The Study of Suitability of Coir Fibres as Wrapping Paper

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investigation was developed to identify the compatibility of fibres from the coconut husk or known as coir fibre be used as the primary material in the production of paper industries, this fibres can be an alternative material t can replaced uses of wood in the future in order to protect the environment and to promote wrapping that en ironmentally friendly. In addition, in this study the recycled paper was embedded in the coir fibers sample in ction to hold the coir fibres together. The main purpose of this study is to determine the suitability of the coir bres with the recycled paper and mechanical properties of paper with different volume of alkali solution and ratio of coir fibers with recycled paper. The tensile strength index and absorption test were chosen as the responses to this study and to determine the significant difference between the ratio of the coir fibres used with recycled paper and to figured out which sample is the most suitable to be used as wrapping paper. The result shows that as the alkali lution increased, the mechanical properties of paper increased. In addition, the combination of 50% of recycled paper and 50% of coir fibres has produced paper with best mechanical properties in cooking time of 90 minutes with fixed temperature of 180^{0}C.This conclusion approved that the coir fibres can be one of the alternatives raw materials to replaced wood fibres in application for wrapping paper.

ey word : Bursting test; coir fibres; tensile strength; wrapping paper.

1.0 Introduction

Paper is one of the most significant inventions that been produced in all regions around the world. owadays, paper is more than just a substrate for writing, printing, wrapping and packaging but a versatile material with many other uses in industrial and construction processes. The scientific study also had discovered the potential of paper as a biodegradable, inexpensive and renewable polymer substrate in all industries. Paper is defined as a felted paper that been produced by pressing together the fine mesh of cellulose fibers traditionally from wood. Pulp and paper industries have been considered as the main consumer for natural resources (wood) and energy consumption (electricity) which including water. It was reported that annual paper consumption for 2004 is 52.45 kg per person and was 16.32 % greater than in year 1991 (Laftah et.al, 2015). The demand for printing and writing also grew gradually by more than 10 % from 1980 to year 2000. While the paper produced for packaging applications in the year 2009 takes up around 51.7% of total manufacturer production with the versatile uses for protecting the product contains from damage and spoiled (Rahaman, 2015). Higher demand for this paper industries requires the need for alternative as the local supplies of wood in many part of the world cannot support the demand for pulp and paper production which result; huge areas of rainforest are destroyed gradually each year to meet the needs supply for paper from wood fibers. Recently, the scientific research had discovered an alternative in paper making industry using a non-wood raw material as more attention has been given due to the rising consumption of wood resource for the paper production. This non-wood plant fibers pulping capacity has increased two to three times faster on a global basis as fast as the wood pulping capacity.

Numerous developing countries now are shifting towards the alternate pulping technologies using non-wood fibers sources that are more environmental friendly and non-toxic to human and environment. Initially, this non-wood fibers pulping occurred in country or regions where the wood supply is decreased and insufficient to sustain the needs for paper making industry. The alternative sources using the non-wood fibers for example are

wheat-straw, rice-straw, sugarcane straw, banana fibers and also the coir pith which have the potential to growth as the non-wood fibers particularly abundant, biodegradable, inexpensive, and potentially renewable (Main, 2014).

laysia nowadays also are shifting towards using the secondary sources in packaging industry such as old corrugated containers and waste paper. However, the consumers now demanding paper that are produced by a clean technology which eco-friendlier and made up with the non-wood fibers or recycled paper. The challenges that been faced by this industry is how to produce a quality paper pulp using fewer raw material such as wood,[1] while protecting the environment by minimize the production of pollution from residual effluents that been resulting from the cooking, bleaching and pulping the raw materials. This is because the sulfur-containing agent used in the bleaching process lead to various serious pollution problems not only to environment but also to humans being. The new pulping process by using less harmful and less polluting chemical have been developed by the researcher to solve this pollution problems while preserving the environment. The most common method of pulping process for the non-wood fibers is using an active alkali solution. This method is much more safer to the environment as the bleaching process does not contain any sulfur (Jukka et.al, 2011). An active alkali solution will act as sulfur free accelerator which is gratefully the most effective method with a lower cost and eco-friendly to environment.

