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Particleboard Manufactured from Wood Chips Used in Garbage Decomposer

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Particleboards bonded with urea-meramine resin were manufactured from chips used in garbage decomposer and their properties were investigated in comparison with those from untreated wood chips. Modulus of rupture and modulus of elasticity were not so different between the board from treated wood chips and the control board. Wood chips used in garbage decomposer absorbed more moisture in high humidity condition and this tendency was observed in the particleboard from them. Particleboard from treated chips showed lower formaldehyde emission. In water soak test board from treated wood chips showed smaller thickness swelling. Treated wood chips and the particleboard from them were more susceptible to termites. Wood chips underwent various change in garbage decomposer chemically and physically and this modification affected the properties of particleboard from them.

Key words: particlebopard, garbage decomposer, thickness swelling, formaldehyde emission, termite

1. Introduction

Recently garbage decomposer has become more and more popular in the city life. Usually sawdust is used in garbage decomposer and used sawdust has been reused for fertilizer or improving soil quality.[1)2)] When wood chips in small size are used, they become wood powder but in large size chips, their shape is maintained even after garbage is extinguished. These residual chips can be used as boards before they ultimately are used as fertilizer. Wood chips undergo various changes chemically and physically during garbage decomposition and this change may give some interesting properties to resultant boards. In this report particleboards were manufactured from wood chips used in garbage decomposer and investigated their properties.

2. Materials and methods

Wood chips: Wood chips of Sugi (*Cryptomeria japonica* D. Don) were used for garbage decomposer. After three months run of garbage decomposer, wood chips were taken out and washed to remove undegradated garbage. Size of chips was measured before and after using for decomposer.

Manufacture of particleboard: Particleboards were manufactured from the chips before and after using for garbage decomposition. Urea-melamine resin was used for bonding and resin content was 9% based on dry wood chips. Board size was 240mm x 210mm x

8mm. Hot pressing condition was 180℃ for 10 minutes at 40 kg/cm^2 with one shot. Board properties such as bending strength, thickness swelling in water soak test, formaldehyde emission were tested according to Japanese Industrial Standard A 5908. Moisture absorption and desorption test was carried out in desiccators contained 18% sodium carbonate solution (relative humidity 92% at 20℃) for absorption test and 52.2% sodium hydroxide solution (relative humidity 5.5% at 20℃) for desorption test. Board sample size was 150mm x 50mm x 8mm.

Degradation test by termite: Laboratory cultured subteranean termite (*Coptotermes formosanus* Shiraki) was used for degradation test of wood chips and board samples.[3] Wood chips (10g) and board samples (20mm x 50mm x 8mm) were placed in the laboratory colony termite. Mass loss of samples was determined after one month from initial attacking.

3. Results and discussion

During the decomposition of garbage, wood chips were partially degraded by mechanical mixing and by microorganisms into fine pulp. The average size of wood chips is 13.2mm in fiber direction, 17.1mm in width and 2.8mm in thickness before use. These values changed to 9.8mm, 6.7mm and 2.0mm respectively after use. The size reduced 60% in width and 25-30% in length and thickness. Therefore particleboard from untreated wood chips was consisted from larger element.

Fig. 1 shows the result of bending strength of particleboards. There was no clear difference between the boards from untreated wood chips and from used wood chips. Wood chips did not weaken in their strength during the garbage decomposition.

Fig. 2 shows the result of 24 hours water soak test.

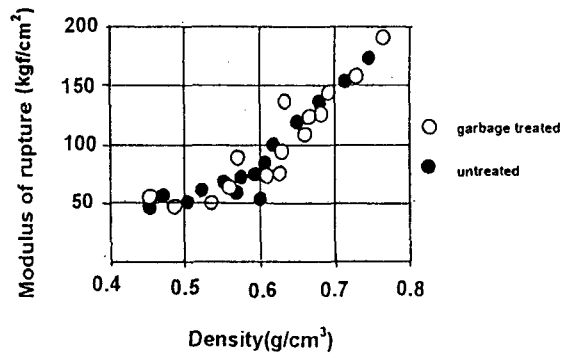

Fig. 1 Relationship between board density and modulus of rupture.

Thickness swelling of the board from used chips was smaller than the board from untreated chips. During the garbage decomposition wood chips were subjected to high moisture and temperature at 50-60℃. It is well known that steaming at high temperature is effective to improve the dimension

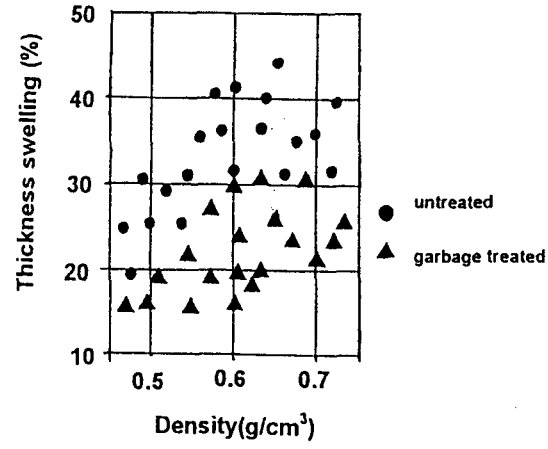

Fig. 2 Results of 24-hr water soak test.

stability of pressed woody materials.[4)5)6)] In the garbage decomposer, wood chips are treated for a long time so the effect for fixing compressed deformation of wood is enough even at low temperature. This steaming effect at low temperature also affect the compressibility of wood chips during the hotpressing. The board mat from treated chips was easily pressed to the target thickness during the

hotpressing while the mat from untreated chip was difficult to press to the target thickness.

