RECENT RESEARCH ACTIVITIES

Influence of electron beam irradiation as pretreatment on wood flow forming

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Wood flow forming is a technique, in which products of various shapes can be obtained by hot-pressing wood in a metal mold to cause detachment and movement of cells and then rejoining. Currently, the problem is that the load required for flow is high. The purpose of this study is to examine the influence of electron beam irradiation as a pretreatment on mechanical properties of flow formed wood with and without containing resin

Flat-sawn specimens of hinoki (Chamaecyparis obtuse) were used as a test material in oven-dry condition. Irradiation was carried out using a EBC-300 (NHV Corporation) at an accelerating voltage of 300 keV and an average absorbed dose of 0 to 263 kGy. Free compression tests were performed on the irradiated specimens at moist and heated conditions to obtain stress-strain curves. Young's modulus, proportional limit stress, and flow starting stress obtained from the curves were decreased by increasing dosage, which suggests the electron beam decomposed the cellulose chains. The proportional limit strain, flow starting strain, and maximum strain in the curves indicated that the EB irradiation promoted the flow deformation, though it did not affect the elastic deformation and densification deformation. The change in shape of specimens during the compression test was also remarked. The deformation along the tangential direction which was also observed for the non-irradiated specimens, was accelerated by the electron beam irradiation. The irradiation also induced deformation along the fiber direction which was not observed in the non-irradiated specimens, and this deformation enhanced with increase of the dosage. It was indicated that the deformation along the fiber direction was caused by fracture of the wood fiber due to the EB irradiation by a scanning electron microscopic observation [1].

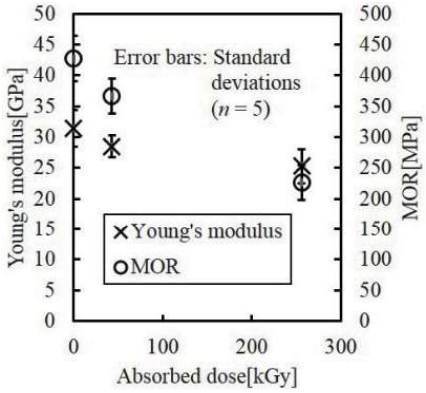

Figure 1. Influence of absorbed dose on Young's modulus and MOR of molded specimen

On the other hands, the specimen after irradiation was heat-treated in a blow dryer and soaked into a phenol resin aqueous solution under reduced pressure until the weight increase rate became about 180%. After conditioning the specimen at 30°C, the molding was performed using a materials testing machine (INSTRON5582) and a disk molding die. A strip of specimen was cut from the molded material and used for a three-point bending test that was performed using a materials testing machine (INSTRON4411). Young's modulus and modulus of rupture (MOR) decreased with increasing absorbed dose. However, even with the lowest breaking stress, the strength was about 200 MPa as shown in Figure 1. A boiling test was also examined to check water resistant of the molded specimens. The dimensional stability of irradiated specimen against water reduced, though its effect was small.

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Reference

[1] Hideaki Sugino, Soichi Tanaka, Yuga Kasamatsu, Satoko Okubayashi, Masako Seki, Tsunehisa Miki, Kenji Umeura and Kozo Kanayama, "Influence of Electron-beam Irradiation on Plastic Flow Deformation of Wood", *Mokuzai Gakkaishi*, vol. 66, no. 2, pp.59-66, 2020.