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Preliminary Production of Material Compound from Sago Waste

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Abstract

Sago palm or its scientific name, Metroxylon sago Rottb is commonly found in tropical low forests and processed into sago flour. Processing of sago flour will produce sago waste (SW).This excess waste has been found to cause ecosystem imbalance. The research looks into the preliminary process of recycling the sago waste into a new material compound that can be used by any modeler as a substitute in the production of any products that are compatible with the material. The process goes through the filtering stage, drying stage and molding stage using only natural resources as the main ingredients with different level of contents tested. The compound is also tested for its durability as a

modeler material. The research shares the results from the process, the end product that can be used for model making and a sample of a product that is produced from the material compound.
Keywords: Sago waste (SW), Ecosystem, Binding, Dried Sago Waste (DSW)

Introduction

Malaysia has the largest amount of sago cultivation with its cultivated area covers 200,000 hectares. The largest sago cultivation area is located in Sarawak. Most sago plants are planted around Dalat, Pusa and Mukah. The sago planting area is 111,383 hectares planted by smallholders while 24,531 hectares are planted by the estate (Abner and Balitka, 1999). 75% of sago cultivation is recorded in Mukah and 50% sago flour is produced from the cultivation. According to a mill producer in Mukah, at present 2000 to 3000 logs of sago trees are processed daily which accumulates to 100 tonnes of waste daily for one mill. Previously, sago waste was dumped into the river Mukah and without strict regulation from the authority, the chances of sago waste being dumped into river was high. At present, the sago waste is still being dumped into the river (interviewed with the Mukah sago mill owners in 2017). Many research have been conducted related to sago waste, such as Bujang (2014) using sago as food and fuel alternative, Zainab (2012) in using sago as sound absorbing panels and Awg-Adeni et al., (2012) on sago for bioethanol production. However, there is yet any research that look into transforming sago waste into substitute materials that are currently used to model making products such as car model and anything similar. Therefore this research looks into conducting a process of transforming sago waste into material compound that can be used for model making products.

Material and Method

Material

Dried sago waste fiber

Sago waste was obtained from Herdsen Sago Mill,Pusa, Sarawak. Sago wastes are produce at the end of the process of sago flour production. The wet waste are filtered and squeezed to separate water from sago waste. This water and drained sago waste fiber (SWF) have their own benefits. After that the fiber are treated with cinnamon powder for curing or treatment as recommended by Retno (2016) in the curing and treatment method. The treated sago waste are dried in the oven at 120^{o}C for 24 hours to prevent bacterial growth in the fiber. Additionally, drained wastes are easier to blend into powder. 58% of the starch content is still present in the drained sago waste although it has been dried and this conform the findings by Awg-Adeni (2012) in his research on sago waste for bioethanol production.

Binding

Three types of binders are used for the production of compound materials. The binders are mixed with dried sago waste separately. Three types of starch used were sago flour, commercial starch flour and corn flour (Table 1). These three different starch can be combined with dried sago waste fiber and the suitability of each starch are assessed separately.

No	Starch	Mixtures of binder
1	Sago Flour	1liter LSW + 250g sago flour + 500ml plain water
2	Commercial Starch Flour	1liter LSW + 250g commercial starch flour + 500ml plain water
3	Corn Flour	1liter LSW + 250g corn flour + 500ml plain water

Table 1: three different mixtures of binder

Method

Modification of SWF and LSW

The first process was done by separating wet sago waste into sago waste fiber (SWF) and liquid sago waste (LSW). This process uses a filter to extract sago waste (SW). One kilogram of wet sago is able to produce 850g of wet SWF and 1.5 liters of LSW. Both SWF and LSW must be separated because they have their own function in the process of making material compound. After the separation process of SWF and LSW was done, SWF will undergo a drying process to preventing bacterial reproduction on SWF and ensure that the product can be stored for a long time. Heating is done in an oven at 120^{O}C for 24 hours. The starch content found in dried sago waste (DSW) fiber is 58%. After drying, the waste are blended using kitchen grinder to produce sago powder (SP) of 1mm screen. 1.5 litres of LSW mixed with 10g of starch flour and 500ml of water are needed to produce a strong material compound. The mixture are heated at 100^{o}c for 5 minutes and used as a binder. After heating for 5 minutes, the solution is cool for 15 minutes. After that, the mixture is filtered to obtain concentrated sago starch. The end product produced 1.2 liters of binder.

