

MODIFICATION OF RICE HUSK TO IMPROVE THE INTERFACE IN ISOTACTIC POLYPROPYLENE COMPOSITES

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Abstract— The effect of surface treatment on the properties of rice husk/polypropylene composites was investigated. Rice husk with particle sizes of 20, 30, 40 and 60 mesh was modified by alkaline treatment and coupling of silanes with and without previous alkaline treatment. The rice husk was characterized by FTIR, TGA, SEM and a qualitative hydrophilicity test by using a water-toluene system. The TGA results and the qualitative hydrophilicity test indicated that silanized rice husk decreased their hydrophilic character and increased their thermal stability. SEM images showed a regular geometry in the 60 mesh husk which consisted of short fibers. Test specimens were obtained according to ASTM D-1708 standard, by molding injection process using a ratio of 30 % rice husk/70 % polypropylene (PP) based on weight. A quantitative improvement in tensile strength was observed in composites filled with alkali treated rice husk and silanized rice husk in comparison with composites filled with untreated rice husk.

Keywords— Composites; alkali treatment; silane; mechanical properties; rice husk.

I. INTRODUCTION

For the last two decades, natural fibers have been used as fillers and reinforcement in low-melting-point thermoplastics. These organic filler fibers have been shown to represent low-cost renewable reinforcements that enhance material properties such as stiffness and strength (Rodríguez *et al.*, 2003). Yet another attraction of using these materials is the fact that it would allow various agro-wastes to be appropriately (Han-Seung *et al.*, 2004).

In terms of organic fillers, rice husk obtained from milling process of rice, *Oryza sativa*, one of the major food crops in the world, can be used as organic filler because of its availability. Disposal of rice husk is a particularly serious problem, which requires special attention due to the large quantities. It is estimated that rice husk of approximately 20% is obtained from the total rice by the milling process. Rice husk roughly contains

35% cellulose, 35% hemicellulose, 20% lignin and 10% ash (94% silica), by dry weight basis (Prachayawarakorn and Yaembunying, 2005). On the other hand, PP is one of the universal polymers and has many advantages such as easy processibility, corrosion resistance, mechanical rigidity, low density, and low cost (Toro *et al.*, 2005; Jang and Lee, 2001). The main problem in the broad use of these fibers in thermoplastics has been the poor compatibility between the fibers and the matrix, and the inherent high moisture sorption, which brings about dimensional changes in the lignocellulosic based fibers. The efficiency of a fiber reinforced composite depends on the fiber-matrix interface and the ability to transfer stress from the matrix to the fiber. This stress transfer efficiency plays a dominant role in determining the mechanical properties of the composite and also in the material's ability to withstand environmentally severe conditions. Additionally, it is important to maintain good stiffness to impact strength balance in order to expand the applicability of these natural fiber-reinforced composites (Karnani *et al.*, 1997).

II. METHODS

A. Materials

The thermoplastic polymer, Isotactic Polypropylene (PP), was supplied by Aldrich Chemical Company Inc. In the form of homopolymer pellets with a density of 0.9 g/cm³, MFI of 4 g/10 min, Tm of 160-165°C, Mn = 97,000, Mw = 340,000. Silane coupling agents used in this study were Trichlorovinylsilane (TCVS) 97% supplied by Aldrich and Dichlorodimethylsilane (DCDMS) 99% supplied by Dow Corning, rice husk was supplied by rice company San José, Jojutla, Mor., Morelos variety A70 (20, 30, 40 and 60 mesh), Sodium hydroxide 97.6% and anhydrous ethanol 99.9%, were supplied by J.T. Baker.

B. Alkali treatment

The rice husk was soaked in a 0.5N NaOH solution at room temperature maintaining a ratio of (500mL alkali solution /50g rice husk) rice husk was kept immersed in the alkali solution for 2 h. The fibers were then washed several times with fresh water to remove any NaOH