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Evaluating the Effect of Photo-Aging on Brightness Property of Soda Paper Produced from Bagasse

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ABSTRACT

This study was done in order to investigate the brightness property of soda paper produced from Bagasse. The paper samples were wetted using chelating agent of EDTA (Ethylene Diamine Tetra acetic Acid) in various concentration levels. This process neutralizes available metallic ions in paper samples. After drying wetted samples with EDTA, they are wetted again by solutions containing transitional metal ions. For accelerating aging tests, a simulated apparatus was used for accelerated light induced aging tests. 6 UV lamps of Black Light and 4 regular fluorescent lamps .The output frequency of photo-aging was in range of 300 to 400 nm. Light induced treatments were implemented in time spans of 0, 10, 20, 30 and 40 hours. All measurements were done on the basis on TAPPI standard. The obtained results demonstrated that increasing concentration of the chelating agent will decrease brightness of the samples significantly, whereas their brightness was increased significantly by extending the aging time. Results revealed that the most prevalent effect on decreasing of brightness property was associated with Fe^{2+} ions while the least considerable one was related to ions of Zn^{2+}.
Keywords: aging, soda, wavelength, brightness, Ethylene Diamine Tetra acetic Acid.

1. INTRODUCTION

A major problem with paper manufactured from pulps produced by chemical methods is the potential brightness reversion upon exposure to sunlight [1].

The low brightness stability, caused by high concentrations of chromophores, limits its utilization [2].

There is also a general agreement that the initial color reversion processes are associated with photochemical processes. In this regard, a number of researchers have attempted to elucidate the mechanism of photodegradation of wood [3], pulp [4-5], extracted lignin [6-7], and lignin model compounds [8-9].

Important intermediates in the photo-yellowing process are phenoxy free-radicals, which are oxidized in the presence of singlet oxygen into chromophoric structures of carbonyl compounds as well as ortho- and para-quinonoids [3].

Chemical modification of potential chromophoric groups has been examined [10-11]. The removal of photosensitive carbonyl groups by reduction was shown to have a limited effect in protecting lignin against photo-degradation.

2. MATERIAL AND METHODS

Samples of soda paper were procured from Pars Paper factory. They were saturated with EDTA as the chelating agent in three levels of 0, 0.5 and 1% for neutralizing metallic ions. The samples were saturated again with solutions containing metallic ions of Fe^{2+}, Cu^{2+}, and Zn^{2+} after being dried.

The resultant samples were dried by mild fan blowing kept out of moisture and direct light. A simulated apparatuses was employed in order to launch hastened optical aging examinations. The output waves had a wavelength range between 300 and 400nm. Brightness treatments were accomplished in 0, 10, 20, 30 and 40 hr intervals.

Measurement of brightness of the papers was done according to TAPPI standard of T524 Om-94[7] using a Technobite Micro apparatuses. Statistical analysis was run by SPSS software. Multi-domain Duncan test was used for comparing the average values earned.

3. RESULTS AND DISCUSSION

Table 1 has summarized results of changes in brightness on different times, EDTA concentrations and metallic ions.

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Table1. Data related to the brightness property of soda paper samples in different times and concentrations of EDTA and metallic ions

Used ion	EDTA %	0 hr	10 hr	20 hr	30 hr	40 hr
Fe^{2+} 0.3ppm	0	72.82	64.34	61.12	60.39	60.29
	0.5	72.89	64.83	61.8	60.91	59.21
	1	72.55	65.37	62.39	60.71	59.8
Cu^{2+} 0.1ppm	0	72.75	68.11	67.26	67.37	65.25
	0.5	72.65	69.29	68.48	67.35	65.85
	1	73.11	69.85	68.83	68.02	66.89
Zn^{2+} 1ppm	0	72.45	68.41	68.41	67.13	66.55
	0.5	72.85	69.11	67.79	67.8	67.11
	1	72.7	69.15	68.35	68.11	67.89

Table2. Duncan test results for studying the effect of ion variable on the brightness Property of soda paper samples

Ion	Subset	
	1	2
Fe^{2+}	64.40	
Cu^{2+}		68.73
Zn^{2+}		68.92

Table3. Duncan test results for studying the effect of EDTA variable on the brightness Property of samples

EDTA	Subset	
	1	2
0	66.84	
1		67.58
0.5		67.63

Table4. Duncan test results for studying the effect of time variable on the brightness Property of paper samples

Time	Subset			
	1	2	3	4
40	64.32			
30		65.31		
20			66.79	
10			67.60	
0				72.75

Table 2 insists that the most and least dominant effects on brightness content of the samples are associated with Cu^{2+} and Zn^{2+} ions, respectively. According to Table 2 it can be argued that the effects of metallic ions in this study are generally in agreement with the results from investigations of other researchers [12-13]which can be summarized by the following relation:

$Fe^{2+}>Cu^{2+}>Zn^{2+}$

Study on different levels of the chelating agent of EDTA in table 3 indicates that the averaged effects of this material in decreasing of brightness for all concentrations are classified in two distinctive groups.

Table 4 clearly shows that each level of optical aging increases the brightness content significantly, while each time duration has individually imposed considerable effect on raising the brightness.

Curves of Cu^{2+} and Fe^{2+} are almost similar. Ni et al. (1998) have concluded that Fe^{2+} imposes much detrimental effect on the yellowness content due to formation of oxygen-bearing radicals. Mn^{2+}, Cu^{2+} and Fe^{3+} have shown almost similar trend while Al^{3+} has incurred the least pronounced effect [14].

4. CONCLUSIONS

The following remarks were made by studying the results of this research:

1) Chelating agents such as EDTA apply a positive effect and cause brightness Property to be decreased in lower ratios when time elapses.
2) Brightness has been increased at longer aging times.
3) The most remarkable effect in raising the brightness content belongs to Fe^{2+} while the least pronounced effect is associated with Zn^{2}.

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