Nowadays, paper is made out of wood from the trees. Instead the implication of trees, other sources that available to manufacture paper pulp nowadays such as from banana fibers and pineapple fibers. Therefore, these kind of sources is being compared, basically by measure its strength capability from aspect of burst and tear. The coconut fibers is one of the valid sources that has potential as an additive for paper and pulp making as this agricultural residue can be found abundantly in Malaysia and Indonesia (Bahari et. al 2015). Coir fibre consists of cellulose and high content of lignin (Arsyad et.al, 2015). There are two compounds that found in coir fibre which are Polysaccharide compound and macromolecules polyphenolic compound. These compounds contribute to the strength or ductility of its properties by considering between the fibres bonds formed. Natural fibre such as coir fibre have hydrophilic properties which the surface of natural fibres has a good bonding strength. Coir fibre or coconut fibre proved to be one of the good raw material alternatives in paper making because of its availability to withstand with heat, strong and light. Therefore, large surface area of fine fibre enhances sheet consolidation and forming the fibre bond that mixed with recycle paper. The coir fibers which contains a higher lignin and cellulose contents were used in this study to produce a better conversion of pulp and paper in aspect of forming strong bond between the fibre and recycled paper. Coconut tree is a tropical plant which tremendously growth interface or in transition area and coastal area of tropical countries. This coir fibers; lignocellulosic natural fibers has tremendous application towards these days technology such as paper, pulp, car seat, mattress, cardboard and even as activated carbon in waste water treatment potentially renewable, biodegradable, inexpensive and flexible polymer substrate products in the world (Main, 2014).

Since the availability of the coconut fibre is plenty, its shows a potential useful as an alternative for the raw material for the paper making industry and thus will decrease the usage of raw materials from wood in this industry. The aim for this study is to evaluate the compatibility of coconut fibre or known as coir fibre in pulp paper making and the alternative production of paper availability by using coir fibres as raw material. The implementation of alkali such as sodium hydroxide as a pulping reagent and few amounts of starch for the pre-treatment to remove the impurities that attached in the fibre and to obtain required form of the fibre.

2.0 Material and Methods

2.1 Sample Collection

The coir fibres that used in this experiment were supplied from the local seller around Bandar Seri Alam. This coconut husk can be found abundantly and can get with a lower price as it one of the natural waste that people usually will throw away or burnt. The coir fibre that used is the brown fibres that can obtain from the outer shell of

matured coconut.

2.2 Pre-treatment of the coir fibre

The coir fibres undergo pre-treatment process. The brown fibres were separated from the outer shell of the coconut. The coir fibre will then placed in the specimen tray in the laboratory for further process. The coir fibres were cutted into smaller size 1-3 cm and was disintegrated with laboratory blender. The fibres were washed and cleaned with water to remove any impurities such as grit and soil. Sodium hydroxide (NaOH), distilled water and starch were also used in this experiment for pulping process.

2.3 Soaking Process

The chemical pulping of the coir pith involved soaking with 1.0 mol of Sodium Hydroxide (NaOH). The coir fibres were then soaked with distilled water and Sodium Hydroxide for 90 minutes of boiling time at fixed temperature, 180°C for producing the strongest paper with using different concentration of active alkali (18% w/w, 20% w/w. 22% w/w). The alkali ratio was measured according the percentages of the total water in the beaker.

Diagram 1 shows the soaking process for the coir fibres in different concentration of alkali solution

2.4 Washing Process

Fibres that have been cooked at the fixed cooking time of 90 minutes with different concentration of sodium hydroxide, the coir then is washing with distilled water to remove any extraneous matter or chemicals residues on the fibres. Next, a cloth filter that supported by a wire mesh test sieve in range of 20-50 mm was used during the washing process. Fibres then washed again with a running distilled water to ensure that all fibres been cleaned properly, and no chemical residues within the fibres.

Pulp preparation from recycled paper

The recycled paper was cut into several pieces and soaking into the distilled water to soften the paper. The ..cled paper is then blended using the laboratory blender into smaller pieces to make it compact when mixed with coir fibres sample with different ratio of fibre and recycled paper by weight.

2.6 Moulding Process

Three picture frames used for the moulding process. The picture frames that has glass and cover are removed Each side of the frame were stapled with a piece of cloth. The cloth was stretch while stapling to avoid any sagging areas which could affect the properties of the pulp.

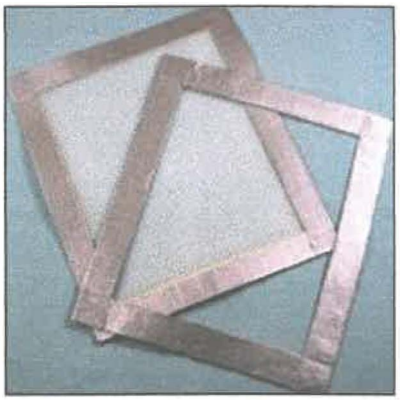

Diagram 2 shows a picture of moulding frame that use in the moulding process.

2.7 Pulping Process

The washed pulp was blended with a presence of water in laboratory blender before to make sure the fibres were soft enough and to ensure the coir fibres in uniform length for pulp consistency to a good quality of wrapping paper were produced. The coir fibres were weighed is 70 grams for one whole A4 moulding size frame. The sample then being weighed again and mixed with different ratio of recycled paper which is;

Table 1 Indicate the different types of weight ratio of recycled paper and coir fibre.