Table 1 shows the formaldehyde emission from the boards. The board from treated chips showed lower formaldehyde. During garbage decomposition amino acids and protein were formed from garbage. Wood

Table 1 Nitrogen content of chips and formaldehyde emission from boards.

Raw material	N content (%)	Board density (g/cm³)	Formaldehyde (mg/l)
Untreated	0.0 (0.0)*	0.61	2.2
Garbage treated	0.1 (0.9)*	0.62	0.7

* Chip surface

chip from garbage decomposer contained nitrogen while untreated chip did not. Amino acids and protein are well known as formaldehyde catchers.[7] The presence of these compounds on the chip surface might reduce the emission of formaldehyde.

Fig. 3 shows the changes of moisture content of wood chips and boards in high humidity atmosphere followed by low one.The board and chip from

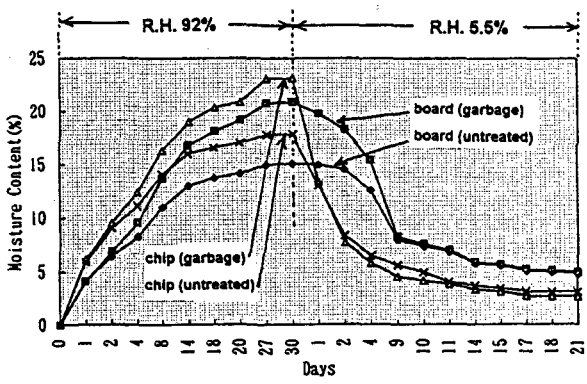

Fig.3 Changes of moisture content of chips and boards.

garbage decomposer more rapidly absorbed and desorped moisture than the control chip and board. But this difference was not observed after the treated chip was extracted with methanol. The main component of methanol extract was trehalose, 0.4% on dry chips. Other than trehalose inorganic salts were also included in the chips from garbage decomposer. Ash content of treated chip was 7.0% while 0.3% in control chip. Those materials may act an important role in absorption and desorption of moisture.

Fig. 4, 5 and table2 show the results of degradation test of chips and boards by termite. Chips and boards from garbage decomposer were attacked by termite rapidly. There might be certain substance in the treated chips that attract termite, but even after alcohol-benzene extraction followed by hot water extraction,

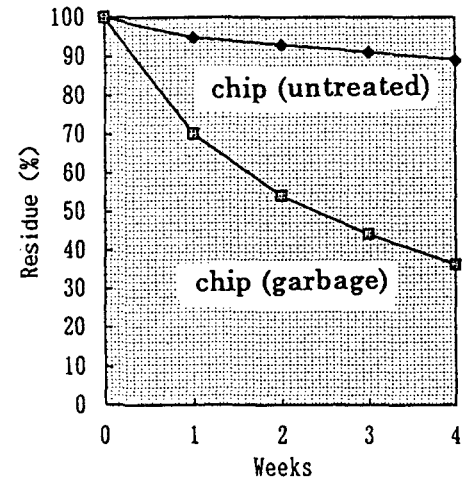

Fig. 4 Mass loss of chips by termite.

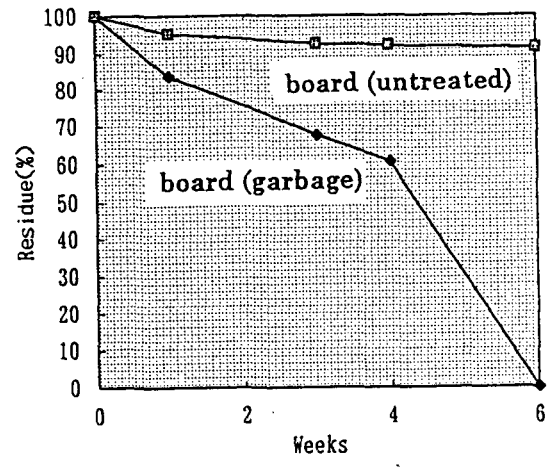

Fig. 5 Mass loss of boards by termite.

Table2 Residual rate of samples after 2 weeks termite test (%)

Wood meal* (untreated)	99.4
Wood meal* (garbage)	11.1
High density board** (garbage)	86.5

* Extracted with benzene-ehtanol followed by hot water

** 0.8 g/cm^3

wood meal from treated chips, prepared to the same size of control wood meal, were attacked more rapidly than control. This fact indicates the rapid termite attack of treated chips due to the softness of chips rather than special chemical components.

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