MBDC

Styropor® Expandable Polystyrene as a Technical Nutrient

A Report on MBDC's Cradle to Cradle Assessment

A meeting of the minds

BASF, one of the world's leading chemical companies, produces Styropor® expandable polystyrene (EPS) resins that are converted into expanded polystyrene foam. These foams are used for thermal insulation for the building and construction market, and for protective packaging.

MBDC is a product and process design consultancy established by architect William McDonough and chemist Dr. Michael Braungart in 1995. Based in Charlottesville, Virginia, MBDC provides environmentally intelligent product research and development, and design and business tools to companies of all sizes. BASF has a long-standing relationship with MBDC based on their mutual commitment to the environment.

This report summarizes MBDC's Cradle to Cradle Design assessment of BASF's Styropor® EPS resins.

Helping Make Products Better™

BASF

The Chemical Company

Terminology

- **Cradle to Cradle Design:** MBDC's Cradle to Cradle Design concept is about prosperity and health. If people are to prosper within the natural world, all the products and materials manufactured by industry could, after each useful life, provide nourishment for something new. The concept can be compared to the basics of an ecosystem. Consider, for example, how carbon dioxide allows for photosynthesis, and how mulch creates fertilizer. Cradle-to-cradle is really about designing things with no "end-of-life" with materials that can serve their highest purpose and provide maximum value perpetually, not just once.

  Since many of the things people make are not natural, they are not safe "food" for biological systems. Products composed of materials that do not biodegrade should be designed to circulate safely and continually within closed-loop industrial cycles.

- **Technical nutrient:** MBDC's term for a material that remains in a closed-loop system of manufacture, reuse and recovery, maintaining its value through many product lifecycles. The systematic approach of eco-effective design extends to the development of the systems and logistics for the perpetual reclamation of technical materials.

- **Downcycle:** This refers to recycled materials taking a journey that might eventually lead to the landfill or incinerator. For example, polystyrene recycled from EPS foam may be downcycled into plastic wood, flowerpots or desk accessories. Although these items do not go to the landfill or incinerator immediately, they are converted into less superior objects that eventually end in the landfill.

MBDC: "High praise for Styropor® EPS"

MBDC conducted a rigorous evaluation of the "environmental health and intelligence" of BASF's Styropor® EPS resins. Based on the study, MBDC has concluded that Styropor® EPS resins have great potential for use in cradle-to-cradle, sustainable designs.

MBDC has determined that Styropor® EPS is suited for circulating in a cradle-to-cradle life cycle as a technical nutrient.

William McDonough, co-founder of MBDC and a leader in the sustainable design movement, said this about his firm's evaluation of BASF's Styropor® EPS resins:

"Truly understanding what's in the products we use in building is a critical component of sustainable design. BASF understands that, and they're taking the lead by thoroughly assessing the environmental intelligence of Styropor® EPS. This will allow them to say, 'We know exactly what our product's environmental profile is, and you can use it with confidence.' That's a powerful demonstration of respect for the environment and for those of us who specify building products."

Using its strict protocols for chemical and material assessment, MBDC examines and benchmarks every chemical ingredient in a given product and its production processes for potential human and environmental health effects. MBDC's scientists worked with BASF's engineers and suppliers to ensure that the human health and environmental characteristics of the resin and its production processes were thoroughly understood from a cradle-to-cradle perspective.

And BASF is further demonstrating its leadership by working with its supply chain in an effort of constant improvement to further optimize the inputs and life cycle of EPS to fully realize Styropor's potential as a cradle-to-cradle material.

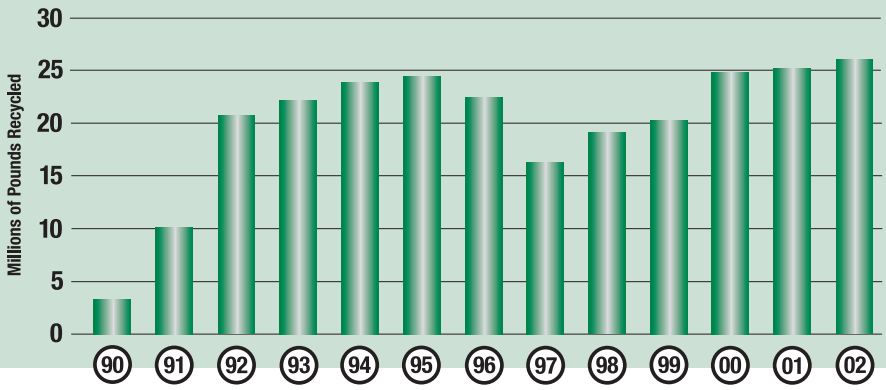
EPS Recycling

According to MBDC, to qualify as a technical nutrient, a material must offer the potential to be recycled into products of equal value. As a particle foam, EPS foam provides the opportunity to be processed with a special grinding technology to its original particle, blended with virgin particles and molded into new foam parts or boards.