Ratio of Recycled Paper and Coir Fibre	**Weight Ratio of Recycled Paper and Coir Fibre**
1:1	35 gram of recycled paper, 35 gram of coir fibre.
1:2	23.33 gram of recycled paper, 46.67 gram of coir fibre.
2:1	46.67 gram of recycled paper, 23.33 gram of coir fibre.

The frames were hold vertically as were dipped into the pulp, then were turn horizontally once the pulp have fully submerged. Immediately lift the frames from the pulp and hold for a while to allow the water to drain off which leaving the humid pulp on the mould frames. The frames were turns over onto a damp cloth with the frames on top of it and the excess water is soaked from the paper using a sponge. The excess water then blotted softly with the sponge until the paper begins to separate from the screen. The screen was slowly lift from the pulp and leaving the only moist pulp on the damp cloth. The moist pulp was leaved to dry overnight at room temperature and pr sure.

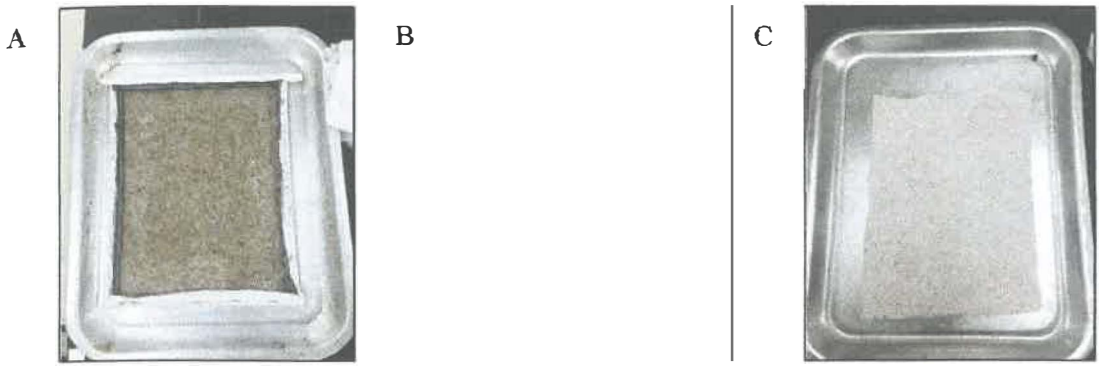

Diagram 3 shows the coir fibres with mixed ratio of (paper1:1 fibre) (A),(paper 1:2 fibre) (B), (paper 2:1fibre) (C) with recycled paper.

2.8 Tensile Strength Test

Tensile strength testing is to determine tensile properties of the wrapping paper by break a strip of paper sheet with maximum stress and moving speed of 10mm/min. The testing conduct by using SHIMADZU tensile strength tester machine. Tensile strength is important method for paper testing where to identify the basic physical of paper. Basically, fibre orientation is measured between machine direction and cross direction. Paper web run on the machine in machine direction whereas cross direction is perpendicular to the paper sheet run on the machine. Machine direction gives greater result than cross direction. A total of 15 strips from each sample were tested and average of these values from the testing were recorded then proceed with tensile index calculation.

2.9 Water Absorption Test

The test is carried out by making two sample each ratio of paper which are 1:1 (fibre: paper), 2:1 (fibre: paper) and 2:1 (fibre: paper). The purpose doing that is to know if more fibre than recycle paper can produce a good wrapping paper or more paper than fibre can produce a good wrapping paper. The samples are cut into small pieces (3cm×3cm). It is shown in diagram 4.

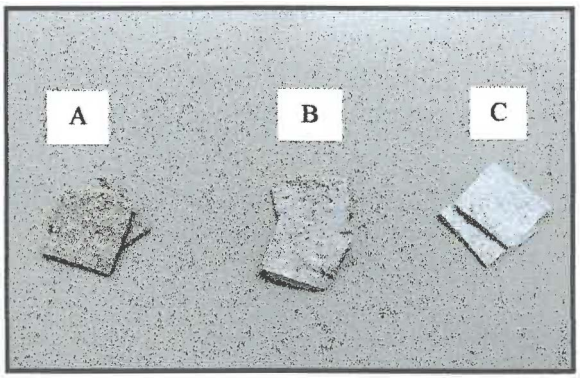

Diagram 4 show each sample is cut into 3cm^2 From left A (paper 2:1 fibres), B (paper 1:1 fibres), C (paper 1:2 fibres)

All the sample were then putted on the analytical balance to calculate the paper pulp weight in gram (g). All the samples were immersed in the tray that filled full of water at the same time. The samples were left for 5 minutes to ensure the absorption process occurred effectively. After 5 minutes the samples were reweight on the analytical balance. The data was tabulate in the table 2.