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Technology Brief 4

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Plastic Foams for Concrete Homes

Many of the benefits of concrete houses built with insulating concrete forms (ICFs) come from the plastic foams of which the ICFs are made. Plastic foams are lightweight, easily cut, excellent insulators, and good barriers to air and moisture. They are also strong enough to hold concrete and serve as the backer for interior and exterior finishes.

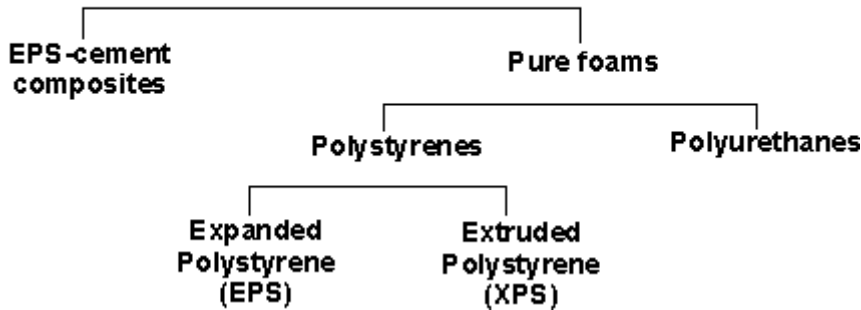
What exactly are plastic foams?

Plastic foams are plastics that have been "frothed up" while molten, then cooled. The process fills them with countless tiny bubbles, much like a sponge. Manufacturers create many different foams by varying ingredients and manufacturing methods.

What foams are used for ICFs?

The ICFs sold in North America are made of either expanded polystyrene (EPS), extruded polystyrene (XPS), polyurethane, or a cement-foam composite.

Types of Foams for ICFs



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EPS and XPS are made from the same plastic (polystyrene), but the process is different. EPS begins as small plastic "beads" that are expanded and fused together. It is the same as the white foam in many disposable coffee cups.

XPS begins as a continuous mass of molten material. It is familiar as the yellow foam used in trays for fresh cuts of meat at the supermarket.

Polyurethane foam results when two separate ingredients (an isocyanate and a polyol) are mixed and react with one another. Cement-foam composites are not actually a pure foam, but a mixture of Portland cement and loose EPS beads.

Most ICF manufacturers mold their form units out of the foam they judge best for the job. But in several ICF systems the formwork is assembled from standard flat sheets of foam, available from building suppliers. With these systems the buyer may have a choice of different types of foam.

What's the difference between types of foams?

Evidence indicates that all of the foams used in ICFs produce excellent houses. However, each has its own unique profile of properties. Note also that any one of these foam materials may vary. By changing manufacturing, producers can get somewhat different properties with the same plastic, so any numbers given here for a type of foam are approximate. Consult specific ICF manufacturers for exact specifications.

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Typical Properties of Plastic Foams

	EPS	XPS	Polyurethane	Composite

Density (lbs/cu ft)	1.35-1.80	1.60-1.80	2.00	21
R-value per inch	4.17-4.35	5.00	5.90	3.00
Compressive strength (psi)	15-33	25-40	30	72
Tensile strength (psi)	18-27	45-75	30	42
Water absorption (%)	< 3.0	< 0.3	2.0	N/A
Retail cost (\$/bd ft)	.17	.35	.70	N/A

EPS is usually the least expensive. It also insulates well, is resistant to air and moisture infiltration, and moderately strong. It is available in either molded or sheet form.

XPS, compared with EPS, is usually more expensive, has about 25% higher insulating value, somewhat greater resistance to water, and higher strength. It is ordinarily available in sheet form only.

Polyurethane has a somewhat higher insulating value than either of the polystyrenes and comparable strength, but may cost somewhat more. It is available in some molded ICF products. A closely related foam, called polyisocyanurate, is available in sheets. But polyisocyanurate sheet is not usually recommended for use in ICFs.

Because they contain cement, the composite materials tend to be strong, heavier than the pure foams, possibly more durable, and require somewhat more effort to cut and shape. Their insulating value is a bit lower. Cost estimates are unavailable since the material comes only in completed, molded units.

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Are these materials safe?

All of the plastic foams are highly inert. None is considered toxic by U.S. government agencies. None contains any formaldehyde. None has been linked to respiratory problems or skin irritation, as have some fiber-based insulations. Attempts to find any emissions from polystyrene foams used in walls failed. No emissions could be detected by the most sensitive instruments. The plastic foams used in ICFs are also formulated so that they do not burn by themselves. Extensive research on the polystyrenes concluded that when they were forced to burn their emissions were "no more toxic" than the emissions of burning wood.

How do I choose the right one?

Most important is to choose the right ICF, not a particular foam. The properties of an ICF are only partly determined by the foam it contains. For example, the cost of ICF units might be lower for a product that uses a more expensive foam because the manufacturer has achieved production efficiencies.

However, understanding the properties of the different foam materials helps in understanding the differences among the various ICF systems.

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What's the bottom line?

The plastic foams used in ICFs help to create a superior house. There is no one "best" material to use, but they have variances that help explain the differences among ICF products.

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More Information?

Energy Comparisons of Concrete Homes vs. Wood Frame Homes

RP119 - \$10

Insulating Concrete Forms for Residential Design and Construction

VanderWerf, Feige, Chammas, and Lemay
New York: McGraw-Hill Inc., 1997 - \$75

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