EFFECT OF DIFFERENT SAGO STARCH SURFACE SIZING COMPOSITIONS ON THE PROPERTIES OF PAPER MADE FROM PINEAPPLE LEAF FIBER

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Abstract. Starch is main surface sizing agent. Sizing agent comprised of dispersed natural polymers in an aqueous solution are provided, as well as methods for making these sizing agents and methods for using these sizing agents to size paper. Starch is main surface sizing agent (SSA) of natural polymers. Sago starch was prepared at different ratio of starch with deionized water. The characteristics and properties of the uncoated pineapple paper and SSA coated paper were reported. Different composition of starch ratio not much affected on melting point of sago starch, the melting point is around 90^{o}C. Result showed that, surface sizing agent has pronounced effects in improving strength and water resistance. Increase the ratios of starch were decreased the strength and water resistance. The 1:10 starch ratio only absorbed 0.23g of water for 6 days while 1:25 starch ratio absorbed 0.34g of water for 6 days. Meanwhile, the strength properties were decreased as the starch ratio increases. The 1:10 starch ratio gives highest tear strength (80N) while 1:25 starch ratio (60N) and uncoated pineapple paper only 55N. In conclusion, the 1:10 starch ratio was showed better tear strength and water resistance for pineapple paper.

Introduction

Paper sizing agents are used in paper production to improve the paper's resistance against penetration of water and thus increase its printability and durability. It is one prominent method to modify cellulose fibers in order to control the penetration of liquids into a paper sheets. Several processes and additives are applicable to achieve desired paper properties and protect against water, e.g. by bulk modification, surface treatment or structuring of papers and cellulose fibres. Hence, the application of sizing agents during paper production is essential, as they hinder penetration of water into the sheet [1]. Today, alkenyl succinic anhydrides (ASA) and alkyl ketene dimers (AKD) are the most common chemicals used for this purpose. However, conventional ASA and AKD are produced from crude oil based olefins, as the main source of raw material. Nevertheless, as prices for crude oil are constantly rising, scientists and researchers around the globe are forced to search and came up with several alternative sizing agents that are based on renewable raw materials [2].

Apart from that, the others driving force for this development is the high awareness for environmental issues and also the even higher demand for chemicals that are not based on crude oil products. Expectations regarding the properties of these new compounds are big, in which, they should provide alternatives for conventional products without lacking efficiency. Furthermore their stability under papermaking conditions ought to be the same as for common products.

This paper presents a newly developed, green paper sizing agent based on sago starch and its effect on the properties of pineapple paper produced. Sago starch was chosen to be developed as sizing agent because sago starch has exhibit numerous remarkable characteristics, including high paste viscosity, high paste clarity, and high freeze-thaw stability, that give advantageous to be used in papermaking. In this work, sago starch sizing agent was prepared at different ratio of starch with deionized water. Then, the characteristics and properties of the uncoated pineapple paper and pineapple paper coated with sago starch sizing agent were reported. Based from results obtained, sago starch sizing agent has pronounced effects in improving strength and water resistance of the pineapple paper produced.

Experimental

Sago starch was obtained from supplier and used as received. A sago starch solution was formulated by mixing the starch powder with the deionized water with different ratio. The translucent paste of sago starch was prepared by the addition of deionized water and was being heated up to 80 ^{o}C with vigorous stirring for 6 hours. The translucent paste was cooled for 1 hour before applied at the surface of pineapple paper. The paper was coated with different composition of sago starch. All the papers were brushed 4 times to get homogenized surface thickness. Later, the coated papers were putted into the oven for 20 minutes at 60^{o}C for drying. Finally, the coated papers were being readily for testing. As for paper testing, the pineapple papers were dried in a vacuum oven at temperature of 60 °C for 24 hours before testing. Tear indexes and water absorption of the pineapple paper sheets were tested according to TAPPI standard test.

