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The Modification of Stress-Strain Properties of KOCC by the Mechanical Means

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ABSTRACT

The stress and strain properties of KOCC were modified to improve the performance of KOCC as a packaging raw material. The refining consistency, refining degree, blending conditions and the grammage of handsheet were varied. The stress-strain properties, tensile energy absorption were measured. The refining improved significantly the stress and strain properties of paper, especially at lower refining consistency. The increase of grammage also contributed to the improvement in the stress and strain of paper. It was also found that the refining, blending and grammage contributed to the increase of tensile energy absorption. However, it is strongly recommended to apply the combination of refining consistency, refining degree and mechanical treatment(blending).

Keywords : *KOCC, refining consistency, freeness, grammage, stress strain properties, blending, tensile energy absorption*

1. INTRODUCTION

The consumption of industrial papers depends on the industrial and economical situation strongly. All products should be packed to protect safely during transportation. The extension of packaging concept also increased the importance of packaging. Korean industrial paper manufacturers have been imported lots of OCC from America, etc. and used it as the important raw material. However, as the global environment is getting worse rapidly, there are various types of campaigns to protect and preserve the global environment. The regulations are also established to reduce the emission of greenhouse gases and demanded forcibly to participate the environmental preservation campaign. Many developing countries and underdeveloped countries are facing the serious problems. Even some advanced countries like America, Australia, etc. that consume the enormous energy also try to find another ways which can reduce the burden in the greenhouse gas reduction.

Such trends caused to increase the reuse of

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wastepaper, thus the quality of OCC was deteriorated significantly, while the price of OCC was rose. Eventually, the Korean industrial paper manufacturers have to increase the use of KOCC in order to overcome this difficult situation. Unfortunately, KOCC had recycled several times already, thus there are serious problems in qualities and processes. The weakening of pulp fiber especially could not meet the requirements from industrial packaging paper and boxboard. Furthermore, many modern Chinese paper mills and paperboard mills with huge capacities are constructed recently. Therefore, the export of liner and/or paperboard to china is impossible if the quality and price competitiveness are not improved. Therefore, it is urgently required to develop the technology which can overcome such kinds of difficulties. Researches on the utilization technology of OCC were carried out by Seo etc. (1), Ahn etc. (2), Ryu etc. (3), Pang etc. (4-5) and Lee, etc. (6) Our research team also carried out the study to maximize the utilization of KOCC by the improvement of physical properties of KOCC (7-9). Most important thing is the development of environmentally friendly technology which can minimize the use of chemicals and energy consumption. Thus, the study is carried out to find out the solutions that can improve fiber bonding ability and stretch of paper.

2. EXPERIMENTALS

KOCC collected from wholesale mart is used as a raw material. The adhesive tape is removed manually, and torn out KOCC into small pieces and soaked in water for 24 hrs. The soaked KOCC was disintegrated with laboratory pulper, and then thickened and stored in cold room for the future experimental works. The disintegrated KOCC was refined to 350, 400, and 450 ml CSF at 0.5% and 1.0% consistencies. Hobart mixer does not cause severe damage, but introduce the curl and/or the internal fibrillation of pulp fiber. Mechanical treatment with Hobart mixer was also applied to the refined KOCC at 30% consistency in order to increase the stretch of the sheet. The grammages of handsheet were controlled to 80, 90, and 105 g/m^2 for both the refined KOCC and the refined KOCC applied with additional mechanical treatment. The stress-strain characteristics and tensile energy absorption were measured for the handsheet prepared from treated KOCC.

3. RESULTS AND DISCUSSION

There are lots of parameters affecting stress-strain properties of paper. Of such parameters, the furnishes, refining and papermaking parameters such as wet pressing and drying conditions, etc. are very affective on stress and strain properties. The study was focused on the effect of refining and additional mechanical treatment. Although Htun (10) mentioned that the yield strain is 0.16% in ordinary handsheets dried under full restraint independent of furnish type, wet pressing, and beating, but different furnishes, refining conditions and degrees, wet pressing conditions, and drying conditions are usually applied to the different paper grades. The response of paper is also strongly depend on the pulp fiber properties such as surface chemical properties, fiber dimension (i.e. coarseness), fiber bonding ability, refining, and other papermaking conditions.

