415g Surfactant Degradation in Melt Processed Polyethylene-Organoclay Nanocomposites

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Polymer-clay nanocomposites continue to generate much interest, owing to their potential for exceptional improvements in properties at lower filler concentrations as compared to their micro- and macro-composite counterparts. The key to achieving these benefits is exfoliating the clay into the polymer matrix to generate high aspect ratio particles. The first step in this direction is to make the hydrophilic smectite clay more organophilic using an ion exchange reaction between the naturally occurring alkali metal cations residing between aluminosilicate layers and alkyl ammonium surfactants to produce an “organoclay”. Unfortunately, the currently used alkyl ammonium surfactants have low thermal stability and are known to breakdown at the high temperatures required for melt processing most polymers. This could possibly affect the level of platelet exfoliation and interfacial bonding, which influence the physical and mechanical properties of the final nanocomposite. Since melt processing seems to be one of the most convenient and attractive methods of producing nanocomposites, the subject of organoclay degradation during melt mixing has been the subject of recent attention in several laboratories.

The objective of this study is to examine surfactant degradation in polyethylene- organoclay nanocomposites prepared by melt processing. Since polyethylene has a low melting point, it was possible to conduct this examination over a wide range of temperatures (150 °C to 240 °C). Organoclay degradation was characterized using WAXD analysis and its effect on nanocomposite mechanical properties was determined by stress-strain analysis. Finally, the thermal stability of the three organoclays with different alkyl contents (number of alkyl tails) are compared with each other by measuring the amount of surfactant lost during their thermogravimetric analysis (TGA). The surfactant degradation observed during TGA is also correlated to that seen in melt processed nanocomposites and a suitable degradation mechanism is proposed.