conditions do occur in masonry construction and should be taken into consideration by the design professional when he compares Foamed Cellular Plastics to other methods of insulating masonry walls.

Other Foam issues are:

1. Possible corrosion of electrical service boxes, ground wires, galvanized ties and steel studs.
2. The possible long term effect on any wood exposed to moist foam.
3. Possible growth of certain types of fungus.
4. Release of Gases other than Formaldehyde as well as Particulates.
5. The effect of Urea Formaldehyde in masonry and mortar.

All products must be able to technically verify statements presented in their literature. It is unfortunate that insulation can't be seen and one must assume the material is in place, does not deteriorate and continues to perform its intended function without adverse effects to anyone or anything. To this day, legal action is still taking place as a result of Foams placed in walls in the 70's. The information in this publication does not apply to Molded or Extruded Expandable Polystyrene.

The Federal Standard covering this type of material was withdrawn from use by HUD over seventeen years ago.

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**Masonry Walls Foamed with
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Wall Opened for Inspection on 13 April 1999