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# MAKING SILL TABLE WITH THE MATERIAL OF WOOD WASTE AND RESIN

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**ABSTRACT** – The activity of workshop practicum construction materials-based, Construction Engineering of Civil Engineering Education Department's Workshop, produces wastes such as woods pieces, sawdust, galvanized pipe pieces/PVC that are still not able to utilized maximally. Every semester, yield of the practicum activity becomes waste. The research making table from wood waste and resin is one of solution and innovation to utilize the waste to become having more economic values. In the previous study, with physical and mechanical test, it could be found that the tighter the assembly of wood waste, the stronger its capability to hold its tensile force. This research used qualitative method. From the supervising of the steps of making sill table from the material of wood waste and resin, there is one type of sill table which was implemented in this research, it is split the wood waste into elongated. This research was done by three times trials with different kinds formula of resin and catalyst. The result of this research is the steps and formula of the volume comparison of resin and catalyst to make sill table from waste and resin that could be a learning guidance for woods construction practice subject and interior finishing practice subject in Construction Engineering Education Study Program and giving solution as a form of responsibility for waste handling.

**Keywords:** Wood waste, table, physical and mechanical test, economic values, resin.

## 1. Introduction

The needs of woods to fulfill the needs of human being becomes more increasing time by time, meanwhile the availability of nature resource that produces woods becomes more decreasing. Hence, there needs an effective and efficient handling in the woods-using.

The activity of workshop practicum construction materials-based, Construction Engineering of Civil Engineering Education Department's Workshop, produces wastes such as woods pieces, sawdust, galvanized pipe pieces/PVC that are still not able to utilized maximally. Every semester, yield of the practicum activity becomes waste. Applications that have gained increasing focus are recycling into other wood based panels (e.g. oriented strand board, OSB, and medium density fibreboard MDF), wood composites (e.g. wood-cement and wood-plastic composites) and bio based chemical, albeit the development of these option is some what limited, due to technical barriers arising from low quality wood waste (Czarnecki et al., 2005; Ircow, 2014; winder and Bobar, 2016)

The wood waste was separated manually into 34 fractions and analysed with aim to different material classes (Off-cuts, Packaging, constuction and demolition, furniture and misplacements), quality grade (I to IV) as well as content of physical and chemical impurities (Giorgia Faranca et al, 2019). As the composition and level of contamination affect recycling options, detailed information

about wood waste composition is required (vis et al, 2016). In nowadays era, waste becomes one of the environment problems that must be found the alternative solution to solve. Wood waste represent an important source for secondary raw materials. The wide variety of different wood types, applications and sources makes a very heterogeneous material from a recycling perspective (Bergeron, 2014).

Particle is defined as particle board aggregate components that becomes an important part from wood or another berlignocellulose components, including all the small parts of wood (Maloney, 1977). Particle tightness is one of physical characteristic that impact towards another physical and mechanical characteristic. Particle board must have certain characteristics for needs of planning in last use or as quality determination in accordance with the desire of user, especially those related to the power or mechanical characteristics. Herry's research (2001) mentioned that the obtained-particle board tightness value is vary that caused by composition which are contained in phenol formaldehyde resin are vary or also can caused by the adhesive is not spread equally when the resin is sprayed into the wood's blender is not optimal, this can impact particle board tightness value.

Hartomo (1992) distinguishes the types of synthetic resin according to their mechanical characteristic into three types, they are thermoplastic resin, thermoset resin, and blend resin. The types of thermoplastic resin are; polyamide, polime, vinyl/acrylic, cellulose derivative or nature composition, rosin, shellac, oleo resin, and mineral candle. Those resin can be softened when heated also got creep when subjected to voltage. This resin only used for non-structural light burdens. The result found that tightness value from each sample is different so that it can be concluded the tightness value of artificial woods with resin is higher than multiplex and borneo wood (Sultono et al, 2017).

