Colour Reduction of Kraft Bleach Effluent By-The Addition of Hypochlorite

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SUMMARY

Calcium hypochlorite was added in the extraction stage of C/E/H bleaching sequence of bamboo and mixed hardwood pulp. Our object was to reduce colour of caustic extraction stage effluent so that it may be recycled again in the process by mixing with grade II effluent. Colour was measured directly from the standard chloroplatinate colour unit curve, which was prepared with the help of Spectrophotometer at 465 nm. Results of present study showed that by the addition of only 1% Calcium hypochlorite in the extraction stage of C/E/H bleaching sequence, colour can easily be reduced by 80% It was found that the total chlorine consumption was higher by 0.25—0.5% in C/EH/H bleaching sequence without affecting the pulp quality. The pulp in fact was superior than the conventional C/E/H sequence pulp.

INTRODUCTION

Effluents from the extraction stage of pulp bleaching are dark brown coloured due to dissolved lignin and lignin-derivatives. Although they are non-toxic but because of their of non-biodegradable nature, it causes aesthetic pollution of river water when it is discharged, hence colour removal become essential.

Woodard etal (1) claimed that 90% colour of pulpmill waste water can be removed by an activated sludge. Ganczarczyk (2) also reported the effective reduction of colour from pulp mill effluent by activated sludge treatment. Berger (3) studied removal of the coloured substance by activated carbon in all the colour waste water of kraft pulp mill and found that the pH adjustment towards acidic side increases colour removal efficiency due to the decrease solubility of lignin at low pH. According to Jauhari and Maheshwari (4) addition of 1.25% Calcium hypochlorite, as active chlorine on pulp basis, can reduce colour of alkali extraction stage effluent remarkably.

Kapoor etal (5) reported optimum doses of hypo for maximum colour and COD reduction of bleach effluent (in the extraction stage) of bamboo and mixed hardwoods of Baster area. Colour removal, of pulp mill waste water, by fly-ash, cinder collected from coal fired boiler, and calcium hypochlorite was also studied by Dubey and Joshi (6). Report concluded that alongwith colour reduction 30% BOD and 45—50% COD is also got reduced. Irrigation and land disposal of pulp mill effluent was studied by Blosser and Owens(7). They found that soil acts as a media for colour removal and intensity of colour removal depends on type of waste applied and the type of soil used.

Subrahmanyam (8-9) reviewed various physical and chemical odour removal methods for pulp and paper mill effluents. Report (9) concluded that chemical methods are economically feasible and beside achieving 90% colour reduction 20—40% BOD also gets reduced. Activated carbon may not be economical for colour removal purpose.

The present study deals with the colour removal of caustic extraction stage effluent by Calcium hypochlorite with main aim of recycling this effluent after treatment. The side effects of this process are studied in detail.

EXPERIMENTAL

Optimisation of C/E/H bleaching sequence to get around 78% PV. brightness was done for

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TABLE—I
OPTIMISATION OF CHLORINATION STAGE OF BLEACHING

Condition & Results	Expt. No. 1	Expt. No. 2	Expt. No. 3	Expt. No. 4
Pulp, g	50	50	50	50
Chlorine applied on pulp %	6 0	6.5	7.0	7.5
Consistency, %	3 0	3.0	3,0	3,0
Temperature, °C	30	30	30	30
Chlorination time, hr.	1.0	1 0	1.0	1.0
Residual chlorine, ppm	71	142	156	213
Chlorine consumption	96.0	92.9	92.8	88 9

TABLE—II
OPTIMISATION OF ALKALI EXTRACTION STAGE OF BLEAHING

Condition & Results	Expt. No. 1	Expt. No. 2	Expt. No. 3	Expt. No. 4
CONDITION				
Pulp, g	50	50	50	50
Alkali on pulp, %	2.5	2 5	2.5	2.5
Consistency, %	5 0	5.0	5.0	5.0
Extraction temperature, °C	55	55	55	55
Time of extraction, hr.	1.0	1.0	1.0	1.0
Hypochlorite as Cl_2 on pulp %	0.0	0.5	1.0	1.5
RESULTS				
K. No. (25 ml) of pulp	5.26	5.06	4.21	3 61
Brightess of pulp, % PV	32 0	34 5	38.0	46.0
Copper number of pulp	1.399	1.272	1.081	1.006
Viscosity (0.5% CED) of pulp, cps	11.75	11.60	11.15	7.91
Colour of effluent, chloroplainate colour unit	7600	3040	1530	1060
Colour reduction %	—	60.0	79 8	86.1

Note :—Chlorination stage of bleaching was constant for all the experiments i.e. Table—I, Expt. No. 1.

