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Compounding Method for High Quality Building Materials using Fine-Powder Ligneous Refuse Technology

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Much ligneous refuse is uselessly thrown away or burnt. In particular, scraps, splinters and shavings which generate during the log sawing process are not fully utilized. This paper reports on the basic technologies for producing high quality fracture resistant and non-corroding building materials with wood texture by using the fine powder ligneous refuse as a timber raw material and by compounding it with plastics.

Key words ; building material , ligoneous refuse , recycle , wood texture , wood flour(powder) , plastic , compound

1. INTRODUCTION

Board building materials such as plywood, laminated timber, fiber board, particle board and synthetic wood blend products, which are made by combining various types of plastics with wood flour, have been developed by the technology for breaking down, powdering and reconstituting timber. While the use of coniferous and broad leaf trees for plywood has been increasing a large proportion still consists of tropical timber varieties (lauan, etc.,), resulting in a number of problems. For laminated timber, defective areas of the timber, such as knots and cracks, are discarded prior to processing, inevitably resulting in large losses, and this means that the effective use of wood resources is limited. Fiber board and particle board aim to make effective use of a wide range of resources such as refuse from timber processing, remnant forests and small diameter timber by reconstituting timber into board after breaking it down into fiber or chip form. Further, fiber and particle board are comparatively cheap and are used for a wide range of purposes. However, they lack the distinctive texture of wood, and they are confined to use underneath a variety of finishing materials, such as laminated building materials including a surface plastic film, because they do not wear well in humidity and moisture. Synthetic wood products include molded building materials using PVC resin or ABS resin with wood flour and such products as the subsurface material used for automobile interiors, which consists of PP resin and wood flour. However, timber (wood flour) content in these products is low (up to around 15% by weight), and the effect of increasing timber usage is low, producing little wood texture.

Much ligneous refuse is uselessly thrown away or burnt. In particular, scraps, splinters and shavings which generated during the log sawing process are not fully utilized. This paper focuses on basic technologies for producing high quality fracture resistant and corrosion resistant building materials with wood texture through the application of technology to utilize fine powder ligneous refuse as a timber raw material (usage of all ligneous refuse can be increased if it will be powdered finely) and technology to compound it with plastics (comparatively simple materials to compound and mold with timber in order to improve productivity and performance).

2. EXPERIMENTAL

2.1 Wood Powder (Experiment 1)

Extrusion molding is commonly used as a way of forming rectangular and cylindrical timbers as different from board materials such as fiber board. In particular, various types of plastics including urethane, PVC, ABS and PS are used as building materials in the form of expanded synthetic timber. Some of these products also contain wood flour, and they show a uniform property in terms of being crack and warp resistant and non-corroding. However, they are synthetic timber in name only and lack the texture of wood. The wood flour commonly used in these materials is made of long, thin particles with a raised surface which help bonding, and these are the characteristics of cellulose powder. This experiment was conducted from the perspective of the issues to be resolved in this type of compounding.

－1. Materials

Spruce and hemlock spruce scraps and shavings which generated during processing at the Matsumoto panel plant were used in this study.

－2. Method

① Material powdered in powdering machine and sieved.

② Material powdered in powdering machine, unravelled and sieved.

③ Material powdered in a powdering machine, unravelled with addition of abrasive and sieved.

The characteristics of the fine powders obtained by above three processes were compared.

Powdering machine Hosokawa ACM-60,
Unravelling machine Eirich R02
Siever Asano ST-52

2.2 Mixing and Extrusion (Experiment 2)

The compounding of each of the wood flour samples obtained in ①, ② and ③and plastics were done. The compounding of three types of wood flour obtained in experiment 1 with PVC resin, the typical plastic used with wood flour in the past, with a content of over 30%, equivalent to double the conventional amount, were performed in order to assess the possibility of producing a high quality building material with the texture of wood.

