APPLICATION OF COFFEE SKIN-BASED GREEN PACKAGING

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Abstract

The concept of "Green" is evolving with new innovations and techniques to protect environmental sustainability, embodied by corporate social responsibility, green manufacturing, waste reduction, recycling and manufacturing of sustainable supply chains and environmentally friendly supply chains. To reduce the use of plastic packaging, the industrial world is turning to green packaging. The eco-friendly packaging that was the subject of the study was a cellulose-based polymer made from cellulose, a major component in plant tissue. Coffee pulp has a high hydrated cellulose microfibrils with a unique morphology using certain chemical treatments. The content of this cellulose can be used as environmentally friendly packaging paper that will be used as packaging of processed coffee products. The method used in this study is by chemical means to remove the lignin content on the coffee skin as well as mechanical methods in the manufacturing process. In this study conducted four (4) experimental scenarios to produce a strong coffee skin packaging and have smooth fiber. From the experiment it was obtained that the packaging with a coffee skin proportion of 33.33% and 66.67% used paper waste had the highest tensile strength with a maximum load that could be held 94.2183 N and a maximum length increase of 11.0262 mm due to finer and denser scrap paper waste fibers binding together to fill the gaps of used paper fibers that had hollowed out adhesive. This ratio also shows good resistance when made into coffee product packaging so that the packaging used becomes environmentally friendly by utilizing coffee waste itself, to produce pulp from coffee skin which is further used as raw material for making coffee packaging.

Keywords: Green Packaging, Coffee Skin, Recycled Paper, Tensile Test.

I. INTRODUCTION

The Concept of *Green Supply Chain Management* (GSCM) is offered as a solution to reduce environmental degradation and control air, water, and waste pollution through the adoption of environmentally friendly measures in business operations. According to [2] the definition of the concept *"Green"* is evolving with new innovations and techniques to protect environmental sustainability, embodied by corporate social responsibility, *green* manufacturing, waste reduction, recycling and manufacturing of sustainable supply chains and environmentally friendly supply chains. Seeing the importance of environmentally safe packaging in achieving GSCM, several factors are needed in the manufacture of packaging. Form factors, packaging weight, to ease of packaging recycled after use become important considerations leading to environmentally friendly packaging. These factors can also lead to significant cost savings throughout the supply chain process.

The basic material of existing product packaging is dominated by *nondegradable* plastic materials. About 99% of plastics are produced for petroleum-based *packaging.* According to research [5] there is more than 30% in the form of Low Density *Polyethylene* (LDPE)/*Linear Low Density Polyethylene* (LLDPE) and 20% in the form of High Density *Polyethylene* (HDPE). The three plastic materials that dominate are the main pollution problems, especially in marine and river areas. Plastic waste pollution is one of the important environmental problems to overcome, because the production of single-use plastic products continues to increase rapidly.

To reduce the use of plastic packaging, the industrial world is turning to green *packaging.* Eco-friendly packaging comes in several different forms including: recycled packaging, biopolymers derived from plants and others. Recycled packaging consists of various percentages of conventional plastic that is reused into other forms of packaging products. The idea is that all plastics are reused to make other new products and not directly thrown into waste disposal or use waste from production as raw materials for packaging. Biopolymers are made of plant material and can degrade in a relatively quick time in landfills. The most common form is corn starch-based starch, such as polylactic (PLA). [6] equips PLA ingredients made into products such as *biodegradable* food trays and disposable cups. In research [1] revealed about Polyhydroxyalkanoate (PHA) made using starch-based ingredients, usually from corn starch or sugarcane. PHA is commonly used as an application product including packaging, molding goods, paper coatings, non-woven fabrics, adhesives, films, and additives. Another eco-friendly packaging is a cellulose-based polymer made from cellulose, a major component in

plant tissue. In the [4] This type is commonly also called *Eco-composites* made from recycled agricultural waste and cellulose fibers leftover crops.

According to a press release Kemenperin.go.id [7], the coffee industry is currently being encouraged by the government as one of the leading industries with an average production of 700 thousand tons per year. Indonesia is one of the 4th largest coffee bean producing countries in the world after Brazil, Vietnam and Colombia. With such large production, 67% is exported abroad and 33% for domestic consumption. Interestingly, the change in the lifestyle of our society with the proliferation of *roastery,*cafes and coffee shops that are growing rapidly. According to Director General of Small, Medium, and Miscellaneous Industries (IKMA) Kemenperin Gati Wibawaningsih [8], the potential of small and medium-sized coffee industries (SMEs) processed coffee in the country is supported by 13 coffee production centers spread across various regions in Indonesia, including in Aceh, West Sumatra, Riau Islands, Jambi, Bengkulu, Lampung, Central Java, Bali, NTB, NTT, South Sulawesi, West Sulawesi, and Papua with a total of 476 business units. Especially in South Sulawesi, coffee centers are located in Kampong Kopi Bawakaraeng, Pallantikang Village, Pattallassang Subdistrict, Gowa Regency. The coffee industry in Indonesia is divided into 3, namely small-class coffee processed industry (Cottage industry), middle class coffee processing industry and large class coffee processing industry. This class difference also results in the existing coffee packaging is very varied. Starting from simple packaging using cover paper or simple plastic packaging to aluminum foil packaging. More research is needed to create environmentally friendly packaging to support the coffee industry in Indonesia.

