Chapter 16

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Thermal properties of Polymers and Polymer Nanocomposites - Terms, Definitions, Significance

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16.1 Introduction

Polymer materials has multiple relevancies across various fields and works under varied temperatures. Thermal properties are as important as mechanical, chemical and electrical properties, since polymers are sensitive to smaller changes in the temperature. In Semi-crystalline polymers, sharp melting point is observed unlike a gradual polymer softening polymer melt in Amorphous materials. At higher temperatures, melt flow orientation, molecular weight affects the flexibility and the impact strength and also aids in decrease of dimensional stability. Thermoplastics usually require higher temperatures to completely degrade due to the presence of tough covalent bonds. Thermosets on the other hand develops chemical bonds and they also require elevated temperatures for complete degradation. However, these materials are considered to be less sensitive to higher temperatures than thermoplastics as in there will not be a significant effect on the mechanical and thermal properties in these materials. When the polymers are exposed to higher temperatures for a long time in the presence of air, oxidation takes place which gradually develop cracks in the layers of the materials and eventually lead to depletion of mechanical and thermal properties of the polymers.

Most polymeric materials are designed at melt temperatures. Initially, heat is utilised in melting the polymer and then to cure the product in room temperature. Curing involves cooling polymer products from relatively high temperatures which often results in shrinkage and dimensional changes. In Polymers, volume changes or dimensional changes with respect to temperature is more when compared to metals and ceramics. Hence, in amorphous polymers, shrinkage during injection moulding process is 1% whereas for semi-crystalline polymers it ranges from 3% - 4% [1]. When the polymers are blended with the fillers and stabilizers or composites, these dimensional changes need a special attention and also appropriate thermal