Effect of molecular structures on dynamic compression properties of polyethylene

Abstract

The properties of polymers are strongly affected by their molecular structures. Therefore, three different types of polyethylene; low density, low-linear density and high density polyethylene were used in this study to experimentally investigate the dependency and attractive effect of molecular structures towards compressive properties of polyethylene over a wide range of strain rate studied. For the mechanical tests, an experimental technique based on the compression split Hopkinson pressure bar was introduced to perform high strain rate testing whereas a conventional universal testing machine was used to perform static compression testing. Additionally, two constitutive equations were employed to validate the yield behaviour of all tested polyethylene specimens under different levels of strain rates. Results indicated that the molecular structure of polyethylene did affect its mechanical properties in terms of yield behaviour, stiffness, strength, rate sensitivity, activation volume and absorbed energy, respectively. Meanwhile, the levels of strain rates also played as secondary roles that influenced the mechanical properties of the polyethylene specimens. Of the three types of polyethylene specimens, high density polyethylene recorded an excellent performance in terms of yield behaviour, absorbed energy, stiffness, and strength properties than that of other polyethylene specimens. However, low linear polyethylene showed greater rate sensitivity than that of other polyethylene specimens under both static and dynamic regions. Interestingly, both constitutive models almost agreed with the experimental results.