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Producing Paper using Pineapple Leaf Fiber

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Abstract. Experiments using pineapple leaf fiber as raw material in paper production have been conducted to assess the advantages in terms of mechanical properties, especially tensile strength, tearing strength and thickness of the paper. In this paper, samples of pineapple leaf fiber is mixed with a recycle newspapers in different composition of which is, 25%, 35%, 45%, 55%, 65% and 75% pineapple leaf fibers mixed with 75%, 65%, 55% , 45%, 35% and 25% of the recycle newspapers. The mixtures have been tested for mechanical properties and thickness by using the Universal Testing Machine (UTM) and micrometers. The results from tensile and tearing tests were then compared with data obtained from previous experiments. Through the observation of the experiment, it was found that the data obtained with similar experiments conducted previously. The results have been proved in tears testing and stress testing. Tearing test data shows that the longer the beating time imposed on the mixture, the lower the tearing force required to tear the paper samples. On the other hand, the tensile test results shows, the longer time beating the bear on the mix, the higher the tensile force should be imposed on the sample. The experimental results can help in the formulation of the pineapple leaf fiber-based paper production in accordance to the usage.

Introduction

The use of non-timber resources as ingredients for the production of paper covers 10% of its use throughout the world. However, the situation differs according to the country and depending on the country. For example, China uses more than wheat straw and other non-wood fiber as raw material for paper production [1]. Demand for paper in today increasingly technological progress increases with current. These challenge the opinions of the opinion that the progress of information technology will lead to less use of paper and the community to create a paperless world. With regards to this situation, many alternatives have been introduced to replace the main sources of wood in pulp and paper industry [2]. Using wood as a raw material for paper production causes deforestation and the subsequent possibility of a limited timber resources crisis. In recent years, demand for pulp has increased rapidly, especially at the developing countries. Because shortage of wood resources as the primary basis for the production of paper, there are other alternatives such as the introduction of non-wood lignocellulosic-based material that has been used as a substitute for wood. Among the countries using these materials are India and China. Malaysia is no exception to that is actively looking for alternative non-wood materials to replace the existing base. Before this, there were some materials that have been commercialized as an alternative, such as the empty fruit bunches of oil palm, banana fiber and carpet grass [3]. The use of pineapple leaf fiber can be considered relatively as new in the paper manufacturing industry in Malaysia. This paper is intended to improve or add to the products of paper-based materials of natural fibers as an alternative way to reduce environmental problems involving for example the felling of trees without close supervision. In addition, other factors to consider are the cost of paper production. This research can also determine whether the pineapple leaf fiber suitable as a base that is capable of providing an increase in the mechanical properties of the product. Additionally, this project is

collaboration between the University Tun Hussein Onn Malaysia (UTHM) with the Malaysian Pineapple Industry Board (LPIM) in the search for alternative or new methods of production of paper from pineapple leaf fibers. In addition to that, it will help to the economy of small and medium industries (SMIs) in the venture industry and paper companies in the future.

Background

In 1980s, there were 150 large companies that resulted in a paper that covers 45% of total production. In 2000, production increased by two-fold, from 170 million tones / year to 320million tons / year [1]. In 1979, Robert has created a machine for the production of paper and it has been patented in the same year [1]. After the next few years, Bryan Donkin has invented a machine for the production of paper pulp in 1809 [1]. The machine is more advanced than before because they speed up the process of obtaining pulp from raw materials. The papermaking industry in 2002 was recorded as the number of 331 x tones. Although the quantity of paper products is still high, but it still cannot accommodate requests from clients. It is estimated that more than 9000 machine that is used for papermaking and it involved 200 states around the world, and there are 15 large companies that resulted in 82% of the total world production of paper [1]. In this study, the research emphasis is concerned with grammage, thickness, tear, and strength. For strength and tear, as shows in Figure 1, this shows data from research done previously. Based on the available details, the production process through various stages before is done. In addition, there are several processes in the production of pulp for paper such as mechanical pulping and chemical pulping. At present, there are more effective processes for production of pulp in the process of chemical mechanical proces. In this process, it combines the concept of chemical and mechanical pulp in order to produce the highest quality. At the onset of fiber will be separated by mechanical means and then it will be dissolved using chemical [4]. In addition, the use of pineapple leaf fiber can reduce the rampant felling of trees and thus reduce environmental pollution. From the previous study [5] found that, using pineapple leaf fibers in the polymer that mixed with the polymer will not result in changes and thermal properties of the polymer, but it will reduce production costs in terms of the composite and the effect on the environment. In a short time, the increased use of natural fibers will cause a positive impact on farmers and smallholders in the global context. In addition, it will cause an increase the area of the green earth, and reduce the cost of raw materials [6].