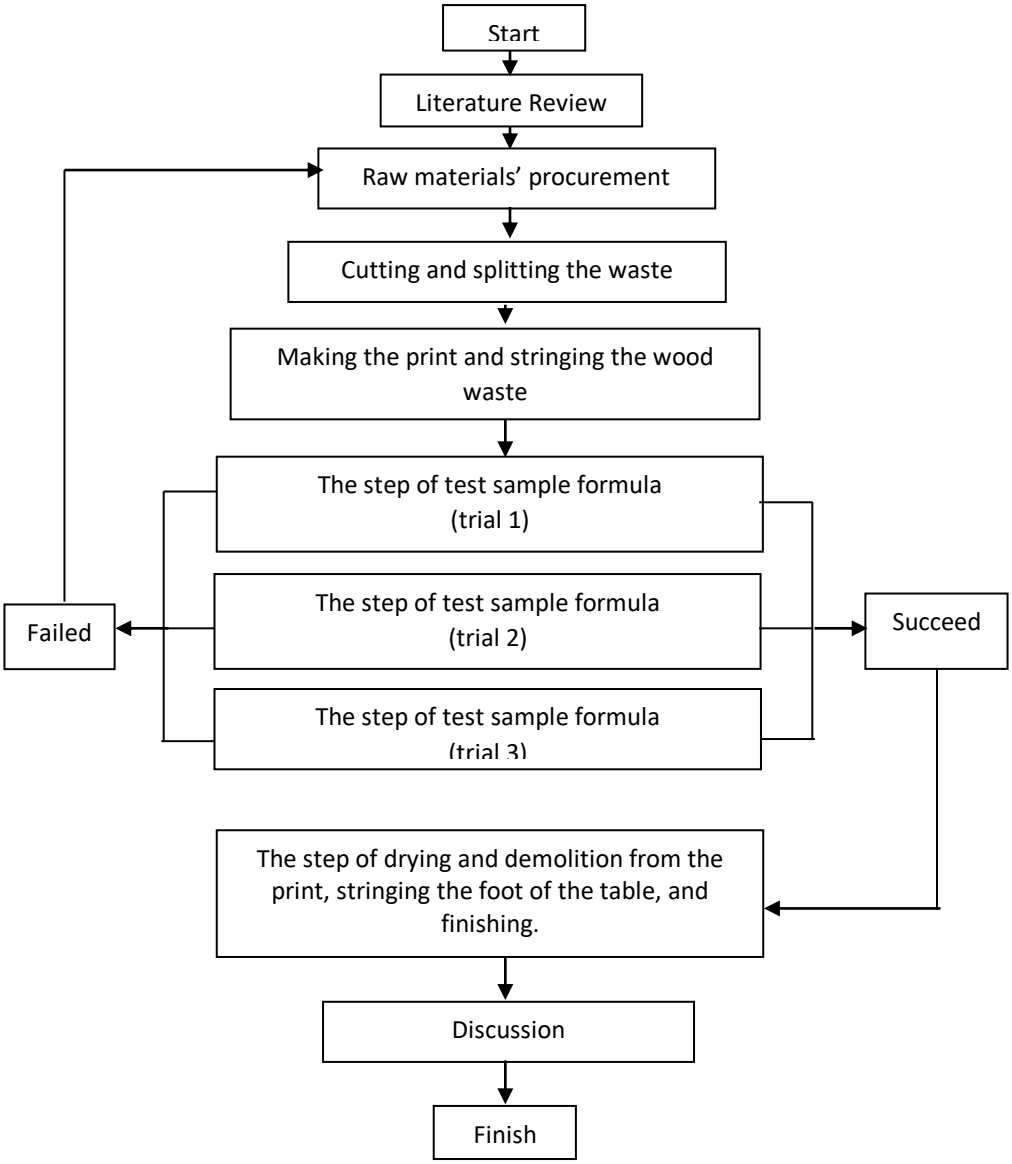
The research of making sill table from the material of wood waste with resin adhesive is one of innovation and solution to benefit the waste so that it can have an economic value. The innovation is to utilize the waste as combination materials to make table, cupboard, chair, and etc. Before using it as the combination material, there needs to conduct a compressive and tensile strength testing to figure out the expediency from the result of this research. After conducting mechanical characteristic and physical characteristic test, the following step is making the stuff in order take advantage from the product as material for buildings or furniture.

## 2. Research Method

This research method used observation technique and experiments-making of few sample research, they were sill table, and then being compared to resin formula and catalyst on the application of sill table-making. There were tools and materials used in this research. The materials needed in conducting this research are: Borneo woods (waste), resin and catalyst, resin stain, waxes, film polyester, wood stain, 5mm plywood, nails, wood's adhesive, sandpaper, welding electrodes, iron paint.