Figs. 1-6 showed that the refining consistencies, refining degrees, blending and grammages had affected greatly the stress and strain propertiesof paper. The increase of refining degree and grammage increased both the stress and strain. Higher stress and strain were especially obtained at lower refining consistency. When the blending treatment is applied, little bit higher strains were obtained at higher refining consistency (1.0%), but the improvement of strain in the lower grammage handsheet (80 g/m^2) was not observed. The blending treatment with Hobart mixer

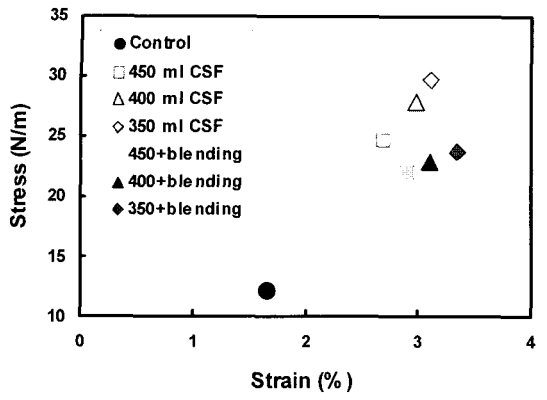

Fig. 1. The stress-strain properties of handsheet (80 g/m^2) made from KOCC refined at 0.5% and blended with Hobart mixer at 30%(Control : KOCC).

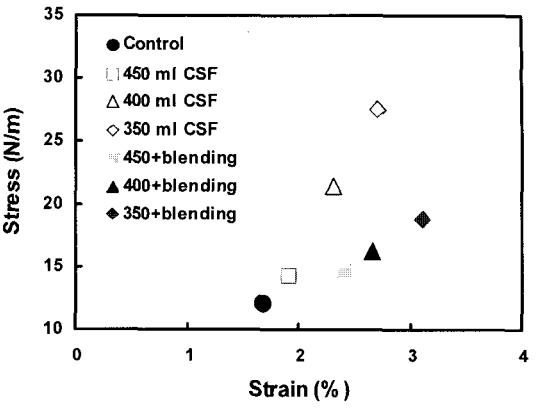

Fig. 2. The stress-strain properties of handsheet (80 g/m^2) made from KOCC refined at 1.0% and blended with Hobart mixer at 30%.

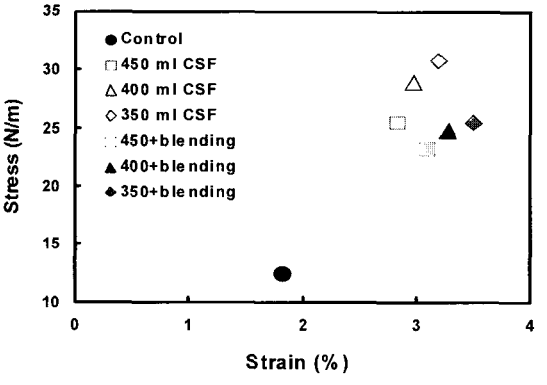

Fig. 3. The stress-strain properties of handsheet (90 g/m^2) made from KOCC refined at 0.5% and blended with Hobart mixer at 30%.

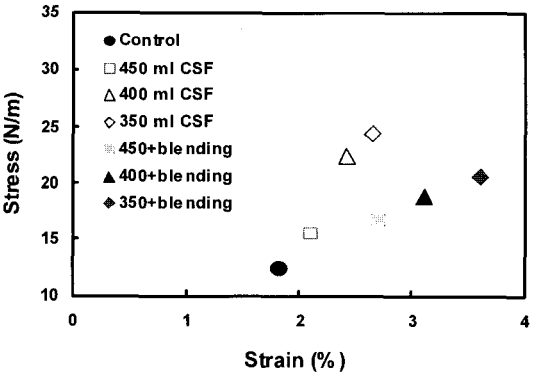

Fig. 4. The stress-strain properties of handsheet (90 g/m^2) made from KOCC refined at 1.0% and blended with Hobart mixer at 30%.

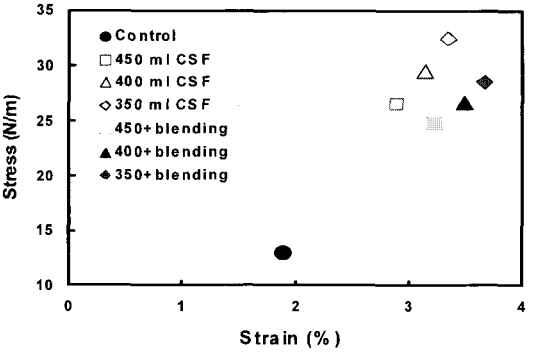

Fig. 5. The stress-strain properties of handsheet (105 g/m^2) made from KOCC refined at 0.5% and blended with Hobart mixer at 30%.

