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Development of Ultra-Low Density Material made from Wood fiber and Konjac glucomannan

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【Introduction】 Recently, a concern about the global environment is rising and possible problems in the future are worried. One of these problems is exhaustion of fossil resources. A large amount of fossil resources are used in chemical products. Foam plastic materials which are used as an insulator are also mainly made from fossil resources. Therefore, development of the alternative materials made form non-fossil resources is required. In this study, the main aim was to develop an ultra-low density material being equal with plastic foam without using fossil resources. As a key material, konjac glucomannan (KGM) which is gel polymer was used, and ultra-low density material was made only from KGM and wood fiber.

【Materials and Methods】Wood fiber made from *Shorea* spp. and purified KGM powder with the average molecular weight of 1,000,000~2,000,000 were used as raw materials. Wood fiber were mixed with KGM powder dissolved into hot water of 80°C to be 0.7wt% and stirred for 30 minute. After cooling down to 60°C in the room temperature, a little amount of calcium hydroxide solution was added as coagulant. The mixture was stirred quickly and poured to a molding case. It was heated at 60°C for 1h and boiled for 10minutes. The formed gel was freeze-dried. Wood fiber content was varied from 0.0 to 75.0%. [Mechanical property] Three-point bending test and compression test were performed according to JIS A 9511. [Thermal conductivity] Thermal conductivity was measured by transient heat probe method according to JIS A 1412-2. [Humidity control capacity] Temperature and relative humidity inside steel box within material were measured in the climatic chamber. The temperatures of the climatic chamber varied sinusoidally around 25°C, which had three wave periods of 3, 6, 24h. [Sound absorption coefficient] Normal incident sound absorption coefficient was measured based on the two-microphone transfer-function method according to JIS A 1405-2. Frequency ranged from 200 to 3,200 Hz.

【Results and Discussion】The densities of the newly developed materials increased with increasing wood fiber content, being ranged from 0.010 to 0.035g/cm^3. The density of material was about 1/10 of insulation fiberboard and was almost same as foam plastic materials. The values of MOR in bending and compressive strength increased with increasing the density, and showed 60kPa and 20kPa, respectively, with the fiber content of 75.0%. Fig.1 shows the thermal conductivity in a relation to the material density. The values of the thermal conductivity ranged from 0.036 to 0.042W/mK with increasing the density. These values were much lower than conventional wood-based materials, and comparable with that (0.035W/mK) of polystyrene foam with density of 0.025g/cm^3. The humidity control capacity of the material increased with increasing wood fiber content. The material with the fiber content of 75.0% showed almost the same humidity control capacity as Sugi (flat-sawn), however, faster response to the humidity change. The sound absorption coefficient of the material with fiber content of 75.0% showed higher performance than that of insulation fiberboard and was similar to that of glass wool.

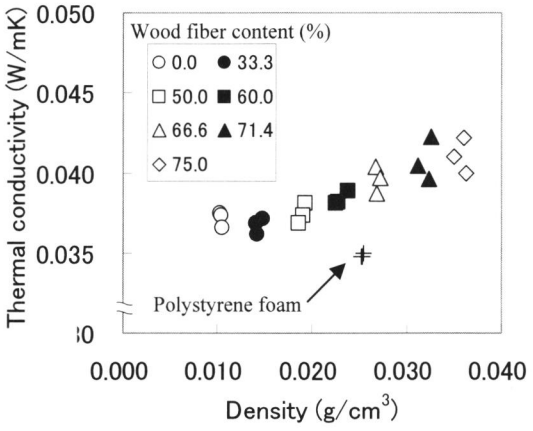

Fig.1. Thermal conductivity as a function of material density.