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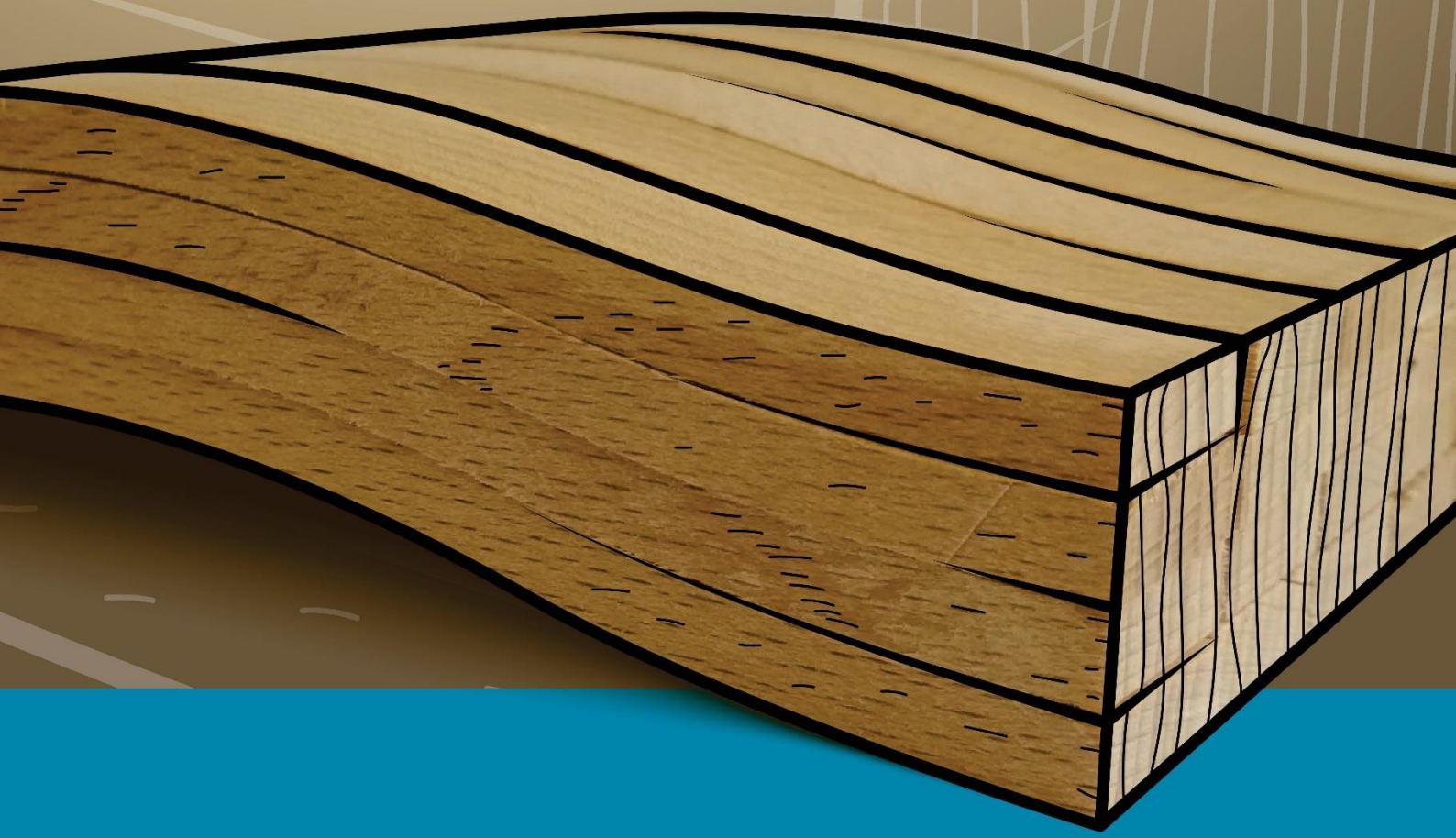