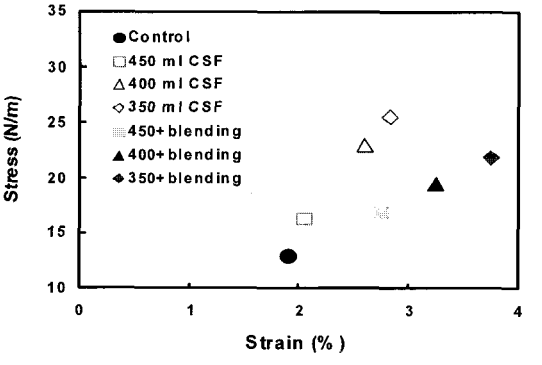

Fig. 6. The stress strain properties of handsheet (105 g/m^2) made from KOCC refined at 1.0% and blended with Hobart mixer at 30%.

improved the strain significantly, although some sacrifice in the stress was accompanied. Such improvement in the strain was remarkable in KOCC refined at higher consistency. This means that the effects of blending with Hobart mixer on the stress-strain properties were affected by the refining consistency and grammage of handsheet.

We found that the degree and type of improvement in the strain by the blending treatment depended on refining consistency (Figs. 7-8). When KOCC refined at 1.0% was treated by Hobart mixer, the decrease of stress was lower, but the increase of strain was higher than those of KOCC refined at 0.5% consistency. Thus, proper combination of refining degree, refining consistency and blending treatment is beneficial in improvement of stress and strain performance.

It is well known that the strain property and toughness of paper have very close relation with its tensile energy absorption. As can be seen in Figs. 9-14, the higher tensile energy absorptions were obtained at the lower refining consistency, and improved by the mechanical treatment with Hobart mixer, although

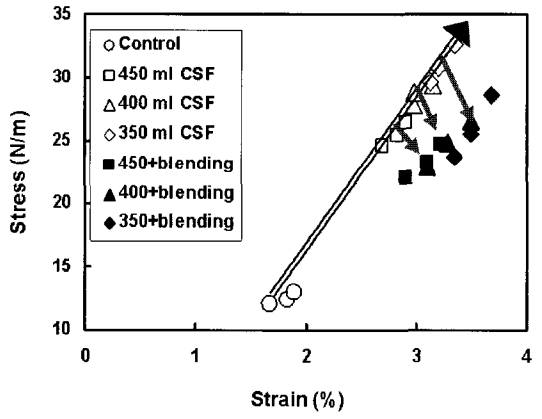

Fig. 7. Effect of refining and blending on the stress-strain properties of KOCC handsheet (refined at 0.5%).

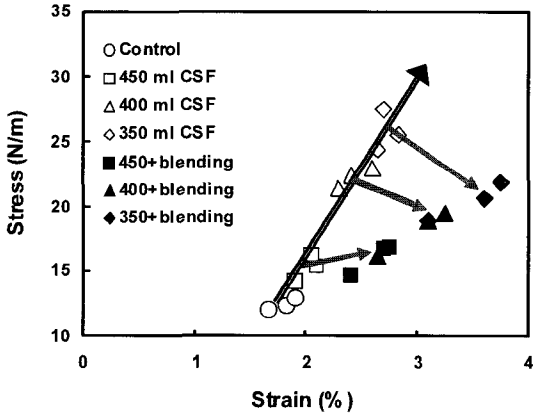

Fig. 8. Effect of refining and blending on the stress-strain properties of KOCC handsheet (refined at 1.0%).

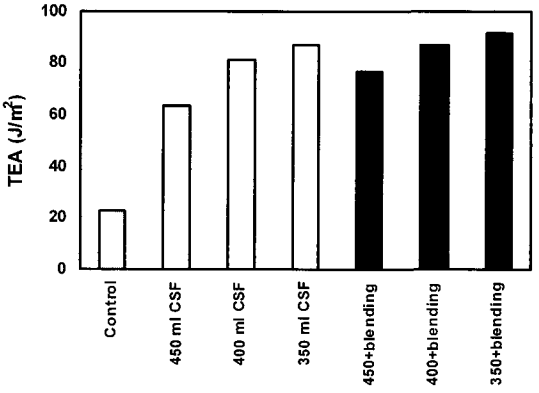

Fig. 9. Effect of refining and blending on the TEA of KOCC handsheet (refined at 0.5%, 80 g/m^2).

