
RECENT RESEARCH ACTIVITIES

Recent studies on production of sustainable materials by using natural resources

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One of the main theme in our laboratory is the substitution of the fossil resource-based materials by the natural resource-based ones. In this article, the recent studies on the theme were introduced from the viewpoint of the promotion of usage of the fiber material derived from plant, and of the development of the adhesives (or the binder) derived from natural resources.

Promotion of usage of fiber material derived from plant

Though wood is the representative plant-derived material, its usage has been insufficient in terms of the reduction of fossil resource-consumption. It is required for the wider usage of wood to enhance the performance and reliability of wood and wood-based materials. Chemical treatment, or introduction of chemicals into wood, is one of the major methods for the enhancement. In the conventional treatment, however, distribution of chemicals in wood was irregular, leading to the inadequate performance and reliability. This irregularity can be categorized to macroscopic irregularity, indicating that the chemically treated wood includes the untreated cells in its structure; and microscopic irregularity, indicating that each cell includes the untreated regions in its amorphous structure. The macroscopic irregularity is mainly caused by the aspirated pits that disturb the flow of chemical solution in tracheid for coniferous wood. Then, we assumed that the water hammer phenomenon can be applied to reduce the macroscopic irregularity by penetrating the pits, which is now under examination. Meanwhile, for reducing the microscopic irregularity, focus was placed on the diffusion of chemicals into cell walls during conditioning, or process of evaporating solvent from wood impregnated with chemical solution. The microscopic irregularity was clarified to be controlled by the relative humidity and temperature during the conditioning [1].

Bast fiber of kozo (*Broussonetia kazinoki* × *B. papyrifera*) has been used as a raw material for Japanese paper, called washi. The supplement of the fiber, however, has been decreasing with the decrease in the production of washi. To increase the fiber supplement, focus was placed on the development of a new bast fiber-based material that can be used in huge industries (e.g. automotive industry). It was required for such a material to have high rigidity and strength. In our study, the process of producing the fiber board was applied to produce the fiber material derived from kozo-bast fiber. It was indicated that the long fiber unique to kozo made it difficult to control the strength and Young's modulus, which may be related to the difficulty in controlling the arrangement of the long fiber in the materials.

Development of adhesives derived from natural resources

In our previous research, the feasibility of applying natural raw materials to the adhesive for wood-based materials has been studied. The mixture of sucrose and some other natural materials (citric acid, ammonium dihydrogen phosphate (ADP), or wattle tannin) was confirmed to act as the adhesive, in which the attribution of the caramelization of sucrose was indicated. In our recent study, to improve the low pH and mechanical properties of the particle board bonded with sucrose-ADP mixture, the calcium carbonate was added to the mixture. The feasibility of using the mixture of sucrose and ammonium nitrate (AN) as a new natural adhesive was also investigated. Bagasse of sweet sorghum (*Sorghum bicolor* L. Monech), known as an agricultural waste, has been also regarded as a fiber materials, and thus the utilization of the bagasse and citric acid for manufacturing of particleboard was also studied in recent years [2].

References

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