WOOD KPLUS

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10TH HARDWOOD CONFERENCE PROCEEDINGS

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Enhancing the internal bonding after boiling for particleboard made of recycled furniture

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ABSTRACT

Wood is renewable resource that play a major role in wood and wood based products, and energy production. In recent years, interest growth in application of recycled wood since it has a direct impact on carbon footprint. The carbon dioxide released in the atmosphere in wood combustion is the same absorbed by the tree during growth; the released CO_2 is collected again within a neutral carbon cycle. As a result, it does not contribute to global warming, However, recycled materials like the production and particleboard keeps the absorbed carbon continuously inside the wood products for a long period (Kim and Song, 2014). The aim of this research work is to increase the internal bonding (IB) of particleboard after boiling. A series of experiments were conducted, in order to optimize the recipe for the production of recycled wood-based particleboard. For this a low formaldehyde emission, water and cooking resistant glue would be the perfect solution. The particleboard must fulfil the standard (EN 1087-1:1996). The most critical tests are internal bonding after boiling and formaldehyde emission. Pallet blocks need an adhesive that can withstand 2 hours of boiling and then 1 hour of soaking in 20 °C water. Thereafter, they should still be able to provide 0.25 MPa of tensile strength when wet. Based on previous knowledge, phenol and melamine formaldehyde adhesives may fulfil these requirements. Phenol formaldehyde with 41.5 % dry matter content, melamine formaldehyde with 65 % of dry matter content recycled (hammer milled) melamine-faced particleboard, hardener were used to produce boards with dimension of (300 x 300 x 25) mm. Different pressing force and time were used with different amount of adhesive and hardener. As a result, it was found that melamine formaldehyde is suitable to increase the IB, using 14 % of melamine formaldehyde increased the IB to 0.26 MPa with density of 0.655 g/cm^3. In other hand, phenol-formaldehyde was not good.

INTRODUCTION

The insufficiency of the supply of wood is one of the main problems impeding the development of particleboard industry. This issue was occurred because of the growing demands on wood from many branches of the wood processing industry, as well as the energy sector that utilises the wood as biomass, based on the EU recommendation concerning the energy from renewable sources. Good lumber management could involve its reduced consumption in the production of wood composites, through the manufacturing of wood composites with a decreased density, which compared to the density of the standard boards in the respective groups of materials. Furniture manufacturer shown big interest in decreasing the particleboard density. Many factors could be the reason of such decision that could be related to not only ecological reason but also other important considerations that involve economic factors, like decreasing the transportation and installation cost, and ergonomic factors, i.e., easier assembly or improved functionality (Dziurka et.al 2015).

Recent year's production of sustainable material gowns more and more, material recycling of wood waste involved the manufacturing of particleboard or MDF (medium density fibreboard). These methods have the advantage of repeated recycling under separate collection. Industrial wood residues such as shavings,

sawdust, plywood trim, fine particles, chips, or urban wood waste chips are the main materials used in particleboard production. It is mostly used in industries as a replacement material for making household or office furniture, kitchen and bath cabinets, store fixtures, door components and, to a small degree, in flooring (Kim and Song, 2014).
The formaldehyde emission from furniture made of thermosetting resins like melamine resin is famous. Formaldehyde emission from plastic was the main concern of many countries, which lead them to set different regulation and requirements. Among the various resins, melamine resins was used in many useful products. For example, in coating technology, it was used to modify the adhesion properties of other materials they also may be included as curing elements for other resin (Devallencourt et al. 1995). The aim of this research work is to increase internal bond of particleboard after boiling in water and decrease its formaldehyde emission.

EXPERIMENTAL METHODS

Phenol formaldehyde with 48.9 % dry matter content, melamine formaldehyde with dry matter of 65 %, recycled (hammer milled) melamine-faced particleboard, hardener were used to produce boards with dimension of (30x30x2.5) cm. Settings are represented in the Table 1.