Effective recycling is not achieved through material properties alone. The necessary infrastructure must be in place in order to collect the material, separate it from other materials that make up a finished product, and process the material for re-use. In the case of EPS foam, the Alliance of Foam Packaging Recyclers (AFPR), of which BASF is a charter member, has been instrumental in the development and facilitation of such an infrastructure.

AFPR works to facilitate EPS foam recycling between EPS foam manufacturers and original equipment manufacturers, as well as consumers. Currently, more than 110 U.S. plant locations serve as collection centers that together receive millions of pounds of post-consumer foam packaging each year.

AFPR estimates that EPS represents 89 percent of all polystyrene recycled in the U.S., and that 26 million pounds of post-consumer EPS foam packaging were recovered in 2002 (51 million pounds total, including industrial scrap). The rate of recycling post-consumer EPS has increased over the past decade, reaching 13 percent in 2002.



Individuals interested in learning more about EPS recycling can call **800-828-2214** or visit **www.epspackaging.org**.

An environmental material of choice

Aside from its recyclability, BASF's Styropor® EPS possesses a number of attributes that characterize it as environmentally intelligent:

- **Conservation of resources:** Styropor® EPS foams require the least amount of material, compared to many alternative products, to meet the necessary thermal and mechanical performance standards required in construction and packaging applications.
- **Blowing agent:** Styropor® EPS resins use pentane to process and foam the material. During and shortly after manufacture, pentane is exchanged with air in the cells of the foam and may be collected for disposal. In contrast, alternative materials may depend on pentane or HCFCs to not only foam the material, but also to help deliver their thermal performance.
- **Stable performance:** Styropor® EPS foams do not rely on any "insulating" gas, such as pentane or HCFCs, for their thermal insulation performance and thus are completely constant over the long term. Alternative materials that require an insulating gas are subject to gradual diffusion of the insulating gas and, often, this gas can have problematic environmental characteristics as in the case of HCFCs.
- **Polymer chemistry:** Not only is Styropor® EPS foam recyclable as a particle foam, but as a thermoplastic resin. The polystyrene used to make the foam can be alternatively recycled (though generally downcycled) by melting and reprocessing. Alternative thermoset materials, such as polyurethanes, cannot be similarly reprocessed.

BASF focus: Sustainability

The products BASF manufactures are intended to benefit humankind and optimize the ecological footprint, all while meeting the needs of our customers.

In its Corporate Guidelines, BASF has set forth its commitment to the principles of Sustainable Development. These principles include:

- Considering the interests of future generations in meeting the needs of the present generation, and providing innovations and solutions to challenges dedicated to achieving this goal.
- Engaging in business activities that are consistent with our social and societal responsibilities, and with the objective of Sustainable Development.
- Providing products that can be produced, used, reused and disposed of safely, while positively considering the impact placed on human beings and the environment during the process of manufacturing, storage, transportation, sale and use of products.
- Not giving economic considerations priority over safety and health issues, and environmental protection.
- Providing advice and assistance to customers on the safe handling and processing of products, supporting recycling efforts and identifying appropriate disposal methods.
- Systematically researching the impact of production processes and the specific effects of products.
- Taking resource conservation into consideration in research projects, and developing innovation-integrated environmental protection.

A key example of BASF's commitment is the eco-efficiency analysis. This life cycle tool is used to help identify products and production processes that consume less energy, produce fewer emissions and create less waste than alternatives, while maintaining or improving the products' commercial value in the marketplace. The eco-efficiency analysis has influenced BASF business decisions that include capital investments, acquisitions, production techniques, business portfolio adjustments, product positioning activities and expected customer benefits.

Further, BASF works with MBDC to optimize products to expand into the positive agenda of cradle-to-cradle products.

BASF was named by *Fortune* magazine as the number one chemical company on its "Global Most Admired Companies" list in 2003 and is included on the list of the Dow Jones Sustainability Index companies.

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