INTROP Highlight

COMPOSITE PANELS FROM UNDER-UTILIZED WOOD AND AGRICULTURAL FIBER RESOURCES

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Introduction

Production of wood composites such as particleboard, medium density fiberboard (MDF) and oriented strand board (OSB) continues to steadily increase in many countries. New wood-based composites are also progressively developed and successfully introduced as raw material for numerous structural and non-structural applications. Both particleboard and MDF are extensively used in furniture industry as substrate for thin overlays [6]. Using low quality small diameters trees which are not suitable for lumber manufacture is one of the main advantages of such panels. Within the scope of sustainable use of our forest resources underutilized wood species and agricultural fiber resources from various plants including rice straw, jute, coconut fiber, oil palm, bagasse, kenaf and bamboo are also getting popular to be used as raw material to produce different types of value-added composite panels [2,3,5,6]. As it is well known overall production process of such composite panels are quite similar to each other. In most cases, the chip or low quality logs are reduced into particles, fibers, or strand by using hammermill, disk refiner or flaker before the particles are dried to an approximate moisture content of 2-4%. Usually particles are classified as fine and coarse on different size of screens in a typical particleboard manufacture. Figure 1 illustrates various types of raw materials including particles, fibers and strands used for manufacture of experimental panels products. In the next step the material is blended with interior or exterior adhesive depending on the panel type. For example urea formaldehyde is the most widely used resin for manufacture of particleboard and MDF being interior panels while phenol formaldehyde is used for OSB having resistance under the outdoor conditions for building purposes. Wax and some other chemicals are also added into the resin to enhance overall properties of the final product. Blending is followed by the forming line where the raw material is configured into three layer loose mat having fine materials on the face and coarse material in the core layer of the panels. In the case of any type of fiberboard including MDF, thermally treated chips are converted into fibers using different techniques and equipment such as pressurized refiners. Multi opening presses are commonly used for most manufacturing processes of the composite panels. Heat and pressure are applied to the mat to cure the adhesive and give the desired strength properties to the final products. Figure 2 shows unpressed mats and finished panels. Last twenty years or so continuous press line is also getting more popular with respect its better efficiency and higher productivity. As mentioned above formaldehyde base adhesives are widely used in composite panel production. However these binders create significant health problems for both short and long-term exposure due to formaldehyde emission.

Therefore, formaldehyde emission has been the major concern associated with urea and phenol formaldehyde bonded wood composite panels [1,6]. From the perspective of green approach starch and soy based adhesives are getting attention in the industry. Starch from various plant materials such as corn, cassava, potato, and rice were studied to be used in wood composite panels as binders in past studies [2,5]. In one of these attempts modified starch combined with very small amount of formaldehyde based adhesive was used to produce experimental particleboard panels having an underutilized species, Eastern redcedar as raw material. The samples made in this work had modulus of elasticity values of 2,241.92 MPa, 2,344.32 MPa, modulus of rupture values of 11.17 MPa, 12.14 MPa and internal bond strength values of 0.57 MPa, 0.62 MPa for the panels with 0.70 g/cm3 and 0.80 g/cm3 density levels, respectively [5]. It was found that these panels satisfied properties stated in the American National Standard Institute [4]. However the dimensional stability of the samples need to be enhanced.

Figure 1. Various types of raw materials used for experimental composite panel manufacture [5,6].

Figure 2. Unpressed mats and finished panel products [5,6].

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