Figure 1: Seimpelkamp press

Table 1: Board recipe

Board ID	Adhesive Amount (%)	Hardener Amount (%)	Pressing temperature (°C)	Pressing time (s)
Ph-10-130-8[a]	10	0	130	8
Ph-10-145-8	10	0	145	8
Ph-10-189-8	10	0	189	8
Ph-8-130-8	10	0	130	8
Ph-12-130-8	12	0	130	8
Ph-8-130-8	8	0	130	8
m-10-180[b]	10	3	180	8
m-12-180	12	3	180	8
m-12-145	12	3	145	8
m-10-145	10	3	145	8
m-10-100	12	3	100	8
m-14-100	14	3	100	8
m-14-100	14	2	100	8

[a]*Phenol formaldehyde,* [b] *melamine formaldehyde.*

Different resin and hardener amount were used with different pressing temperature in order to find the best and cheapest way to increase the water resistance of the particleboard. During particleboard's production with phenol formaldehyde, wood particles stick together that made matt forming very hard. On the contrary, of melamine formaldehyde was very easy.

RESULTS AND DISCUSSION

According to test results, Phenolformaldehyde resin is not suitable for production of water resistance wood particleboard since all board were over cooked and fall apart while boiling after only 15 min, while standard requires 2 hours of boiling, than put in cold water after that make the internal bond test, which has to be equal or more than 0.25 Mpa. In other hand the density of the board was good. Even with the change of resin amount and pressing temperature no good results was achieved See Table 2.

Table 2: Density, boiling test and formaldehyde emission test results.

Board ID	Density (g/cm^3)	Boiling test	Formaldehyde emission
Ph-10-130-8[a]	0.685	Over cooked	Higher than standard
Ph-10-145-8	0.625	Over cooked	Higher than standard
Ph-10-189-8	0.652	Over cooked	Higher than standard
Ph-8-130-8	0.676	Over cooked	Higher than standard
Ph-12-130-8	0.620	Over cooked	Higher than standard
Ph-8-130-8	0.672	Over cooked	Higher than standard
m-10-180[b]	0.689	0.08	Higher than standard
m-12-180	0.700	0.10	Higher than standard
m-12-145	0.709	Over cooked	Higher than standard
m-10-145	0.693	Over cooked	Higher than standard
m-12-100	0.611	Over cooked	Higher than standard
m-14-100	0.655	0.26	Full-fill the standard
m-14-100	0.790	0.25	Full-fill the standard

[a]*Phenol formaldehyde,* [b] *melamine formaldehyde.*

On the other hand, melamineformaldehyde resin found to be suitable for production of water resistance particleboard with the use of certain parameters. Particleboard with 10 % and 12 % of resin, 3 % of hardener and temperature of 145 °C were over cooked. However with increase of pressing temperature to 180 °C specimens passed the bioling test but the internal bond was lower than the requirement with 0.08 Mpa and 0.10 Mpa. By using 14 % of melamine formeldehyde resin, 2 % and 3 % of hardener and pressing temperature of 100 °C, particle board fullfill the requirement with 0.25 Mpa and 0.26 Mpa of internal bond and low formaldehyde emission. For density for all board density was good however for board m-14-100 density was little higher than the standard with density of 0.790 g/cm^3.

CONCLUSIONS

Even with using different amount of adhesive the phenol formaldehyde resin particleboards could not pass the boiling test most of boards disintegrated after boiling in hot water. Since high amount of adhesive will increase the formaldehyde emission and low amount of adhesive could be not enough for the mechanical properties, 10 % of adhesive was used with pressing time 8 min. However, different pressing temperature were used (130, 145, 180 and 189 °C). As result, all produced board could not pass the boiling test most of boards disintegrated after only 25 min of boiling. However, the density was good for all boards.
Melamine formaldehyde proved to be suitable resin for production of water resistance particleboard with the use of exact parameters like using 14 % of resin, 3 % of hardener and 100 °C of pressing temperature. Not only achieve good internal bond after boiling in hot water but low formaldehyde emission. Which made it eco-friendly product.

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