

Abstract

Damping which is an effect that tends to reduce the amplitude of oscillations in an oscillatory system is significant in components under high dynamic loads especially in general mechanical engineering. In this study, Dynamic mechanical analysis is used to compare the damping characteristics of Polyethylene (PE) and Polylactic acid (PLA). The DMA 2980 apparatus is used in the Multistrain mode and the recommended combination for a single-frequency temperature ramp of a frequency of 1 Hz and ramp rate of 3 C ° per min. PE is a tough, semi-rigid plastic with a high modulus between temperatures of 188 - 409K. The properties of PE can be 'tuned' by varying the average length of the molecule chains, making it a very versatile material with a wide range of uses. The benefits conferred on society by the development of PE from fossil fuels have in recent years been obscured by the problem of their ultimate disposal. A suitable alternative has however not been provided. More research and development is being directed towards development of environment friendly materials. Such materials must possess all the mechanical properties of PE and disintegrate within a reasonable time frame leaving no toxic substances or visible traces upon disposal. According to the American society of testing and materials (ASTM D6400-04) and the European standards (EN 13432) a compostable material should biodegrade such that Carbon is converted to Carbon (IV) Oxide to the level of 60% and 90% over a period of 180 days. In other words, it should be strong yet biodegradable. These can be manufactured from biopolymers. The introduction of these biopolymers will reduce the consumption of petroleum, which releases carbon dioxide, a greenhouse emission, unburned carbon fragments and other compounds that give rise to smog and air pollution on burning. They are also compostable, aiding solid waste management. PLA is a biopolymer which can be used to manufacture thermoplastic materials. The density of a polymer is a measure of the proportion of crystals within its mass. The crystallinity of a polymer in turn is directly proportional to its modulus which has a direct bearing on its damping properties. In this study the density of PLA was found to be 1249 kg/m³ while that of PE was found to be 920 kg/m³ . PLA is therefore more crystalline than PE. The Loss tangent ($\tan \delta$) values at 50 C ° and an amplitude of 10 μm was found to be 0.055 for PLA and 0.191 for PE. The damping properties of PE at 50 C ° are therefore higher as compared to PLA. Hence, there is a higher dissipation of energy in PE as compared to PLA on the application of a dynamic force at this temperature. The damping characteristics of PE remain fairly constant with time on application of a sinusoidal force while those of PLA increase.