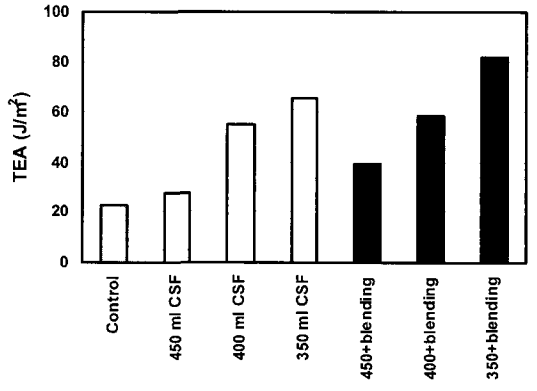

Fig. 10. Effect of refining and blending on the TEA of KOCC handsheet (refined at 1.0%, 80 g/m^2).

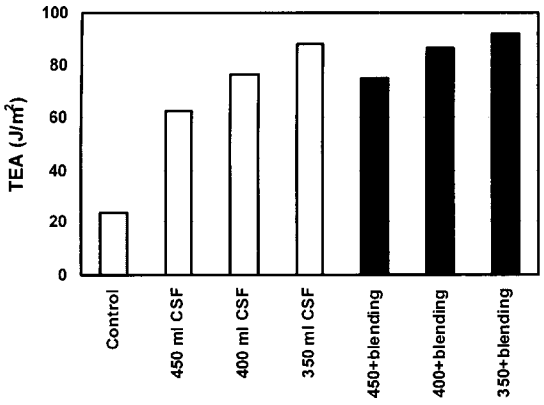

Fig. 11. Effect of refining and blending on the TEA of KOCC handsheet (refined at 0.5%, 90 g/m^2).

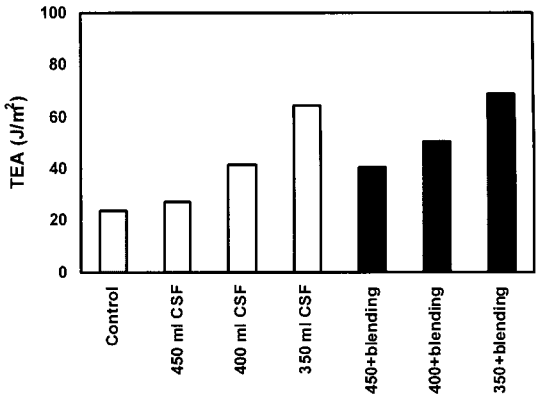

Fig. 12. Effect of refining and blending on the TEA of KOCC handsheet (refined at 1.0%, 90 g/m^2).

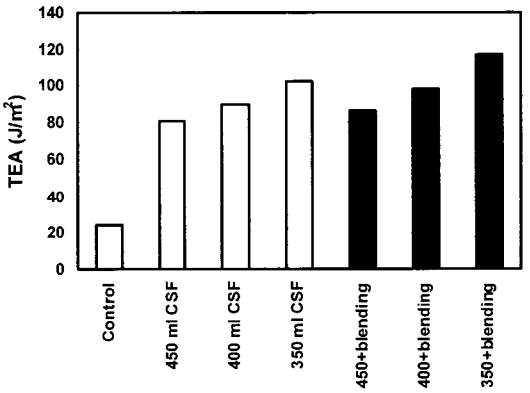

Fig. 13. Effect of refining and blending on the TEA of KOCC handsheet (refined at 0.5%, 105 g/m^2).

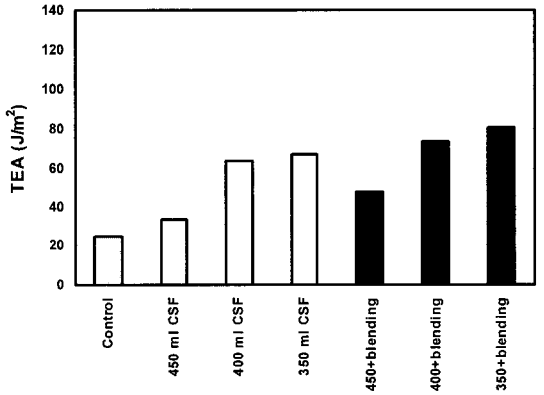

Fig. 14. Effect of refining and blending on the TEA of KOCC handsheet (refined at 1.0%, 105 g/m^2).

there is some sacrifice in the stress. These results were very well related with the result of stress and strain performances of KOCC refined. The increase in grammage contributed to the improvement of the tensile energy absorption of paper. However, the increase in grammage can be the cause of the increase of transportation cost and thickness of packaging material. Thus, it is strongly recommended that the application of blending treatment for the refined KOCC to improve the stress-strain properties.

4. CONCLUSION

The modification of stress and strain properties of KOCC was carried out by the refining and blending with Hobart mixer. It was found that the stress and strain properties whichh is the main problem of KOCC can be overcome by the proper combination of refining consistency, refining degree, and blending treatment without the increase of grammage.

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