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Evaluation of surface roughness and mechanical properties of particleboard panels made from bagasse

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ABSTRACT

The main objective of this study is to investigate some of applied properties of experimental particleboard panels made with bagasse, as an alternative fibrous raw material. Modulus of elasticity (MOE), modulus of rupture (MOR), internal bond strength (IB) and thickness swelling (TS) of the specimens were evaluated. In addition, average roughness (Ra) and mean peak-to-valley height (Rz) were used to determine quantitatively surface characteristics of the panels. Three-layer mats with target density of 0.70 g/cm^3 were formed by using fine chips for the face layer (25 wt.%) and coarse chips for the core layer (50 wt.%). Variable factors were as wood species (bagasse, poplar and mixed hardwood species), moisture content of mat (face layer: 12%, 14% and core layer: 9%, 11%) and press time (6 and 8 min). Statistical analysis showed that all variable factors exerted a significant influence on MOR, MOE, IB, TS, Rz properties of the boards as a single factor. Panels made with bagasse particles had superior mechanical and physical properties compared to the poplar and mixed hardwoods particles. Bagasse boards exhibited better surface roughness, having lower Ra and Rz values, than those made with poplar and mixed hardwoods particles.

1. Introduction

The demand for composite wood products, such as plywood, oriented strandboard (OSB), hardboard, particleboard, medium-density fiberboard, and veneer board products has recently increased substantially throughout the world [1]. Particleboard is 57% of total consumption of wood-based panels consumed and it is continuously growing at 2–5% annually [2]. The demand for particleboards in the sectors of housing construction, furniture manufacturing and interior decoration (wall and ceiling paneling) has continued to increase [3]. On the other hand, accelerated deforestation and forest degradation, in addition to a growing demand for wood-based boards, have raised an important issue regarding the sustained supply of raw material to the above sectors for a long time. As a result of these concerns, alternative fibers could play an important role in manufacture of composite panels such as particleboard [4]. There is a wide variety of non-wood plants (such as kenaf stalks [5], wheat straw and corn pith [6], cotton carpel [7] and cotton stalks and rice straw [8]) and agro-residues (such as coffee husk and hulls [9], kiwi prunings [10], waste grass clippings [11], branch wood and bark [12], waste tea leaves [13], almond shell [14], flax shiv [15] and durian peel and coconut coir [16]) that can be used as alternative fibers.

Among many agro-residues, bagasse is one of the most promising and suitable raw material for both developing and developed countries [2]. Bagasse, an abundant agricultural lignocellulosic byproduct is a fibrous residue of sugarcane stalks left over after crushing and extraction process of the juice from sugarcane. About 54 million dry tons of bagasse is produced annually throughout the world [17]. Asia is the primary production region of sugar cane (45%), while South America is the second largest production region (35%) in the world. According to a report from Food and Agricultural Organization (FAO), Iran produces 5.3 million tons of bagasse annually [18] which is mainly centered in the southwestern province, namely Khuzestan. The utilization of this biomass for processing of novel wood-based composites has attracted growing interest because of ecological and renewable nature characteristic.

The use of very thin overlays such as melamine impregnated papers, veneers, laminates, and vinyl films, on particleboard substrates has forced increasing attention to surface quality. When particleboard is used as substrate for surface coating, its particleboard surfaces must be capable of having resistance stresses to peeling. Fine irregularities on the board surface shows through overlays, affecting the product grade, quality, finishing, and gluing. Because films tend to be thin, they do not have good masking properties, and any imperfections in the board surface can telegraph through the film finish. The rough surfaces reduce the contact between the overlays and particleboard, resulting in a weak glue line and low bonding strength properties of the layers [19].

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