－1. Materials

- Over 30% of the fine powdered wood flour obtained in ①, ② and ③
- Less than 70% of PVC resin containing a strong, moldable copolymer
- Less than a few percent each of lubricant, plasticizer
- 0.5% of epispastic

Total 100%

－2. Method

The above materials except the epispatic were compounded with a blender and heated to around 150 °C. They were then move to a cooling mixer, and the epispastic was added when the temperature had dropped to below 100 °C. The finished compound was made into 3mm thick molded products and the performance and texture was compared.

－Basis of evaluation

Condition of expanded cells was assessed by observing the section of the extruded material with an optical microscope.

○ : Cell diameter is uniform and less than 100 μ m.

△ : There is a scattering of roughly broken cells.

× : Broken rough cells are the majority.

Molded surface was assessed by observing and touching sheet surface

○:Smooth △:Fairly smooth×:Rough with many bumps

Specific gravity of molded product was measured by JISK No. 7112 water displacement method, the closer to timber, the better.

Tensile strength of 300kgf/cm^2 or more by JISK No. 7113 test (tensile speed 10mm/min), is good for building materials.

3.RESULTS and DISCUSSION

3.1 Wood Powder (Experiment 1)

In general, the wood flour compounded with plastics is mostly type ①. From the results in Table 1, the appropriate wood flour water for the current wood flour plastics is considered to be 15% or less. We can therefore agree with such plastics compounder's opinion that the type ① wood flour is difficult to compound.

3.2 Mixing and Extrusion (Experiment 2)

The results of experiment 2 show that it is possible to:

① Make the particles fine and a little heavier with a suitable distribution to mix easily with powdered resin.

② Eliminate moisture effects in the high compounding and molding temperature by greatly reducing water content. Molded products compounded with thermoplastic resin showed the wood texture and the strength needed for building materials even when the wood flour content was higher than in conventional products.

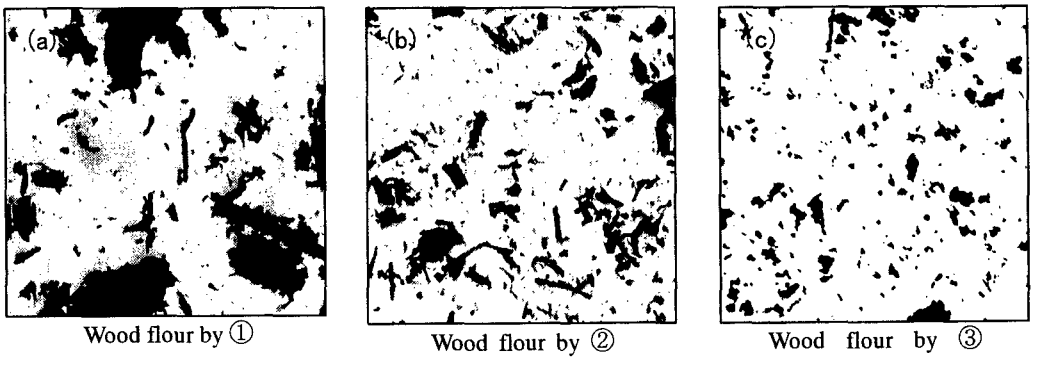

Fig.1 Microstoructures of wood flours obtaind from experiment 1.