Sample production process

Sago waste block process is done by mixing 700g SP and 1.2 liter binder. The mixture is mixed homogeneously and placed in a mold of 210mm x 297mm and compressed for one day. The purpose of compression is to ensure that the blocks are uniformed. After compression the block are dried in an oven at 60^{o}c for 6 hours. The final product is shown in figure 1. Figure 2 shows production process of material compound (210mm x 297mm).

Fig. 1: sample of material compound produce

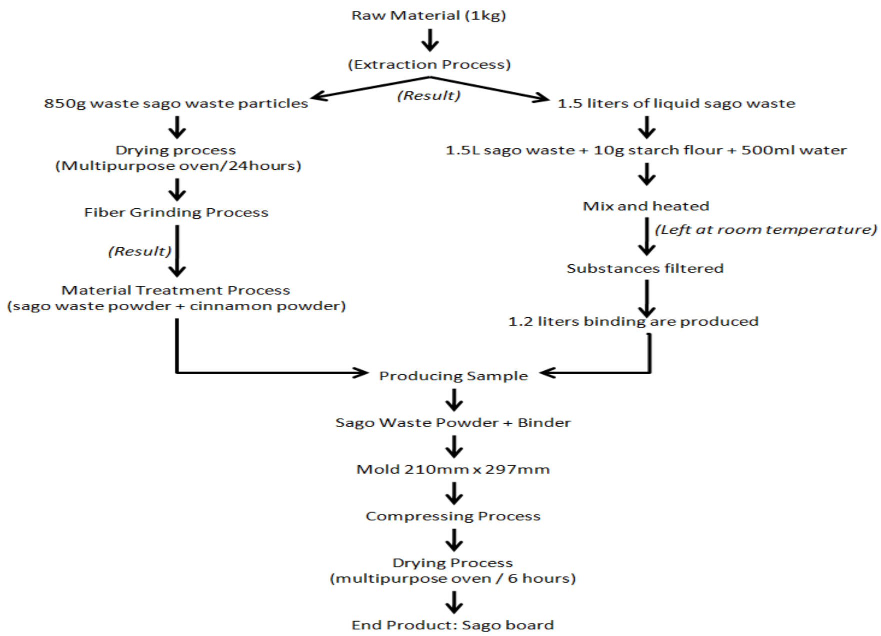

Fig. 2: *production process of material compound (210mm x 297mm)*

Result and Discussion

Sample Analysis

The samples are tested for its strength at Faculty of Engineering, Unimas using Shimadzu universal testing machine. Tables 3 shows the result of final sago block. Each sample has different mixture of binders and with different weight. The different binders affect the strength of the material. The analysis show that sample Number 2 yielded the highest ultimate force. The mixture of samples Number 2 are 500g SP with 250g starch flour and 500ml water as binder. The weight for sample Number 2 is 34.2 and is heavy compared to other samples because the content of sample Number 2 is uniformed and homogenous which make it resistant to cracking or breaking. Nevertheless, the samples can be easily carved, cut and polished by sandpaper. Figure 3 shows the stress (y-axis) versus strain (x-axis) for all samples result conducted. With the new material compound, the sample is cut, carved and polished into a 1.5 scale car model. Figure 4 shows the material compound being turned into a 1.5 scale car model. The car model took 10 pieces of material compound sized A1 x 10mm and a few modeler to produce. The 10 pieces of material compound is equivalent to 40kg of sago waste.

No	Sample		Result
1		Material : 500g sago waste (powder) + 250g sago starch + 500ml plain water weight:26.0g	Force @ Peak (N): 8.870 Youngs Modulus (N/mm²): 12.363 Elong. @ Break (mm): 1.642 Strain @ Yield (%):0.603 Stress @ Yield (N/mm²):0.090 Stress @ Peak (N/mm²):0.212 Strain @ Peak (%):2.020
2.		Material : 500g sago waste (waste) + 250g starch flour + 500ml plain water. weight:34.2g	Force @ Peak (N): 12.240 Youngs Modulus (N/mm²): 11.915 Elong. @ Break (mm): 2.027 Strain @ Yield (%):0.953 Stress @ Yield (N/mm²):0.130 Stress @ Peak (N/mm²):0.293 Strain @ Peak (%):3.247
3.		Material : 500g sago waste (fiber) + 250g sago flour + 500ml plain water weight: 23.2g	Force @ Peak (N): 8.550 Youngs Modulus (N/mm²): 10.331 Elong. @ Break (mm): 1.048 Strain @ Yield (%):0.667 Stress @ Yield (N/mm²):0.087 Stress @ Peak (N/mm²):0.205 Strain @ Peak (%):2.263
4.		Material : 500g sago waste (fiber) + 250g starch flour + 500ml plain water weight:18.50g	Force @ Peak (N): 4.090 Youngs Modulus (N/mm²): 0.693 Elong. @ Break (mm): 3.356 Strain @ Yield (%):1.563 Stress @ Yield (N/mm²):0.021 Stress @ Peak (N/mm²):0.098 Strain @ Peak (%):10.423