Coffee waste in the form of coffee skin is a waste material for coffee processing that until now has not been utilized properly. In his research, El Achaby [3] found that coffee *pulp* has a high *hydrated cellulose microfibrils* with a unique morphology using certain chemical treatments. The content of this cellulose can be used as environmentally friendly packaging paper that will be used as packaging of processed coffee products. The utilization of coffee waste as raw materials for coffee packaging is part of the realization of Green *Supply Chain Management* (GSCM) which will increase the productivity of the coffee industry in Indonesia.

II. RESEARCH METHODS

A. Tools and Materials

The ingredients needed in the study include the skin of a ripe (red) coffee cherry that has been dried; NaOH; Glue; Salt; And water. The tools used in paper making are dryer ovens, blender machines, measuring glasses, stirring rods, digital scales, filter fabrics, *mesh*, pots, container, tensile machines, and digital microscopes. For Tensile Test used UTM Shimadzu Type 5kN.

B. Recycled paper from coffee skins

At first all the ingredients are weighed by following several experimental scenarios. There are four (4) experimental scenarios conducted in this study including (1) 100% coffee skin; (2) 50% coffee skin: 50% waste paper; (3) 66.67% coffee skin: 33.33% waste paper; (4) 33.33% coffee skin: 66.67% waste paper. As for the four (4) scenarios using several free variables, namely the wet weight of coffee skin after boiling; salt concentration; salt concentration; and the weight of water. The research method used in the experiment is by mechanical method, while the method to remove lignin content with chemical processes.

The steps of making paper from the skin of this coffee is starting by separating the coffee skin from the beans, then drying in the sun until it is completely dry. Once dry, the coffee skin is washed thoroughly and then boiled along with soda fire for 1 hour. This boiling is intended to eliminate the level of lignin in the coffee skin. After boiling, defecate the decoction earlier and the results of the decoction are washed with water until clean and not slippery. Mix the coffee skin, glue, and salt into one, then mash with a blender. The mixture is then put in clean water and stirred, then printed.

C. Recycling paper Tensile strength test

After 4 types of coffee skin comparison and paper waste into recycled paper, then the recycled paper is prepared for tensile testing following the ASTM D828 standard for Paper and Paperboard. Recycled paper is cut to a length and width of 254 mm x 25.4 mm and 1 mm thick. The distance between the clamps at the time of tensile testing is 180 mm long. The Testing Tool provides information in the form of the maximum load that can be held by the paper before breaking and the maximum length increase of the paper before breaking. From this data will be obtained a comparison between the strength of the paper and the ratio of materials used for the manufacture of recycled paper.

D. Making Green Packing for Coffee Products

Green packing or environmentally friendly packaging is done by taking recycled paper that has the highest tensile strength. The paper is bent in the shape of a cylinder and glued with glue. Before the glue is dry, the packaging will be temporarily held using insulation for 24 hours until limbering. To make the packaging more attractive, the product logo is added by using a sticky sticker glued to the packaging of the coffee product.

III. RESULTS AND DISCUSSIONS

Recycled papermaking using coffee leather and scrap paper waste has produced packaging paper as seen in figure 1. There are 4 types of paper produced according to the comparison of coffee skin and used paper. Visible color and surface tests of recycled paper made from coffee leather are influenced by the percentage of recycled paperused.

Figure 1. Recycled paper from coffee skin and scrap paper waste.

On Figure 2, it is seen a micro photo of recycled paper that has been made. It can be seen that recycled paper using 100% coffee skin has very coarse fiber and has a lot of voids and is spread across the entire surface of recycled paper. In recycled paper with a composition of 50% coffee skin and 50% of used paper waste obtained a relatively flat surface although void is still quite widely seen on some surfaces of recycled paper. At a ratio of 66.67% of coffee skin and 33.33% of used paper waste obtained surface results are fairly flat and void is reduced drastically even though there is a blackened surface because coffee skin fiber clumps in one particular area. For recycled paper with a ratio of 33.33% coffee skin and 66.67% waste used paper obtained flat surface results and black dots because the gathering of coffee skin fiber is also much less

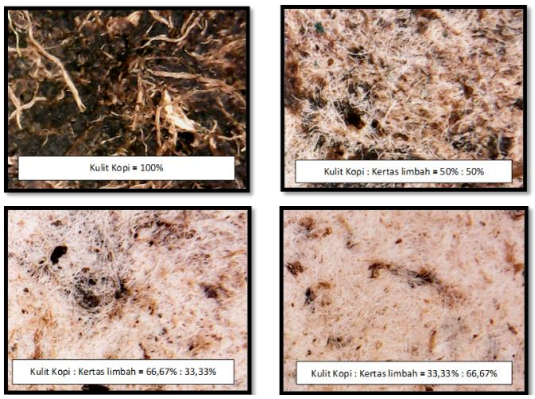

Figure 2. Micro-photos of recycled paper from coffee skin and scrap paperwaste.

