BIODEGRADATION OF EXPANDED POLYSTYRENE MODIFIED WITH A NOVEL POLYMER ADDITIVE

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In 2010, the global production and use of polystyrene was approximately 15.4 million tonnes [1]. With the widespread use of PS in transient packaging applications, it is not surprising that around 70% is disposed to landfill after use [2]. Recycling options for PS are limited with recycling rates in Australia for 2010-2011, for example, at 27.1% for high impact PS (HIPS) and only 8.4% for expanded PS (EPS) [3]. Moreover, the structure and inherent stability of PS contribute to the persistence in the landfill environment and these materials are not recognized as biodegradable [4]. Some recent research has focused on the modification of PS with additives in attempts to impart degradability. Examples include the use of oxo-degradables for foamed PS [5], the addition of modified carbohydrates for biodegradability [6], and the use of zinc oxide for enhanced photocatalytic degradation [7].

A new polymeric additive based on polyamide has been recently developed to initiate the biodegradation of EPS [8]. This biodegradable additive is electrostatically coated on the surface of pre-expanded PS beads thereby introducing a mechanism that can support microbial growth and activate the microbial decomposition of the EPS beads. Figure 1 shows a scanning electron micrograph image of a sample of a modified EPS cup that has been incubated under standard anaerobic test conditions (ASTM D5511) [9] for 25 days. This image shows microbial growth on the surface of the EPS suggesting the additive effectively contributes to the establishment of microbial colonies that may eventually aid in the decomposition of the EPS bead cells. Figure 2 shows a plot of the volume of biogas evolved from the anaerobic reactor vessels over the 25 day test period. In comparison with a standard untreated commercial EPS cup, the product treated with the additive produced significantly more biogas over the test period.

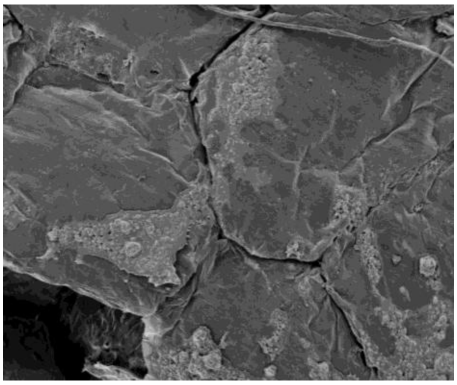

Figure 1. Scanning electron microscope image of EPS at 54 × magnification.

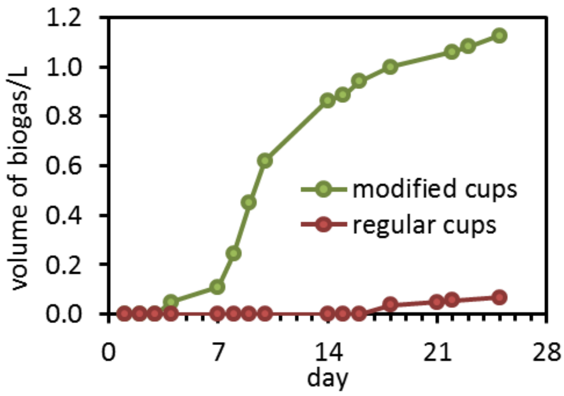

Figure 2. Volume of biogas evolved during anaerobic incubation of modified and standard EPS.

This work reports the results of biodegradation tests on treated and untreated EPS under standard anaerobic test conditions [9]. The results suggest that the EPS modified with the additive has the potential to undergo biodegradation at a rate that would be adequate in a managed landfill. Results of tests using new additives under development to assist the biodegradation of HIPS and EPS will also be presented.

References

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