Melt Processed Polyhdroxyalkanoates' Behavior in the Marine Environment

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Polyhydroxyalkanoate (PHA), a versatile family of polymers from renewable resources, is melt processable for a variety of applications. Extruded pellets, films and foams as well as extrusion coated paper and injection molded items were produced and then characterized in the marine environment for biodegradation behavior. A tierd testing approach was used where the samples were first evaluated using the ASTM 6691 method to determine the amount of carbon dioxide evolved as a function of time. These samples were tested using inoculums of either a known consortium of microorganisms or natural seawater with its indigenous microflora, supplemented with nitrogen and phosphorous nutrients . These PHA samples typically demonstrated 80 percent mineralization within 30 days. Since these materials met the minimum 30 percent mineralization requirement of the ASTM 7081 specification, they were eligible candidates for the tier two level of testing. These experiments involved weight loss experiments in both static laboratory and dynamic aquarium incubations as a function of time. Typical results exhibited over 90 percent weight loss in 45 days in a static experiment with controlled temperatures and 50 percent weight loss in 100 days for the dynamic test where nutritive and seasonal effects influence the weight loss results. Tier three level of testing exposed these samples in situ on coastal moorings that would replicate a more typical real life environment. Tier three testing of these samples demonstrated rates of weight loss that were even slower than aquarium incubations; however, the samples still had over 20 percent weight loss after 60 days. Overall, the PHA polymers, despite the melt processing method used to form these items, exhibited exceptionally high rates of biodegradation in the marine environment in comparison to other polymer samples studied with this same tierd testing approach. With marine debris issues today, this family of polymers can potentially replace other petroleum based polymers and be an alternative for many plastic products.