SUMMARY

This research aims to study the effect of treating refined paper pulp (high α- cellulose) with different concentrations of sodium hydroxide in presence of 0.5 % zinc chloride on aging of treated paper pulp in order to produce more resisting paper to aging to be used in documents that should virtually have the longest life possible.

For this purpose bleached karft wood pulp (American origin) that contain 87 % α-cellulose, 9.5 % pentosan, 0.3 % ash, < 20 ppm silica and 0.6 % lignin, with 12^{o} SR was used.

Enough amount of pulp was treated each time with different concentrations of sodium hydroxide solution (2, 6, 10, 14and 18 %), then the samples were washed with water till neutralization. Thereafter 10 % acetic acid solution was used to remove any traces of sodium hydroxide, and then washed with water till neutrality. After that each pulp was beaten alone till 50^{o} SR. Enough amount of each sample of paper was prepared for carrying out the study.

To study the effect of accelerated thermal aging on samples, each sample was exposed to thermal aging at 100^{o} C for a period of 24-96 hours, then the mechanical, chemical and physical properties of the samples were studied (for both untreated and treated samples) to find out the most suitable concentrations that can be used to get the ultimate aging-resisting papers. The properties studied were elongation, breaking length, burst factor, X-ray crystallinity and degree of polymerization.

For untreated samples (blank samples) that weren't treated thermally or with sodium hydroxide solution, it found that the elongation decreased with the increase of exposing time to heat and as the same results for the breaking length, burst factor, while both X-ray crystallinity and degree of polymerization found to be increased by increasing of exposure time to heat. On the other hand, in case of treated samples with different concentrations of sodium hydroxide, it was found that the elongation, the breaking length, burst factor, X-ray crystallinity and degree of polymerization decreased with increasing concentrations of sodium hydroxide solution from 2-18 %. For instance, elongation decreased about 22 % which the sample treated 18 % sodium hydroxide and breaking length increased from 2908 m (for untreated sample) to 7397 m after treating with 2 % sodium hydroxide, this can be due to that the cellulose treated with this concentration lead to removal of very small cellulosic chains and in accordance the breaking length increases. Burst factor was found to be largely affected, as it loses 84 % of its value in case of treating by 18 % sodium hydroxide. While X-ray crystallinity loses 25 % from its original value and degree of polymerization loses 45 % from its original value in case of treating by 18 % sodium hydroxide.

For the samples treated by 2 % sodium hydroxide then thermally treated at 100^{o} C for time intervals 24-96 hours, it was found that the elongation, the breaking length and burst factor decreased to different degree as a result of increasing the heating time intervals; while X-ray crystallinity and degree of polymerization increase as a result of heat treatment up to 24 hours then decrease thereafter.

Also the FTIR absorption of the prepared samples focusing on active hydroxyl, carbonyl and carboxyl groups and some others of those found in cellulose, or those formed as a result of treatment by alkali or as a result of heat treatment during aging. The study was accomplished using the partial absorption method (absorption intensity ratio for any wave length : absorption at 1325 cm^{-1}) because it is the suitable method in case of cellulose, as the later is characterized by a high molecular weight that leads to interference in absorption. Also the crystallinity indeces and mercerization depth (that makes the cellulose swell by sodium hydroxide) were measured. Measurements of cellulose, crystallinity indeces was done at A_{1430} / A_{893} and mercerization depth at A_{1375} / A_{1325}.

As a result of treating cellulose with sodium hydroxide and treatment heat some breaking down and oxidation of hydroxyl groups, in accordance the absorption at 3425 cm^{-1} decreased as a result of the formation of carboxyl groups that appear at 1715 cm^{-1}.

Also it was found that the crystallization indeces decreased by the increase of both concentrations of sodium hydroxide solution and heat time intervals, so the decrease in crystallization indeces occurred go 54.6 % in blank samples to 43.1 % in samples treated with 18 % sodium hydroxide, while the crystallization indeces increases from 53 % in blank sample to 54 % in treated samples with 2 % sodium hydroxide, after a period of 96 hours of heat treatment.

In addition, a study of the effect of alkali treatment on the samples, on yield, pentosan, lignin, carboxyl content, whiteness and opacity were carried out, it is found that yield decreased with increasing concentrations

of sodium hydroxide solution (2-18 %) from 96.3 % to 86.2 %, while pentosan decreased from 9.5 % to traces from it with the same increasing concentrations of sodium hydroxide solution.

For the lignin, it decreased from 0.5 % until complete vanishing at 14 % sodium hydroxide; while the carboxylic content decreased from 96.6 meq / 100 g in blank sample to 80.8 meq /100 g after treatment with 18 % sodium hydroxide and the whiteness increased from 66.7 % for blank sample to 83.3 % after treatment with 18 % sodium hydroxide, while opacity decreased from 73.6 % for blank sample to 68.2 % after treatment with 18 % sodium hydroxide.

Scanning electron microscopy was used to study both the untreated and treated samples, and it was found that the groups of fibers was vary in thickness and lengths before the treatment become similar in thickness and lengths as a result of swelling caused by alkali treatment.

It can be concluded from the above results and studies that the pulp treated with alkali (2 % sodium hydroxide) gave samples which are more resistant to aging than in case of higher concentration of alkali and treated with heat for different time intervals arrived to 96 hours.

The elongation affected to a small extent by for either alkali or heat treated, while the breaking length increased by 7 % in samples treated with 2 % sodium hydroxide and by 8 % in samples heat treated for 96 hours; on the other hand burst factor affected negatively by a lower degree after treatment with 2 % sodium hydroxide, while those treated with higher concentrations lead to much decrease in burst factor.

For the crystallization, it was found to be slightly affected by about 1 % at 2 % sodium hydroxide then the effect increases thereafter. The degree of polymerization found to decrease in a ratio of 4 % upon treatment with 2 % sodium hydroxide and the decrease reached to 60 % upon treatment with 18 % sodium hydroxide solution.