Abstract

The aim of the present investigation is to develop biodegradable and rigid jute based composites. To achieve that goal, a water based soy resin was used as a matrix with jute as reinforcement in the form of fabric and felt. Composites were developed in three different phases. In the first phase of development, jute-soy composite (60:40) without any modification were evaluated for their mechanical properties, which displayed around 37 MPa of tensile strength. To impart further mechanical strength and to avoid high water absorption property of base composites, natural nanoclay (Montmorillonite) and organically modified nanoclay (Cloisite 20A) were utilized to modify soy resin. In the second phase, nanoclay modified soy resins were used with jute felt to fabricate jute-modified soy composites. Maximum enhancement of tensile strength, flexural strength, flexural and Young's modulus, impact strength, storage modulus of the jute-soy composite was achieved with 5 wt% of Cloisite 20A loading. X-ray diffraction (XRD), transmission electron microscopic (TEM) analyses of composites confirmed the intercalation/exfoliation of nanoclay in the composite interface. In the third phase, for improving strength and hydrophobicity of composites, surface of non woven jute felt was treated by mild alkali and that treated jute felt was utilized along with poly(vinyl alcohol) (PVA) modified nanoclay based soy resin to develop alkali treated jute-modified soy composites. The maximum enhancement of mechanical properties of composite was achieved with 7 wt% of PVA loading. Storage modulus of the optimized composite was found 8 times higher and tensile strength 60% more than that of the jute-soy composite. Water absorption of alkali treated jute-modified composite was reduced by 30%. Soil burial and microbial degradation studies of jute-soy composites were carried out in compost soil and cultured fungal bed, respectively. Weight loss, tensile loss and scanning electron microscopic (SEM) images of composites after biodegradation revealed that composites are biodegradable in nature. Some laboratory based products like sapling pot and molded articles were developed from jute-soy composite. The prime advantages of these composite are their eco-compatibility as jute and soy resin are from agricultural source and biodegradable in nature. These composites can be utilized in automobile, packaging, furniture sectors by replacing non-degradable plastic and plastic based composites.

Key words: Jute felt, soy resin, nanoclay, jute-soy composites, physical characteristics, mechanical properties, biodegradation, and morphological analysis.