Table 3: **stress tests**

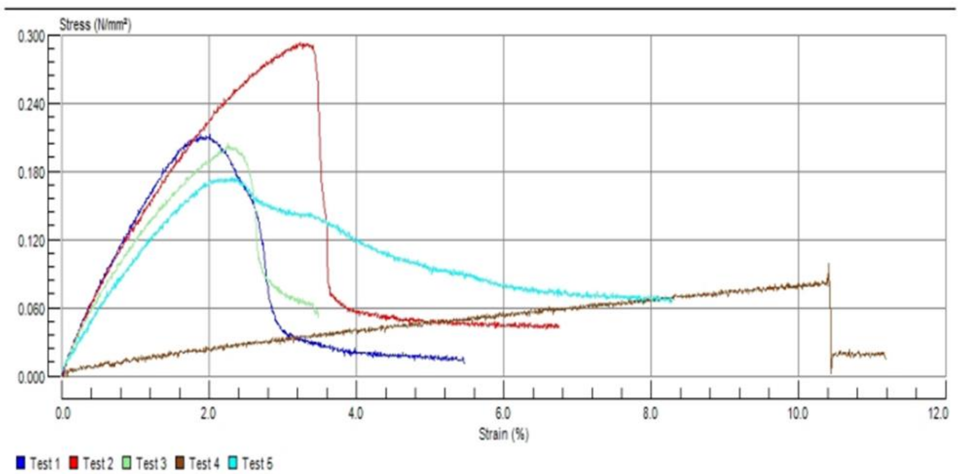

Fig. 3: the stress (y-axis) versus strain (x-axis) for all samples.

Conclusion

Through a study on the physical properties of sago waste, it can be concluded that sago waste has the potential to be used as a compound material for model design purposes and any products that are compatible with the material. Through the filtering stage, drying stage and the molding stage, it can be concluded that the best sample that has the similar property to modelling material is the sample Number 2. Apart from using starch flour and water to bind the sago powder, the sample Number 2 is also able to resist break and crack. This result conformed to the requirement for modelers to produce a model whereby material used should be easily carved, cut and polished by sandpaper. Figure 4 shows how the material compound is transformed into an actual product (1.5 scale car model) that requires carving, cutting and polishing similar to the existing products available in the market such as the green foam and gray foam that are hazardous to health and modelling clay which is very expensive to purchase. With the new finding, there is no longer a need for sago mill owners to dump sago waste into the river and these waste can be transformed into a useful material compound that is not only save the environment but also cheap to produce.

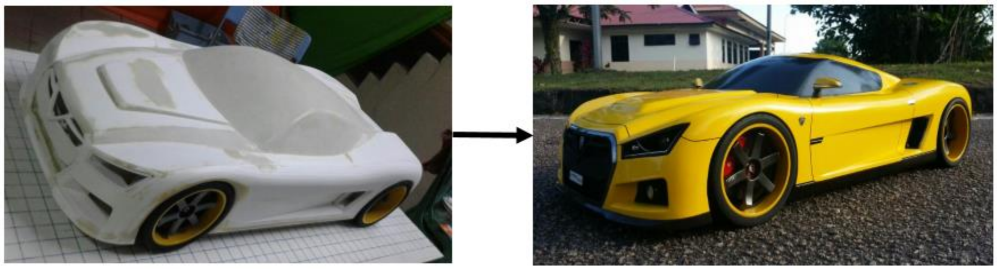

Fig. 4: the material compound can be carved and molded into one sample of model making end products (1.5 scale car model)

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