ABSTRACT

Films cast from dispersions of starch in hot water, are brittle and highly sensitive to water. Starch derivatives and graft copolymers, though compatible with thermoplastic resins, are not industrially lucrative due to high cost and processing difficulties. Experiments were, therefore, conducted to manufacture films by compounding, granulating and extrusion blowing from a mixture of unmodified corn starch (10 - 60%) and low density polythylene (20 - 90%) in the presence of a coupling agent (5 - 20%) such as polyethylene acrylic acid, polyethylene glycol or vinyl acetate copolymer. Gelatinizing agents urea and water (about one-third and one-half of the starch content respectively) were essential for film quality. Operating conditions for compounding were screw rpm of 44 - 46 and barrel temperatures of 122 - 132°C while those for extrusion film blowing were screw rpm of 44 - 46 and barrel temperatures of 120 - 145°C for LDPE compositions and 160 - 185°C in the case of LLDPE compositions. Formulations containing up to 40% starch could be blown into smooth, clear and thin (39 - 96 μm.) films with polyethylene acrylic acid copolymer as the coupling agent. Density, water vapour transmission rate and permeability, water absorption and water soluble matter, and sensitivity to acid and alkali of the starch-based plastics films increased with starch content and were relatively higher in comparison with LDPE. The ultimate tensile strength of these films were in the range of 10.67 to 17.34 MPa while the elongation at break values varied from 122 to 210.8%. Their storage stability was better in granule

form than in film form and was comparable to LDPE. Wet heat ageing was less consequential than dry heat or humid heat ageing. Diminutions in tensile strength and elongation of these films were observed after one month of outdoor weathering and in 4 months of soil burial. Scanning electron microscopy (SEM) of the films subjected to soil burial for 4 months, showed presence of more voids and fractured surface than films under soil burial for 2 months. SEM of starch-rich films showed larger voids. X-ray diffraction (XRD) patterns of these films revealed a decline of crystallinity with increase in their starch content. Infra-red (IR) spectroscopy of the starch-based plastics films under soil burial showed absorption peaks that could be assigned to different chain terminating groups.

Key words :

Starch, Polyethylene, LDPE, LLDPE, Plastics film, Extrusion blowing, Thickness, Density, Water vapour transmission, Hygroscopicity, Tensile strength, Elongation, Storage stability, Thermal ageing, Outdoor weathering, Soil burial, Chemical resistance, Biodegradation, Scanning electron microscopy (SEM), X-ray diffraction, Infra-red spectroscopy.