To test the strength of recycled paper that has been made, it is measured tensile strength at the ratio of coffee skin and used paper waste as presented in table 1 and figure 3.

TABLE I. TENSILE STRENGTH TESTING OF PAPER FROM COFFE SKIN AND SCRAP PAPER WASTE

Material Parameters	Length (mm)	Width (mm)	Thick (mm)	Load Max (N)	Length Increase Max (mm)
Coffee Skin 100%	180	25,4	1	17,9537	1,68047
Coffee Skin 50%: Waste 50% used paper	180	25,4	1	32,0419	5,76617
Coffee Skin 66.67%: scrap paper waste 33.33%	180	25,4	1	57,1807	11,1189
Coffee Skin 33.33%: scrap paper waste 66.67%	180	25,4	1	94,2183	11,0262

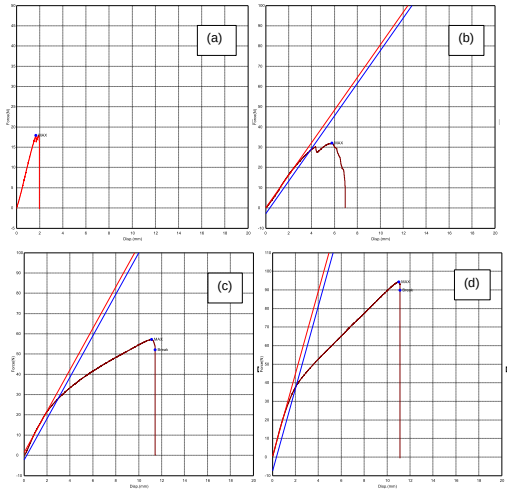

Figure 3. Tensile Test graphics from recycled paper from coffee skins and scrap paper waste. (a) Coffee Skin = 100%, (b) Coffee Skin: Waste paper = 50%: 50%, (c) Coffee Skin : Waste paper = 66.67% : 33.33%, (d) Coffee Skin : Waste paper = 33.33% : 66.67%.

The results of the tensile test showed the maximum load that can be held by recycled paper from 100% coffee skin of 17.9537 N with a maximum length increase of only 1.68047 mm. For recycled paper from 50% coffee skin and 50% waste used paper obtained a maximum load of 32.0419 N and a maximum length increase of 5.76617 mm. For recycled paper from 66.67% coffee skin and 33.33% used paper waste obtained a maximum load of 57.1807 N and a maximum length increase of 11.1189 mm. For recycled paper from 33.33% coffee skin and 66.67% used paper waste obtained a maximum load of 94.2183 N and a maximum length increase of 11.0262 mm. The addition of the recycling paper waste ratio is directly proportional to the increase in strength of the recycled paper. The finer, denser forms of scrap paper waste fibers bind together to fill the cracks of used paper fibers that have hollowly left behind the missing adhesive when washing and immersion (as seen in figure 2) causes the bonding between the fibers to be better. These results are in accordance with the results of Apriani's research (2016).

The results showed recycled paper from coffee skins was 33.33% and 66.67% scrap paper waste showed the highest tensile strength. Based on these results, researchers made a tube-shaped coffee product packaging.

Figure 4. Coffee packaging products from recycled paper made from coffee leather and used paper waste.

This packaging consists of one wide recycled paper that is curved to form a tube and glued with paper glue. The packaging cover is also made of the same recycled paper material as seen in figure 4.4. To add to the aesthetics of the packaging, it is labeled from a sticky sticker using a brand from a coffee manufacturer where researchers obtained coffee skin waste in Kampung Kopi, Gowa Regency, South Sulawesi Province. This is a wise step to utilize coffee waste into packaging coffee products that are environmentally friendly and utilizing coffee waste itself.

IV. CONCLUSION

From the manufacture of recycled paper made from coffee leather and scrap paper waste obtained coffee skin ratio of 33.33% and used paper waste of 66.67% has the highest tensile strength with a maximum load that can be held 94.2183 N and a maximum length increase of 11.0262 mm due to finer and denser scrap paper waste fibers binding together to fill the gaps of used paper fibers that have been hollow left adhesive. This ratio also shows good strenght when made into coffee product packaging so that the packaging used becomes environmentally friendly packaging by utilizing coffee waste itself. It is expected that this result will be the first step towards a sustainable product in the future.

ACKNOWLEDGMENT

The Author Team expresses its deepest gratitude to all those who have provided with assistance, direction, and knowledge ranging from problem identification to the process of making coffee skin packaging to the Bawakaraeng Coffee Village, Gowa, and raw material suppliers in Malino.

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