学 位 論 文 の 要 約

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学位論文の題名

Development of biodegradable biomass board and its properties using soybean straw
（大豆ガラを用いた生分解可能なバイオマスボードの開発研究）

学位論文の要約

The purpose of this research was to manufacture biodegradable biomass board (bio-board) by using soybean straw without any synthesis resin. The procedure of manufacturing bio-board included cutting, soaking, refining, and forming. The manufacturing parameters, including applied pressure (2-8 MPa), heating temperature (110-230 ℃), forming time (0.5-2.5 h), was evaluated, respectively. Two pieces of bio-boards were produced at each experimental condition. After that, the physico-mechanical properties of bio-board were evaluated by standard methods based on JIS A5905.

Bio-boards were manufactured successfully at all experimental condition. These bio-boards were classified as hardboard according to JIS A5905 standard because the density exceeded 0.8 g/cm^3. With the increase of applied pressure, the bending rupture stress ranged from 32.3 to 40.6 MPa, and the tensile rupture stress of the bio-boards was between 15.73 to 22.57 MPa. The water absorption of bio-boards ranged from 87.7% to 97.1%, and the thickness swell ranged from 45.8% to 62.0%. Generally, mechanical properties of bio-board were closely related to the density and moisture content affected by the applied pressure, whereas, bio-board had poor water-proof properties compared to commercialized fiberboard. The bending rupture stress of soybean straw bio-board slightly increased from 39.3 to 43.2 MPa when the forming time raised from 0.5 to 2.5 h. The tensile rupture stress of soybean straw bio-board varied from 17.6 to 24.7 MPa. The water absorption of soybean bio-boards ranged from 97.2% to 123.4%, and the thickness swell ranged from 66.2% to 97.8%. Except for the bio-board made at 0.5 h that had relatively low strength and water-proof performance, the performance at other forming time condition did not have significant difference. With the increase in temperature, there was a decrease in moisture content, the softening of lignin, and the pyrolysis of hemicellulose, which was beneficial to the improvement of mechanical properties of the bio-board. However, excessive heating temperature, especially at 230 °C, did not significantly promote improvement to most mechanical properties. On the other hand, the dimensional stability of the bio-board was greatly improved from 140 to 230 °C.

Furthermore, to evaluate the influence of fiber length on properties of bio-board, soybean straw fiber was prepared with three categories of fiber lengths: long fiber (length >2 mm), short fiber (length < 1 mm), and mixed fiber. Then, three different kinds of bio-boards were made by using these three fibers. The bending properties, screw holding force, dimensional stability and water soaking properties of these bio-boards were further investigated. The mixed fiber bio-boards had shown conceivably better mechanical properties and dimensional properties than long and short fiber length bio-boards, due to its dense structure in which short fibers were stuffed among the interweaving of long fibers. Finally, two methods were tried to improve the water-proof of the bio-board in this research.

Bio-board which was made in this study performed well in mechanical properties. In the making process, none of chemical adhesive and chemical compound was used. The research of bio-board was not only beneficial for solving the problem that traditional fiberboard released toxic gases, but also had a good advantage of the utilization of agricultural wastes. It was also conducive to the protection of forest resources.