

Abstract

This work has been done to improve the properties and uses of Polystyrene (PS) material by addition other materials such as [Low density polyethylene (LDPE), Polypropylene (PP), and Poly methyl meth acrylate (PMMA)] the present work has been carried out in the three stages:

The first stage from work is related with the effect of addition of LDPE, PP or PMMA to PS at different ratios (5, 10, 15, 20 wt %) of the polymer blends.

The second stage is related with studying the addition of ABS or EPDM at different ratios (1, 3 and 5 wt %) to the polymer blends (90%PS: 10%LDPE, 95%PS: 5%PP and 85%PS: 15%PMMA). And, (94%PS: 5%PP: 1%EPDM) and (84%PS: 15%PMMA: 1%ABS) which represent the best ternary polymer blends are then selected.

The third stage is related with investigating the effect of adding nano-TiO₂ in different ratios (1, 3 and 5 wt %) to the optimum samples of ternary polymer blends from the second stage.

Polymer blends and polymer blends composite have been prepared as plates by using twin screw extruder, and the samples are prepared according to ASTM specification.

Studied the mechanical, physical and morphological properties for the prepared samples.

The results, of the first stage, showed that the mechanical properties (tensile strength, flexural strength and hardness) decrease with increase LDPE and PP content in polymer blends, but these properties increase when increase PMMA content in blends. Expect the impact strength increases when increase LDPE, PP or PMMA content in polymer blends. While, the thermal properties (thermal conductivity, specific heat) increase with increase LDPE, PP and PMMA content, but thermal diffusivity increase with increase LDPE content only.

In the second stage, the results revealed that the mechanical properties (tensile strength, flexural strength and hardness) decrease with increase ABS and EPDM content in polymer blends expect the elongation and impact strength increase with increase ABS or EPDM content in polymer blends. While, the thermal properties increase with the addition of ABS and EPDM, expect the thermal diffusion decreases when adding ABS to polymer blends.

The addition of nano-TiO₂ to the best types of polymer blends composites increased the mechanical properties that reached to the maximum values at (5 wt%)TiO₂ ratio for polymer blends composite [(100-X)% (94%PS: 5%PP: 1%EPDM): X%TiO₂] and [(100-X)% (84%PS: 15%PMMA: 1%ABS): X%TiO₂]. Also, fracture strength is (47.5 – 49.6) MPa, Young's modulus (2.65-4.21) GPa, flexural strength (61-63) MPa, flexural modulus (2.7-3.7) GPa, maximum shear stress (0.93-1.73) MPa, impact strength (10.02-12.013) KJ/m², fracture toughness (4.698-8.109) MPa√m and hardness (79-87).

Also, the results showed that the thermal conductivity and specific heat increase with increase TiO₂ content, whereas the thermal diffusivity decreases in both types of nano polymer composite.

The DSC test showed the homogeneous morphology (miscible) for polymer blends and polymer blends composite

The morphology test for polymer blends nano composites gives a homogeneous morphology structure and good compatibility between the nano TiO₂ particles and the components of polymer blends.