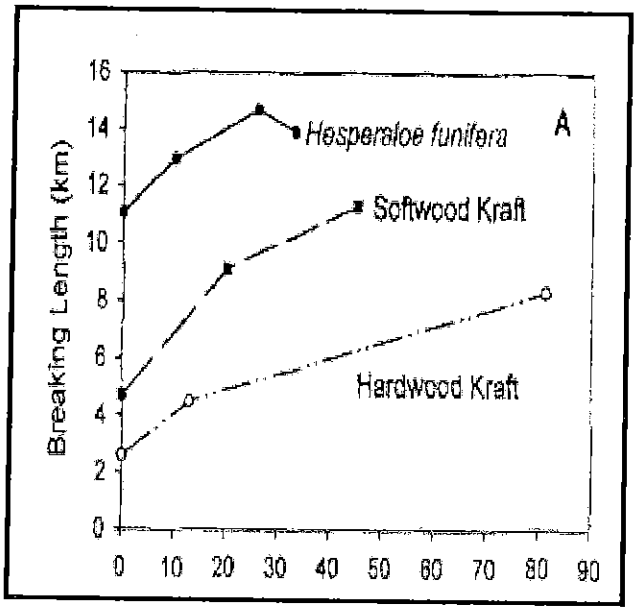

Figure 1 The beating Graf Versus Tensile Strength [6]

Experimental

The experimental procedures used in the study were based on the American Society for Testing and Materials (ASTM) and the Technical Association of the Pulp and Paper Industry (TAPPI) and suggested by Hassan et al [7]. Mechanical tests to be performed are grammage testing, thickness testing, stress testing and tear test. The pineapple leaf fiber has to be cleaned first with water to remove any dirt. Then, the fibers will be soaked in hot water which mixed with a chemical that is Sodium Hydroxide Pallets for one day. After that, the pineapple leaf fibers will be mixed with the used newspapers with the composition of the set; A (25% pineapple leaf fibers + 75% used newspapers), specimen B (35% pineapple leaf fibers + 65% used newspapers), the specimen C (45% pineapple leaf fibers + 55% used newspapers), specimen D (55% pineapple leaf fibers + 45% used newspapers), specimen E (65% pineapple leaf fibers + 35% of newspapers used), and F specimens (75% pineapple leaf fibers + 25% of newspapers apply) . After that, all the mixture is blended at the rate specified period of 10 minutes, 15 minutes, 20 minutes, 25 minutes and 30 minutes. After that, the blended ingredients will be placed on the nets and the last-nets are found on a wooden frame. The frame is made of wood and a fine web. Seeks to remove the liquid content contained in the material. In addition, the span can also be used for faster removal. After that, the paper will be dried at room temperature. Preparation of test sample requires the use of chemicals as a softener to the basic material to facilitate to get the pineapple leaf fiber from the leaves and mixing between the newspapers. After that, the fibers are mixed together with newspapers in a different composition. The aim is to see the reaction on mechanical properties that applied to the resulting sample.

Results

In this experiment, 90 specimens were used to grammage test paper produced. These specimens are separated into groups according to the composition and time of the beating. Referring to figure 2 on the graph, it appears that the mass of papers produced specimens are in the range of 15 grams to 22 grams. The highest recorded in minute 15 with a reading of 21,489 gram followed by a second mass was highest in minute 30 with a reading of 19,711 grams. The third reading of the highest value was in the 25th minute with a reading of 19,111 grams and was followed in minute 20 with a reading of 16,733 grams and the value was the lowest reading in the 10th minute with a reading of 15,267 grams. Referring to Figure 3, a graph of thickness versus composition, the highest reading was at 75% pineapple leaf fibers and 25% of newspapers and reading recorded was 1.3mm. Based on the graph in figure 4, the tension was found for the beating of 10 minutes is 35.2077 Newton (N) and found the increase of tension when the beating plus 5 minutes of the minutes of the 15 th and 20 th minute and the resulting tension is 61.3097N and 74.6293N. Graph seen a decrease in the 25 minutes of 55.069N and the factor graph of the decrease is due to the thickness of the test specimen is thinner than the specimens of other tests. After it is posted a graph obtained the highest reading at 30 minutes into the 86.9177N. From figure 5, the graph shows the resulting forces tearing at minute 10 is 2.980N, and decrease the time plus 5 minutes of the beating of 2.779N, but the graph shows the increase in minute 20 of a total of 5.732 N. Among the factors the increase is due to the thickness of the test specimens are thicker than others. At minute 25 and minute 30, the graph shows a decrease of 3.857N and 1.706N. The pattern of the graph in figure 5 shows that it has decreased and is consistent with the theory and study ever done before. After analysis of the results, it appears that there is data obtained from experiments carried out did not meet before this theory. This is because there are many factors that cause these things. The tests were conducted as a test account from one another. So, any changes on the sample and can be detected by tests done, and it will be affected by other tests.