Tools needed in conducting this research are: cut saw machine, surface planer machine, thickness planer, measuring cup, roll meter, wood clamps, sanding machine, SMAW weld, another supporting gluing such as gloves, mixer, adhesive, transparent plastic, and etc.

The research implementation procedures that had conducted in outline were described on the chart as follow.




Picture 1. Research Flowchart

## 3. Result and Discussion

The result from artificial mechanical board existed values that showed the comparison between artificial board (waste and resin), fabrication artificial board (multiplex), natural wood board (borneo) could be depicted in the table below.

Table 1. Tensile Test

| Name of Sample | S1a | S1b | S2a | S2b | S3a | S3b | S4a | S4b | S5a | S5b |
|---|---|---|---|---|---|---|---|---|---|---|
| Tensile Strength, kg/mm$^2$ | 0.029 | 0.175 | 0.074 | 0.041 | 0.078 | 0.466 | 173.1 | 1.246 | 0.662 | 4.671 |
| Yield Strength, kg/mm$^2$ | 0.02 | 0.12 | 0.051 | 0.028 | 0.054 | 0.321 | 119.43 | 0.859 | 0.456 | 3.22 |

The tensile test table shows resin artificial board and wood waste were being split with size of wood's thickness is 7 mm, the resin's thickness is 6 mm, the board's total thickness is 13,2 mm and the distance between waste is 10 mm, the tensile strength value is 0,029 kg/mm$^2$ and 0,175

kg/mm$^2$, resin artificial board and wood waste were being split with size of the wood thickness is 11 mm, the resin thickness is 3 mm, the total of board thickness is 14,3 mm and the distance between waste is 15 mm, the tensile strength value is 0,074 kg/mm$^2$ and 0,041 kg/mm$^2$, resin artificial board and wood waste were being split with the size of wood's thickness is 10 mm, the thickness of resin is 8 mm, the total of board thickness is 18 mm and the distance between waste is 2 mm, the tensile strength value is 0,078 kg/mm$^2$ and 0,466 kg/mm$^2$, fabrication artificial board (multiplex) with the thickness sized 15 mm and the wide is 17 mm, the result of tensile strength is 173,1 kg/mm$^2$ and 1,246 kg/mm$^2$, borneo wood board with 17 mm thickness and the wide is 20 mm, the tensile strength value is 0,662 kg/mm$^2$ and 4,671kg/mm$^2$. The result of tensile test from each of samples has difference so that it can be seen that artificial wood's tensile test value using resin has got lower value compared to borneo wood and multiplex, the solution to solve it is by tighting up the distance between waste. below are pictures of last result of the resin artificial board and wood waste.

Picture 2. The last result of wood waste artificial board and resin.

## The steps to make table from wood waste with resin

Here are the steps to make table with wood waste and resin from the observation result and application on the field. In this discussion will be described some steps in making sill table (trial 1, 2, and 3) and then make the table legs.

## Procurement of raw materials

The first step is collecting wood wastes. The wood wastes and resin were obtained from practicum result with the average long size is 30-50 cm and the average dimension size is 4x6 cm. The woods are waste of wood work practice subject's practicum that is held on odd semester every year.

Picture 3. Wood work practicum's waste.

## Cutting and splitting the waste

After the waste materials collected, in this step is conducted the cutting and splitting with the thickness size is 2 cm using cut and split machine.

Picture 4. The process of cutting and splitting woods.

Picture 5. The split waste.

## Making print and arranging the wood waste

The third step consists of two activities. They are making the print for sill table measuring 91 cm length, 60 cm width, 3,5 cm thickness, and arranging the wood pieces that have been cut in the previous step.