TABLE—III
OPTIMISATION OF HYPOCHLORITE STAGE OF BLEACHING

Condition & results.	Expt. No. 1.	Expt. No. 2	Expt. No. 3	Expt. No. 4
CONDITION				
Pulp, g	45	45	45	45
Hypochlorite as Cl_2 on pulp %	3.0	3.0	2 5	2 0
Consistency, %	5.0	5.0	5.0	5.0
Temperature, °C	40	40	40	40
Time of reaction, hr.	2.5	2.5	2.5	2.5
pH during bleaching	9—10	9—10	9—10	9—10
RESULTS				
End pH	9.0	8.5	8.5	9.0
Residual Cl_2, ppm	440	446	327	330
Cl_2 consumption, %	69.7	69.2	73.2	65.8
FINAL RESULTS				
Total chlorine consumption %	9.0	9.5	9.5	9.5
Caustic consumption %	2.5	2 5	2.5	2.5
Brightness, % PV	76.5	77.0	77.5	78.0
Viscosity, (0.5% CED) cps.	6.41	7.00	6 81	6.87
Post colour No.	2.56	2.24	2.91	2.81

Note—Caustic extracted pulps Table—II, Expt. No. 1—4, were taken for the above experiments, i.e. Expt. No. 1—4 respectively.

TABLE—IV

LARGE SCALE BLEACHING—EXTRACTION STAGE
(WITH & WITHOUT HYPOCHLORITE ADDITION)

Condition & Results	Expt. No. 1 (C/E sequence)	Expt. No. 2 (C/EH) sequence
CONDITION		
Pulp, g	400	400
Alkali on pulp %	2.5	2.5
Consistency, %	5.0	5 0
Temperature, °C	55	55
Time of extraction, hr.	1.0	1.0
Hypochlorite as Cl_2 on pulp, %	0.0	1.0
RESULTS		
K. No. (25 ml) of pulp	4.88	4.38
Brightness of pulp, % PV	33.5	39.0
End pH	10.0	10.0
Colour of effiuent, chloroplatinate colour units	7600	1340
Colour reduction, %	—	82 3

Note : Chlorination stage of bleaching was constant for both the experiments (i. e. Table-I Expt. No. 1 condition).

TABLE V

LARGE SCALE BLEACHING—HYPOCHLORITE STAGE

Condition & Results	Expt. No. 1 (C/E/H) sequence	Expt. No. 2 (C/EH/H) sequence
CONDITION		
Pulp, g	400	400
Hypochlorite as Cl_2 on pulp, %	3.5	2.75
Consistency, %	5.0	5.0
Temperature, °C	40	40
Time of reaction, hr.	3.25	3.50
pH during bleaching	9.10	9.10
RESULTS		
End pH	8.5	8.0
Residual Cl_2, ppm	390	177
Cl_2 consumption, %	77.5	85.9
FINAL RESULTS		
Total chlorine consumption %	9 5	9 75
Total caustic consumption %	2.5	2.5
Brightdess, % PV	78.5	78.5
Viscosity (0.5 % CED) cps	7.00	7.12
Copper No.	1.59	1.46
Posl'colour No.	2.11	2.06

Note : Caustic extracted pulps of table-IV exp. No. 1 & 2 were taken for above experiments No. 1 & 2 respectively.

bamboo and mixed hardwoods pulp of 24.47 Kappa No. Results are recorded in Table I-III. Large scale bleaching was then carried out by C/E/H and C/EH/H bleaching sequence saparately under condition mentioned in Table IV and V.

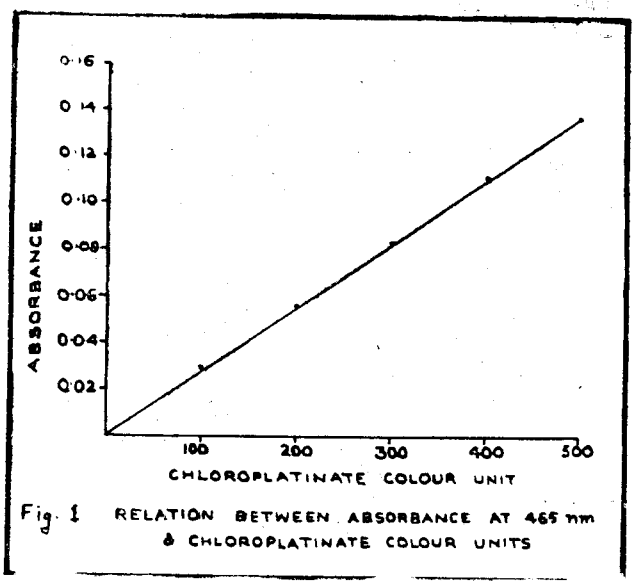

Fig. 1 RELATION BETWEEN ABSORBANCE AT 465 nm & CHLOROPLATINATE COLOUR UNITS

Colour of extraction stage effluent was measured directly from the Standard chloroplatinate colour unit curve with the help or spectrophotometer at 465 mm as the maxima of standard colour samples lies at this wavelength. The standard curve (Fig. 1) was prepared according to Tappi standard method employing a Systronics spectrophotometer Type 106 (MK-II).