Results and Discussion

Tear Test. As per shown in Figure 1, the coated pineapple paper sample show increment in tear strength compared to the uncoated pineapple paper. It can be seen that the tear strength of the coated pineapple paper increased by 78% from the uncoated pineapple paper. It was also noticeable that the 1:10 starch ratio coated pineapple paper showed the best tear strength among all of the coated pineapple paper. It was also found that, with reduction of sago starch ratio in the surface sizing composition, there were remarkable decrement in strength and water resistance properties of the pineapple paper produced. Hence, this exhibit that the strength increased with increases amount of starch in the surface sizing composition. When the amount of starch in the surface sizing composition increased, the thickness of the gel layer formed on the pineapple paper surface will therefore thicker and this result in making the paper stronger. The fact that the long term, thermally reversible changes in modulus of the starch gel parallel

the changes in crystallinity suggests that partial crystallization within the granules, which enhances their reinforcement of the amylose matrix [4].

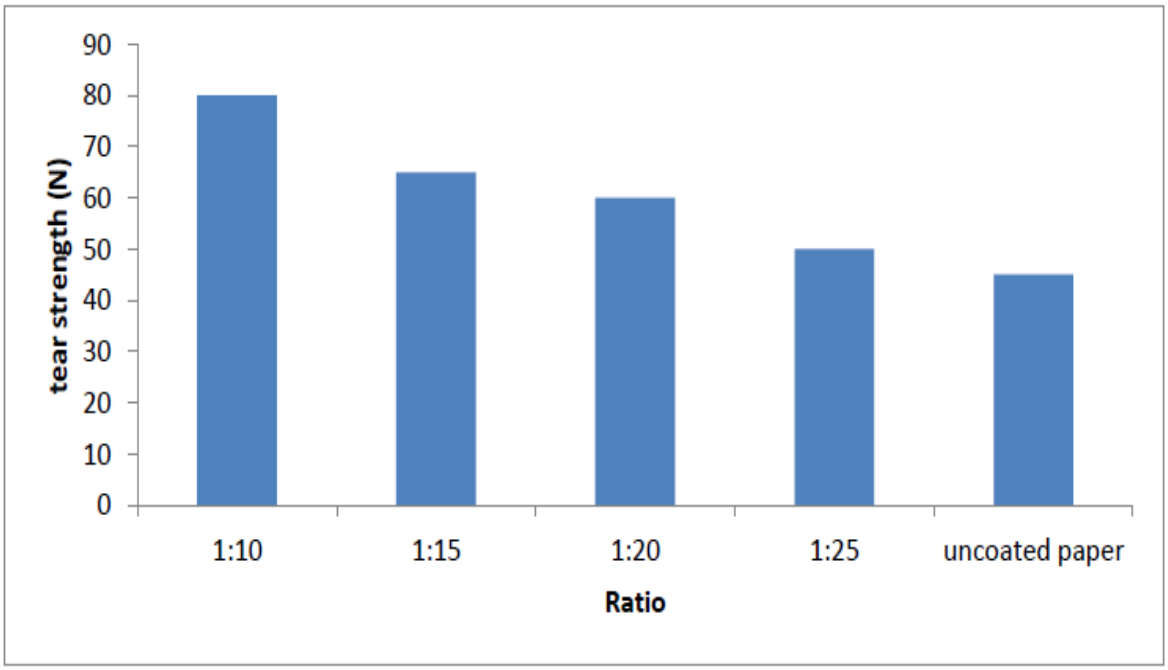

Figure 1. Tear strength for coated and uncoated pineapple paper

Water Absorption Test. The purpose of carrying out this water absorption test is to ensure whether the surface sizing agent that coated on the pineapple paper will provide water resistance barrier for the pineapple paper. From figure 2, it can be seen that all coated papers have water absorption values lower than the uncoated pineapple paper. This means that all coated papers are able to provide a water resistance barrier for the paper. Among all these coatings, 1:10 starch ratio showed the best water resistance barrier with the lowest value of water absorption during the period of testing.

