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Basics

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'Cradle to Cradle' Certified PLA Foam

Synbra Technology bv in Etten-Leur, The Netherlands, is the Synbra Group's in-house polymerisation and 'Technology & Innovation' R&D facility, as well as the group's centre of excellence for materials and product development. Synbra is a leading European producer of Expandable Polystyrene (EPS) and the first plant (5000 t/a) to use a new polymerisation technology for PLA, that was recently developed by Sulzer Chemtech and Purac Biochem, will be built by Synbra Technology in the Netherlands for the production of BioFoam®; a foamed product made from this PLA (see bM 05/2008 and 01/2009).

Processing

The foam expansion process and moulding process for BioFoam is being developed at a rapid pace to facilitate approval of moulded prototypes. Parts are moulded every week for interested international customers. BioFoam processing has now left the laboratory phase and is running in series production for selected parts. The process of moulding is carefully adapted to suit expansion of the raw beads (called BioBeads) in existing EPS moulding equipment, resulting in uniform expanded beads and uniform cell structures (fig 1). A spherical and uniform series of raw beads in three classes (sized 0.6-0.7mm, 0.8-1.0mm and 1.0-1.4mm) can be produced to suit the specific moulding application.

With a slightly modified pre-expansion process and an industrial moulding machine existing moulds for EPS products were used to produce parts, see figures 2 and 4.

Properties

The physical properties of BioFoam have been determined (see table 1) and are close to those of EPS. The thermal properties are strikingly similar, which has led to an interest in refrigerated transport for medical supplies. BioFoam is resistant to liquid nitrogen LN_2 and CO_2 granules or dry ice, the latter is often used in the transport cool chain, see figure 2.

Of particular interest are the results for drop testing in comparison with EPS, which show that BioFoam has all the potential to become a good buffer material - a point that has not gone unnoticed by several blue chip companies, see figure 3 (a and b).

BioFoam has a better resistance to high stress deformation as can been seen from its the characteristics in comparison with EPS.

Carbon footprint

Detailed information on the CO_2 balance of the PLA used by Synbra will be subject of a future article. In addition, a recent study was carried

	BioFoam		EPS	
Compressive strength (kPa)	40 g/l	200	30 g/l	200
Bending strength (kPa)	35 g/l	300	30 g/l	300
Young's modulus (MPa)	40 g/l	4.0	30 g/l	3.0
C-value (-)	35 g/l	2.6	30 g/l	2.7
Thermal conductivity (MW/m·K)	35 g/l	34	30 g/l	33

Table 1 some physical ad thermal properties of BioFoam compared to EPS

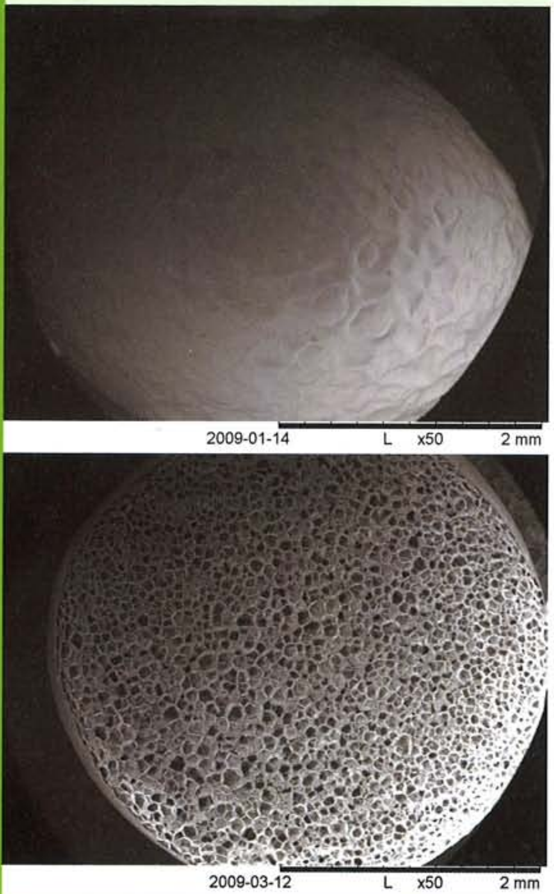

Figure 1: SEM image of an expanded E-PLA bead, with a closed cell structure and a uniform cell size.