Colour reduction results are recordcd in Table II and IV and al o dispicted in Fig. 2. Brightness, Viscosity (0.5% CED) and Copper No. of C/E, C/EH and C/E/H pulps were determined according to standard procedures (Table II-V). Post-colour Number of bleached pulps were also found out after aging the pulp in an oven at 105°C for 18 hrs. (Table III-V).

Physical strength properties of C/E/H and C/EH/H bleaching sequence bleached pulps were found out using standard methods of beating, sheeting and paper testing. Results are recorded in Table VI and VII.

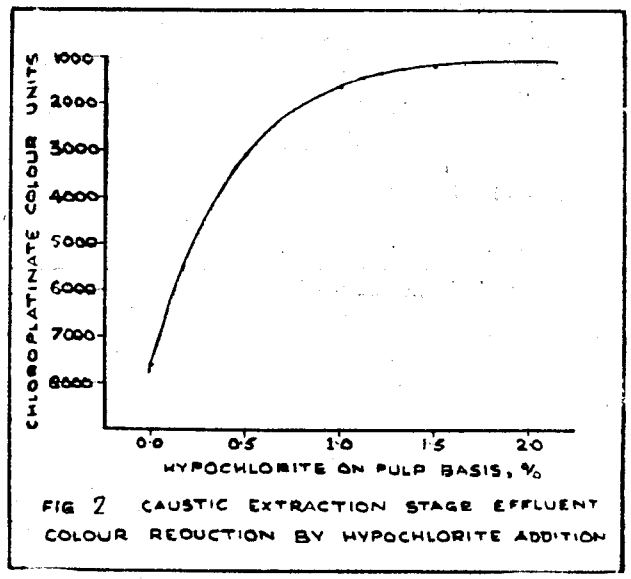

FIG 2 CAUSTIC EXTRACTION STAGE EFFLUENT COLOUR REDUCTION BY HYPOCHLORITE ADDITION

TABLE VI

BLEACHED PULP EVALUATION

Tested For	Freeness of pulp during sheet making		
	32	43	48
Beating time mts.	25	31	36
Basis weight, gsm	59.87	58.52	58.67
Caliper, microns	94.6	90.4	82.2
Tensile strength, kg/15 cm.	5.325	6.175	6.575
Breaking length	5930	7035	7471
Stretch, %	1.87	1.90	1.82
Bursting strength, kg/cm²	2.125	2.400	2.562
Burst factor	35.49	40.01	43.67
Tearing strength, gms	72	84	68
Tear factor	120.26	143.54	115.90
Double folds	98	160	280

Note : Initial freeness of the pulp was 16 SR.

TABLE VII
BLEACHED PULP EVALUATION

Tested for	Freeness of Pulp during sheet making 32	42	48
Beating time, mts.	25	31	36
Basis weight, gsm	61.15	60.67	61.80
Caliper, microns	95.2	93.0	92.2
Tensile strength, Kg/15 cm.	6.100	6.475	7.125
Breaking length	6650	7115	7686
Stretch, %	1.95	1.90	1.97
Bursting strength, Kg/cm^2	2.425	2.725	2.962
Burst factor	39.66	44.92	47.93
Tearing strength, gms.	64	88	70
Tear factor	104.66	145.05	113.27
Double folds	214	326	360

Note : 1 Initial freeness of the pulp was 16.SR.
2. Hypochlorite, 1% on pulp, was added in the extraction stage of bleaching.

RESULTS AND DISCUSSIONS

It is observed from Fig-2 that colour of the effluent decreases with the increase in the amount of calcium hypochlorite added in the extraction stage of bleaching. It is also found out that further addition of hypochlorite beyond 1.5%, on pulp basis, has no significant effect on the colour removal of the effluent. The colour load can easily be reduced to the extent of 80% by the addition of only 1% calcium hypochlorite on OD pulp basis, during extraction stage of bleaching.

The pulp was bleached by C/EH/H bleaching sequence to get around 78% Pv brightness and compared with C/E/H sequence. It is found that the total chlorine consumption was higher by 0.25—0.5% in C/EH/H sequence without affecting the pulp quality. The pulp, in fact, was superior than the conventional C/E/H sequence pulp as evident by higher brightness and Viscosity (TableV) and superior physical strength properties (Table VI and VII).

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