

# Recycled Content in Expandable Polystyrene Foam Protective Packaging

## Trends in Manufacturer Specification of Recycled Content

In the early 1990's, a strong environmental movement swept the United States that called for manufacturers and consumers to demand recycled content packaging. Threats of mandatory content legislation forced many manufacturers into a reactive mode of mandating recycled content from their packaging suppliers.



**“Approximately 11 million lbs (55%) of the 24.9 million lbs of EPS packaging recycled during 2000 were remanufactured into new EPS packaging.”**

More recently, the environmental movement has subsided and there is less legislative threat. More appropriate emphasis has been placed on packaging cost and performance than environmental attributes. However, the lessons learned in the early and mid 1990's have not been forgotten. Although significantly less, some manufacturers (particularly electronics companies) are continuing to feel the pressure of producer responsibility—but now they feel the pressure is to incorporate recycled content into the product itself (not just the packaging).

To economize, some manufacturers are looking to their packaging suppliers to provide recycled content packaging.

Most manufacturers have transitioned from a panic, reactive mode to a steady, proactive mode with respect to environmental issues. Where it is not an economic disadvantage, manufacturers are strongly encouraging packaging producers to incorporate recycled content. Cost being equal, a packaging producer may not get the bid if their proposal does not consider recycled content and other environmental issues. Most manufacturers today recognize the importance of building an environmental resume that can be produced when the environmental pendulum swings back to where it was in the early 1990's.

## Recycled Content in Expandable Bead Foam Applications

In order to appreciate recycled content limitations in expanded bead foam materials, it is important to understand industry supply chains and product manufacturing methods. Manufacturers of expanded bead protective packaging purchase the bead material from plastics resin producers—they don't manufacture it themselves. They then expand and mold the purchased beads into protective packaging products using steam, which softens the plastic so that it can be processed. Because protective packaging manufacturers don't melt the plastic beads, they can only incorporate recycled content in two ways: (1) blend in used expanded particles from bead foams they take in and grind down to the bead level; or (2) purchase beads that already contain recycled content.

## EPS and ARCEL® Moldable Foam

ARCEL® is an interpolymer of 70 percent polystyrene and 30 percent polyethylene, and is very similar to EPS in terms of its processing to make expanded bead products. Virgin plastics resin producers



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make EPS beads through a suspension polymerization process, which means that each individual bead is produced directly from monomer. Since the beads are never melted, there is no opportunity to blend in recycled content. There are some secondary suppliers of EPS who structure their business around incorporating additives into the bead resin by melting it down and blending in the additives. Only two of these secondary suppliers, Polysource and RAPAC, produce a

recycled content bead. No one makes recycled content ARCEL® beads.

RAPAC and Polysource’s recycled content EPS bead is made by extruding and repelletizing 100 percent recovered EPS. This product has only been on the market for about six months. Because the beads are made through an extrusion/pelletization process, they are not perfectly spherical as are the beads made through the virgin production process. This results in a higher level of void space between beads in the final expanded product, which weakens it. The addition of an extrusion heat cycle also results in some degradation of the base polystyrene polymer. The end result is that a product manufactured from recycled material has about 90 percent of the performance properties of products made from virgin bead. Two other limitations of this recycled EPS are: (1) it is only available in medium and large size beads; and (2) it currently has a minimum foam density of 1.25 pounds per cubic foot.

Due to supply and ease of processing, packaging manufacturers normally incorporate recycled content into their products by blending in used expanded particles from products they take in and grind down to the bead level. Grinding the used product, unfortunately, results in a less than perfect job of separating beads and many of the beads are no longer round. Furthermore, because they

### Domestic EPS Recycling During 2000

Post-Consumer:	24.9
Post-Industrial:	15.6
<b>Total EPS Recycling</b>	<b>40.5</b>

**For example, nearly 41 million lbs of post-consumer EPS packaging were recycled during 2000, which includes 24.9 million lbs of post-consumer recycling and 15.6 million lbs of post-industrial recovery.**

have already been fully expanded and no longer contain a blowing agent, they cannot expand to fill interstitial void spaces when reused in a new part. Damage from grinding and the inability to expand results in void spaces in manufactured parts, which may weaken the product. The bottom line is that EPS that is ground and reused as recycled content serves primarily as a “dead” filler material because it lacks blowing agent. The level of recycled content that can be used without sacrificing performance depends on the product that is being produced. Like all plastics, and even other recyclables such as paper, glass and steel, recycled content EPS will exhibit some weakening in its physical properties and appearance. Molded EPS products, particularly those that require relatively thin part cross sections or that require high foam densities (e.g., those used to package heavy computer and electronic equipment) can normally tolerate recycled content levels of five to ten percent. ARCEL®, due to its composition, will tolerate levels up to 12%. Less demanding applications, such as EPS block manufacturing, can tolerate up to twenty percent recycled content levels.

**EPP**

There are three manufacturers of EPP. None supply a recycled content bead; therefore, the only way a molder of EPP can incorporate recycled content is to take in and grind used EPP products back to the bead level.