Figure 2. Moulded parts, box and lid made in BioFoam for the logistics cool chain

out comparing seed trays for growing plants made from BioFoam and from cardboard as two different material solutions. It was calculated how many grams of CO_2 would have been emitted to arrive at the same functional unit for BioFoam and cardboard. It was demonstrated that foams score better than the heavier part in cardboard, see figure 4. The part is a frequently used container for 15 bedding plants and weighs only 50 grams versus 200 grams in cardboard.

Certification

Being produced from the renewable resource PLA, BioFoam is an environmentally friendly alternative to the polystyrene foam products offered today. After use, the BioFoam product can be remoulded to a new product or can be completely biodegraded. Being 'designed for the environment' implies that there is no chemical waste, which means that the product is designed according to the so called 'Cradle to Cradle' principles. The Cradle to Cradle[SM] Design was founded by William Mc Donough and Michael Braungart. The latter is also the founder of EPEA (Environmental Protection Encouragement Agency), an international scientific research and consultancy institute based in Hamburg, Germany, that improves product quality, utility and environmental performance via eco-effectiveness. Together with their USA based sister company MBDC (McDonough Braungart Design Chemistry LLC), EPEA is able to grant companies a Cradle to Cradle certificate for specific products. Synbra actively encourages its suppliers to embrace the C2C scheme.

Tebodin Consultants & Engineers of The Netherlands (who have a cooperation agreement with EPEA) was asked to prepare the application package for the Cradle to Cradle certification of BioFoam. Data was collected and compiled on material safety, water and energy utilisation, as well as information on the social responsibility of the applying company. Based on this information EPEA was able to carry out an assessment study, which has resulted in BioFoam now being officially declared a Cradle to Cradle Certified material. This is the first PLA based product in the world and the first biodegradable foam in the world with this certification. The PLA Bio-Beads made by Synbra have in the meanwhile also been certified, effectively making it the first PLA polymer to be C2C certified in the world..

Conclusion

BioFoam mouldings are based on renewable feedstock that allow a major saving in CO_2 emission compared to equivalent functional units. Clearly this explains why it is attractive to a whole range of industries. The particle foam nature of the material allows a very wide freedom of design with the convenience hitherto only offered by EPS.

www.biofoam.nl

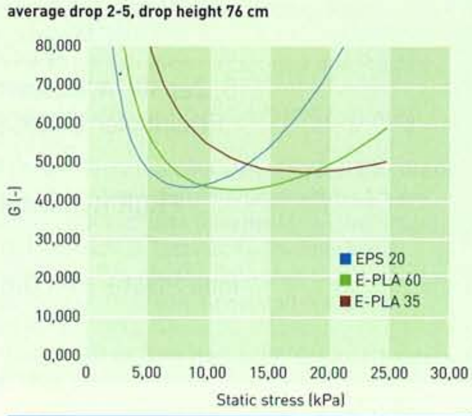

Figure 3a. Drop testing: G-force versus static stress energy for EPS and two densities of 60 and 35 gr/l E-PLA for single drop testing.

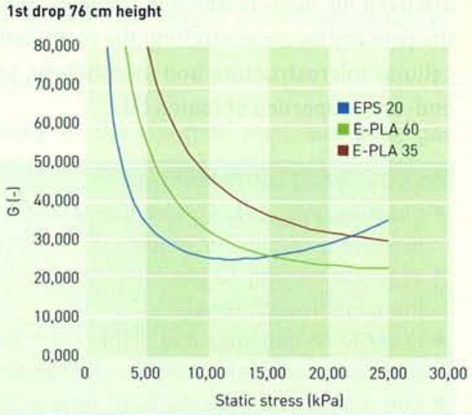

Figure 3b. Drop testing: G-force versus static stress energy for EPS and two densities of 60 and 35 gr/l E-PLA for multiple drop testing

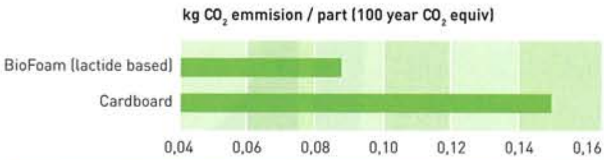

Figure 4: Parts analysed for the comparative study and the CO_2 emission originating from its production for the same functional unit.