Manufacturing and Evaluation of Mechanical Properties for Rice Husk Particle Board Using IoT

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In recent times, different types of particleboards are being preferred in the construction of houses, partitions, furniture etc. The production of such materials can be manufactured using rice husk, which has been obtained as waste produced in rice millers. Adhesive such as formaldehyde, when exposed to fire, causes toxic flames which are fatal in nature. The basic condition for production of particleboards is to check the temperature and humidity content in the rice husk which has been done by using DHT 11 sensors i.e., application of Internet of Thing (IoT) erected method. This identification helps in finding the suitable temperature through which bio-based adhesives have been prepared. In present study, two different types of bio-adhesives namely tamarind with formalin and tamarind with boric acid has been used in manufacturing process. The application of IoT erected method follows a complex preparation method but will partially fulfil the job and reduces human involvement. Finally, when the proper temperature and moisture level has been measured, the preparation becomes easy. After manufacturing the particleboard, the strength has been tested by a three-point bend test and have been compared with commercially available boards with formaldehyde base adhesive.

Keywords: Particleboard, Bio-based adhesive, DHT 11, Sensor, Moisture, Temperature

1 Introduction

The manufacturing of particleboards involves mixing of wood flakes, jute-stick or any sustainable material with a suitable binder or resin[1]. The characteristics such as light weight, density, and cheaper cost make particleboards best substitute over plywood and conventional wood where strength of the material has been compromised.

Rice Husk is a by-product of rice milling process[2,3], which includes fine particles of rice, dust, and ash of husk. The main components include cellulose (25-35%), lignin (26-31%), silica (15-17%), and some moisture (7-8%)[4]. The rice husk collected has been dried and weighed after continuous subjection to testing until the sample contains no moisture content[5]. In agricultural countries, lots of agriculture residues or biomass wastes, such as rice husk and woods, are produced every year. The world annual production of rice has more than 540 million metric tons[6,7].

The key aspect has the utilisation of rice husk and rice straw has an important source of renewable energy[8] where agricultural countries like India have a lot of rice and its wastes.

Adhesives play a major role in production of wood-based composites. Formaldehyde, urea-formaldehyde, and melamine-modified urea-formaldehyde resins are the preferred adhesives for producing panels for exterior grade[9]. Emissions of formaldehyde, a volatile, colourless gas with strong odour usually employed in manufacturing of building materials[10,11] are known to cause throat and nasal congestions, burning eyes, headaches, and badly effecting upper respiratory system. long term exposure leads to the increasing risk of developing cancer[12-15]. Formaldehyde was reclassified as a known carcinogen from a group 2A suspected carcinogen by the international agency of research on cancer, a division in World Health Organisation[12] By increasing the usage of 'Green' materials, the intense exploitation of resources can be reduced, the amount of formaldehyde content releasing into the atmosphere can be controlled, such that the resources can be utilized in a sustainable manner.

Tamarind *(Tamarindus indica)* otherwise called "Indian date," is a large tree belonging to Fabaceae

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