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Sustainability of Polyethoxylated Non-ionic Associative Thickeners

PRODUCT/SERVICE BACKGROUND INFORMATION

Non-ionic thickeners based on polyethylene glycol (PEG) leverage the polymer's high solubility and chemical stability in aqueous environments. These polymers have not been directly replaced by more natural materials due to the lack of a suitable and synthetically efficient alternatives. It is well accepted that linear PEGs below the 14 kDa range exhibit high biodegradability, supported by exhaustive and ongoing research on environmental impact of synthetic polymers. This presents a unique opportunity to consider the retention of PEG for the foreseeable future of water-soluble materials as bio-sourced ethylene oxide begins to emerge on the market. For non-linear materials, polymer architecture and chemical functionality show significant impact on biodegradation kinetics, in many cases causing differences in bioavailability as a consequence of physical properties. In this study, star-shaped sorbitol polyethoxylation products were synthesized with total ethoxylation number (EO) between 50 and 400 and functionalized by esterification with fatty acids from 0 to 5.5 arms. Fatty acid carbon chain length was varied from 18 to 22 with inclusion of unsaturated fatty acids and hydroxyacids. Each polymer was subjected to OECD 301B aerobic biodegradation assays to simulate final environmental fate in wastewater treatment and compared to a PEO linear control. In practice, these thickeners are used at dilute concentrations in surfactant systems, potentially altering the bioavailability in end-user formulations. To simulate the effects of surfactants on the polymer bioavailability, Sorbeth-230 tetraoleate was subjected to the aforementioned assay using 5:1 and 1:1 ratios of polymer to surfactant and compared to the degradation in the absence of surfactant. Blanks with and without surfactant were run in parallel to control for background CO^2 evolution. Up to a 73% increase in polymer breakdown was observed using α-olefin sulfonate (AOS) surfactant.