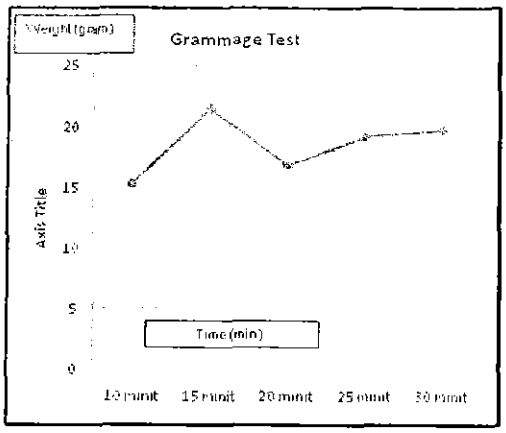

Figure 2: Grammage versus beating time

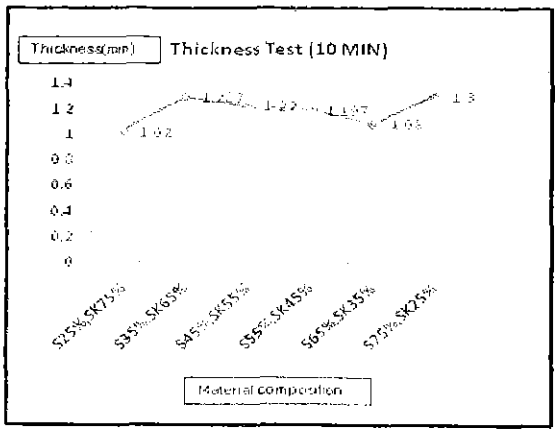

Figure 3: Thickness versus composition

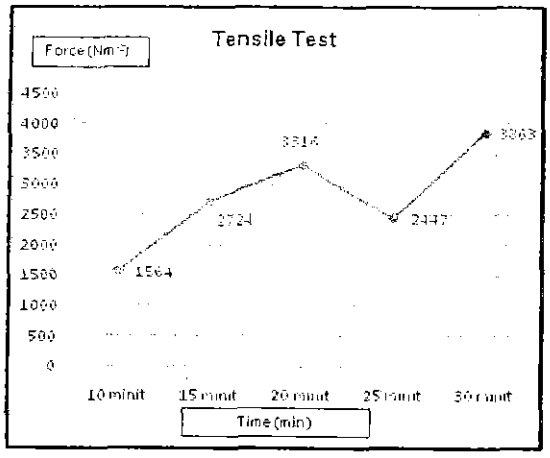

Figure 4: Tensile versus beating time

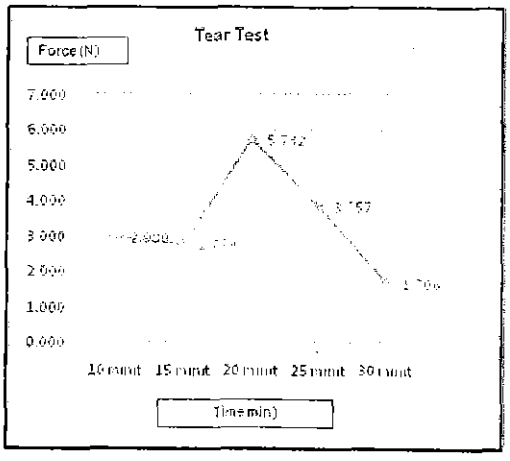

Figure 5: Tear versus beating time

Conclusions

Based on the survey was done on paper made from pineapple leaf fibers, and old newspapers, found that it has the basic properties of such a paper could be written, be torn and it can absorb moisture so it is basically suitable for the paper. However, when evaluating the terms of thickness and other features found on the paper produced, it can only be used as the medium of packaging such as boxes at this time. Referring to the tests that were conducted as a test voltage, the voltage will increase when the beating of pineapple leaf fiber and newspaper added. However, the tearing test, found the force used was decreased when the beatings increased. Based on the observations made, such things happen because of the size of pineapple leaf fibers progressively decreases when the beatings increased. Based on pictures taken using a microscope, the fibers found to be dispersed and located position of the fiber pattern is not fixed. After completed experiments on the use of pineapple leaf fibers in the production of paper, found the study objectives are achieved. With the experimental confirmation of this, applications in the industrial use of natural fibers are very useful because it not only eases of fabrication, but the price is cheap and readily available. Furthermore the mechanical properties, electrical properties, and chemical properties of natural fibers are very good as a place of choice in the manufacturing sector. In conclusion, the results of the latest technologies, development of natural fibers as a material that can be done and improved from time to time in various forms of applications and usage.

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