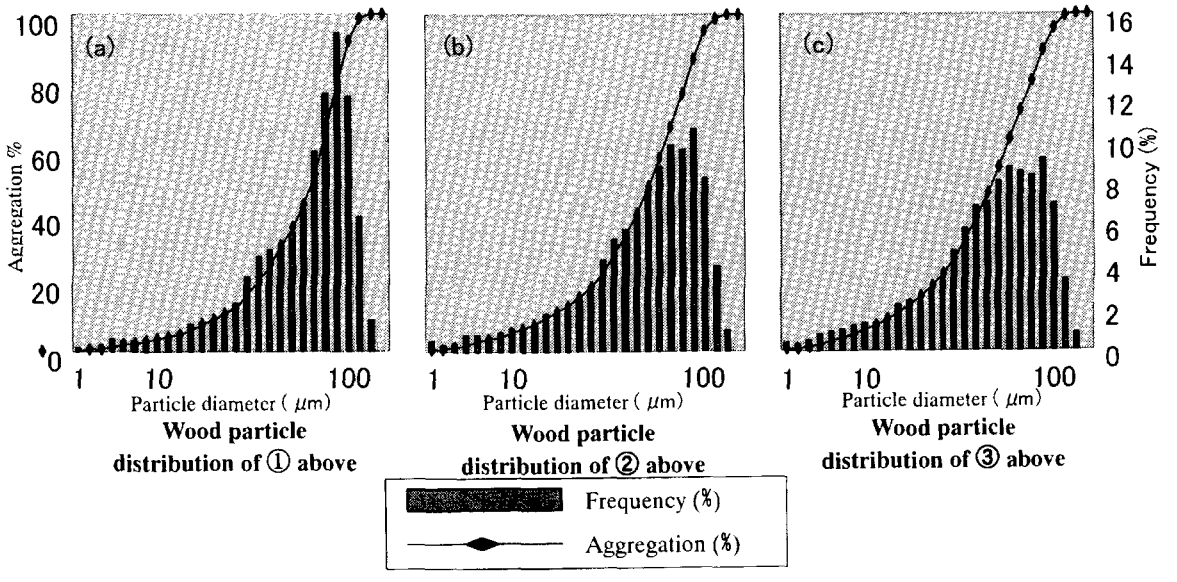

Fig.2 Particle distribution of wood flours obtained from experiment 1.

Table Ⅰ: Comparison of wood flour from experiment 1.

Category	①	②	③
Shape	Large disparity between long and short	Medium disparity between long and short	Small disparity between long and short
Average diameter (μm)	96	82	65
Specific gravity	0.11	0.16	0.21
Water content (%)	6%	3%	2%
Dispersal	Many tangles	Few tangles	Few tangles

Table Ⅱ: Evaluation of compounds from experiment 2.

		Type ①		Type ②		Type ③	
		1	2	3	4	5	6
Compound weight %	Fine wood flour ①	30	40				
	Fine wood flour ②			30	40		
	Fine wood flour ③					30	40
	PVC with copolymer	67	57	67	57	67	57
	Lubricant and plasticizer	2.5	2.5	2.5	2.5	2.5	2.5
	Epispastic	0.5	0.5	0.5	0.5	0.5	0.5
Characteristics	Status of expanded cells	×	×	△	×	○	△
	Molded surface	△	×	△	△	○	△
	Specific gravity of molded product	0.81	0.99	0.74	0.91	0.71	0.79
	Tensile strength (kg t/cm^2)	200	170	240	210	300	230
	Evaluation	×	×	△	×	○	△

4.SUMMARY

① Making fine-powdered wood flour

(All varieties and parts of timber can be utilized as a result of fine powdering. Even if other substances are mixed, it is possible to use them as a filler if they are finely powdered.)

② Making a molded product

(Products can be made from the appropriate volume of materials as necessary, and losses through cutting and chipping can be almost completely eliminated.)

③ Low cost material

(If the manufacturing cost of the fine-powdered wood flour is lower than the cost of general purpose thermoplastic resin, a molded product which compounds them is cheaper than a molded product consisting of general purpose thermoplastic resin alone. It also has the texture of wood, meaning that it has higher added value.)

The achievement of ①, ② and ③ above means that the full utilization of timber resources can be significantly improved.

REFERENCES

1) *Timber Industry Handbook, The New Edition.* Ed., Forestry Laboratory, Ministry of Agriculture, Forestry and Fisheries. 1973 published by Maruzen.

2) *Plastics Compounders.* Ed., Akisada Endo et.al., 1996 published by Taiseisha.

3) Patent publication no. 10-273571. Nagase, Nakayama, Akitani, Kobayashi.

4) Patent registration 8-2064938. Kamite.

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