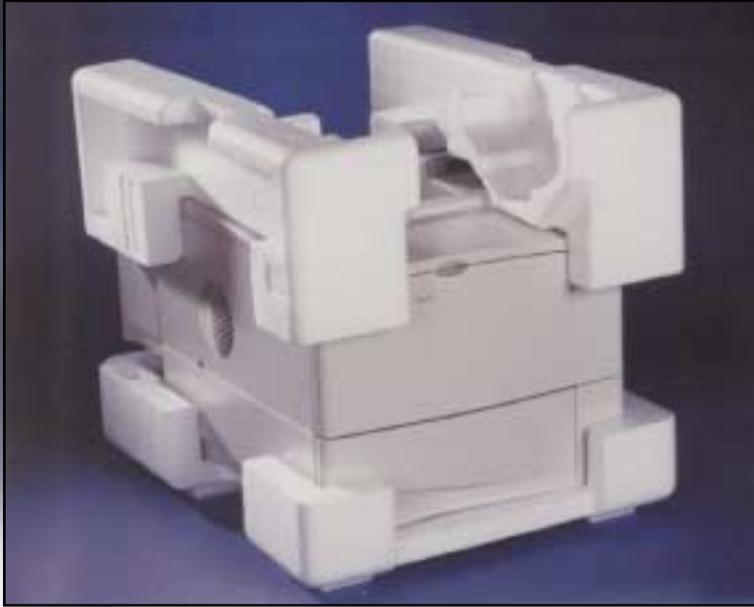
**“Most of the EPS that is recycled comes from manufacturing assembly plants that receive components shipped in EPS protective packaging.”**

facturer introduces compressed air into the bead matrix, which serves as the blowing agent when the manufacturer later applies steam to expand the beads to fill void spaces. This means that reused EPP beads can be re-impregnated with a blowing agent and made to expand to fill some of the interstitial space; furthermore, recycled bead surfaces bond to virgin bead surfaces. However, it is important to recognize that reused beads have already been fully expanded to a target density, and further expanding them results in a reduced density of those beads. Grinding recovered EPP products also damages

<b>Recycling Rate</b>	<b>1.7</b>	<b>5.9</b>	<b>9.5</b>	<b>10.5</b>	<b>10.2</b>	<b>12.7</b>	<b>10.4</b>	<b>7.4</b>	<b>9.5</b>	<b>9.6</b>	<b>12.1</b>
<b>Year</b>	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>

Expandable bead polypropylene molding has some key differences from EPS or ARCEL®. First, EPP beads are purchased pre-expanded from the resin manufacturer and do not contain an impregnated blowing agent in their matrix. The protective packaging manu-

the cellular structure of the beads, which reduces their performance properties. For these two reasons, recycled EPP is normally limited to ten percent or less in shape molded protective packaging products. As much as twenty percent can be used in less demanding applications.



**“Just like regular EPS, recycled-content packaging components are tested in accordance with ASTM D1596 and other recognized protocols to ensure adequate cushioning is provided.”**

### Other Recycled Content Factors

In addition to the technical considerations discussed previously, there are other factors that may limit the ability of packaging manufacturers to incorporate significant amounts of recycled content into expanded bead protective packaging, such as constraints on the availability of recovered material.

EPS protective packaging has an average recycling rate of ten percent. This level of recycling is amazing given that virtually no community-based recycling programs collect EPS from consumers for recycling. Most of the EPS that is

recycled comes from manufacturing assembly plants that receive components packaged in EPS protective packaging. In most cases, EPS recovery for recycling at these companies is already occurring and there is little opportunity for additional recovery. Because EPS packaging represents such a small portion of the residential solid waste stream, community-based recycling programs are not likely to add EPS to their list of materials for collection. The conclusion to be drawn is that recovered material supply (for recycled content manufacturing) is limited to near current levels.

Companies that mold non-foam rigid polystyrene products purchase about one quarter of the EPS packaging that is recycled. EPS molders consume approximately half of the remainder, with an equal amount of material being consumed by polystyrene loosefill manufacturers. Limits on recycled content in EPS protective packaging that are based on lack of supply and competition by other recycled product uses, therefore, result in an average industry-wide post-consumer recycled content percentage of two percent (not including pre-consumer manufacturing scrap). A similar discussion applies to ARCEL® and EPP, which are recovered at even lower levels than is EPS packaging.

In conclusion, even though technical considerations generally limit the recycled content loading in expandable bead protective packaging from five to ten percent, constraints on the availability of recovered material may further limit packaging manufacturers to lower levels of recycled content.

### Sources

*ARCEL® is a registered trademark of NOVA Chemicals, Inc.*

*American Plastics Council, “2000 National Post-Consumer Plastics Recycling Rate Study,” as compiled by R.W. Beck, Inc., September 2001.*

*U.S. Environmental Protection Agency, Characterization of Municipal Solid Waste in the U.S.: 1997 Update.*

*Rod Circle, Technical Manager, PolySource, Inc., November 2000.*

*Photographs provided courtesy of Foam Equipment & Consulting, Profoam International and NOVA Chemicals.*

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