Figure 2 shows that the water absorption rate of paper when coated with sago starch solution at different ratios. It was discovered that all the water absorption rates for coated paper were lower that the uncoated paper. This reflects that the coatings can provide water resistance barrier for the pineapple paper. The 1:10 ratio provides the highest water resistance barrier. Several events take place during heating of starch granules in water that bring about large changes in rheological behavior and are responsible for the establishment of a gel network structure5 The starch with 1:10 have the highest starch thus it have more amylose and amylopectin to form a network gel that act as a water resistance layer to the coated paper [5].

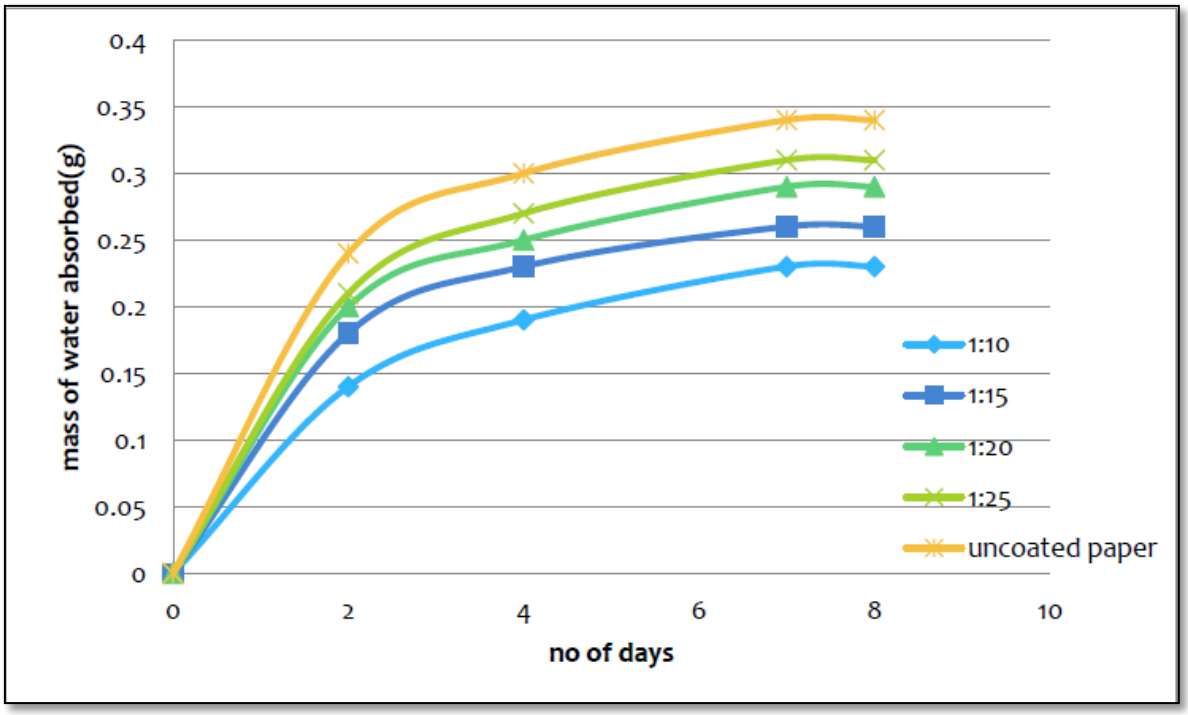

Figure 2. Water absorption rate of the paper coated with different ratio of sago starch

Conclusion

It was observed that, the addition of sago starch as surface sizing agent were improved the properties of pineapple paper. Pineapple paper tear test and water absorption test revealed that 1:10 starch ratio had the most positive effect on the pineapple paper properties. The findings of this work indicated that surface sizing of pineapple paper shows promise for papermaking compared to the unsized pineapple paper.

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