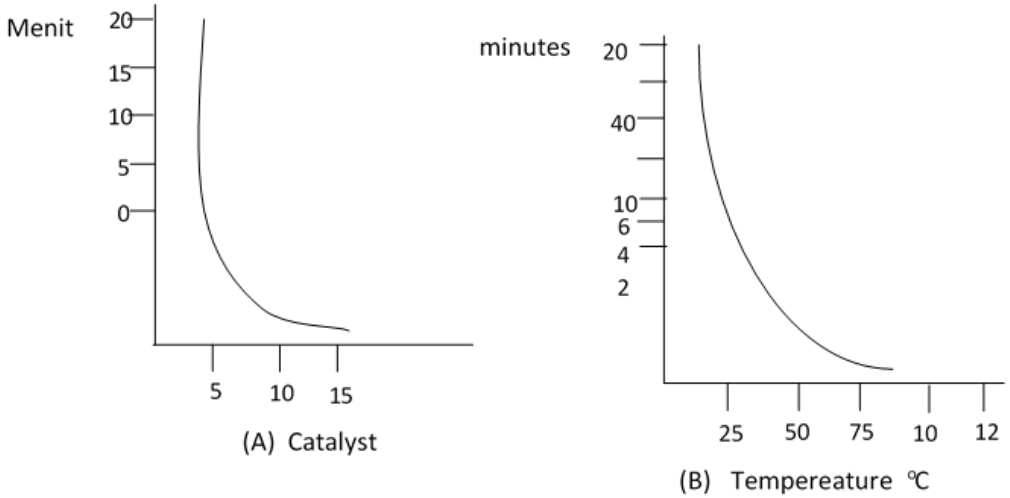
Picture 6. Making Sill Table Print.

Picture 7. Arranging the woods with glued and clamped

Picture 8. The result of finished arrangement.

## The steps of making test sample formula (trial 1, 2, and 3)

The process and reaction hardening during gluing with the help of heating or catalyst component. The catalyst component or hardener can be types of acid, paraformaldehyde, salts, amonium or another chemical component. Additional components are needed to reduce costs or increasing the adhesive characteristic (e.g. the consistency), the additional components can be extender or filler. Some factors that impact adhesive hardening can be seen on picture 9 (Tsoumis, 1991) that is the impact of adhesive hardening towards (A) catalyst and (B) temperature




Picture 9. The impact of adhesive hardening towards (A) Catalyst and (B) Temperature

The fourth step is mixing the resin and catalyst with different comparisons, to get the right formula. Each trial spent 12 liters epoxy casting clear resin.

Table 2. Trial 1 with comparison 1 liter (1000 ml) resin: 35 ml catalyst.

| Sill table dimension | The thickness between resin and wood | Dry time | Result | Information |
|---|---|---|---|---|
| Length= 91 cm x Width= 60 cm x Thickness= 3,5 cm | (3,5 – 2)/2 = 0,75 cm | 1 hour | The result was failed, so many cracks in fast time. | Formula comparison and dimension in trial 1 is not recommended. |

Picture 9. The result of trial 1

Table 3. Trial 2 with comparison 1 liter (1000 ml) resin: 17 ml catalyst.

| Sill table dimension | The thickness between resin and wood | Dry time | Result | Information |
|---|---|---|---|---|
| Length= 91 cm x Width= 60 cm x Thickness= 3,5 cm | (3,5 – 2)/2 = 0,75 cm | 3 hours | The result was failed, there were fewer cracks and longer time than trial 1. | Formula comparison and dimension in trial 2 is not recommended. |

Picture 10. The result of trial 2.

Table 4. Trial 3 with comparison 1 liter (1000ml) resin: 7 ml catalyst.

| Sill table dimension | The thickness between resin and wood | Dry time | Result | Information |
|---|---|---|---|---|
| Length= 91 cm x lebar = 60 cm x tebal = 3,5 cm | (3,5 – 2)/2 = 0,75 cm | 5 hours | Succeed without any crack. | Formula comparison and dimension in trial 3 can be used as a guide to make sill table with wood waste and resin. |

## The steps of drying and demolition from the print and then string it with the table legs and finishing

The last step is separating between the print media with the dried board, and then make the table legs made from hollow iron with the SMAW welding joint system. After the table legs is ready, followed by assembling the sill table and the table legs.

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Picture 11. The result of trial 3 which has been assembled with the table legs.

## 4. Conclusion

Wood waste with resin artificial board is influenced by the resin and catalyst comparison. The tensile and yield strength of wood waste with resin artificial board is smaller compared to factory-made board (multiplex) and natural wood (borneo). The tensile and yield strength is stronger when the distance between waste is closer.

The formula comparison between resin and catalyst with 91 cm length dimension, 60 cm width, and 3,5 cm thickness is 1000 ml resin proportionate 7 ml catalyst, can be made as guidance to make sill table from waste wood and resin adhesive materials. To get maximum tensile strength of a series of wood waste which is going to be arranged, gluing and clamping needs to be done within a tight distance without eliminating its artistic value.

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