Modified Conventional Causticizing (MCC) - A Step Towards Cost Reduction

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ABSTRACT

Paper industry in India is a century old industry. The industry has seen many ups and down with economic, environmental and energy issues. The industry is now strongly facing global competition and hurdling with lack of funds to adopt advanced technologies. In this competitive world cost reduction is a major challenge before the industry for it's survival. The cost of production is affected by two major factors i.e. internal and external. External factors are governed by the others while internal factors i.e. plant efficiency and energy consumption are in the control of industry itself. The internal action can be taken by adoption of new technologies which few of the paper mills already have adopted. However most of the mills are still at cross roads due to their inability to adopt these modern technologies due low scale of operation and high capital investment. For techno-economical reasons, these mills have to think towards indigenously low cost system to minimize the cost of production. In most of the paper mills, causticizing is a gray area due to high investment and hence becomes the limiting factor for capacity enhancement.

The objective of this study was to mix green liquor with final white liquor to increase the production of white liquor at lower cost. The effect of green liquor charge and method to mix it with white liquor have been studied using a rule of proportionate mixing concerning concentration of hydroxyl ion, sulphides and carbonates.

Introduction

Ours is a developing country with ever increasing demand of paper and boards. The wood based paper mills are mainly using mixed hardwoods, veneer waste etc. Most of the wood based paper mills are based on sulphate cooking where the cooking liquor contains NaOH, Na_2S, Na_2CO3, Na_2SO4. Due to increase in the cost of energy, chemicals and other inputs, paper industry has to think very deeply for economical use of chemical and energy. The responsibility towards environment also cannot be ignored while cutting the cost of production. Various possibilities are available to meet these demands. One possibilities is with the incorporation of latest technological development in the field of causticizing. But this can be very costly and most of the mills may not be able to afford this. Such mills can consider conventional causticizing section with modified process of mixing green liquor and white liquor before charging to digestor for cooking. The sulphidity and CE can be maintained at required level in this modified process i.e. mixing of GL and WL. This concept is based on some calculations and literature reviews, further study would be required before adopting proposed system in Indian paper mills.

Concept

Kraft pulping process done by addition of cooking chemical which consist of the active alkali and high sulphidity for good strength of the paper. During the cooking cycle there is a loss of chemicals in the system. These chemicals are made up by Caustic and Saltcake. The mixing of make up chemical caustic results in reduction of sulphidity (Table -2) of white liquor to pulp mill which adversely affects the cooking of wood resulting in poor pulp strength.

The sulphidity can be maintained by increasing the addition of salt cake but this has some limitations. Another approach to maintain the sulphidity level is the addition of green liquor to white liquor to prepare Mixed liquor (ML) (Table-3). For better cooking initially the hydrosulphide concentration should be high and the hydroxyl ion should be consistent through out the cook. So the green liquor is better alternate option for hydrosulphide enrichment. Initial high level of hydrosulphide increases the initial delignification and presence of carbonate provides the more uniform buffer through the digester. While the oxidation reduction studies [Wendall M. latimer, "Oxidation potential," 2nd edition., Pretice hall, Englewood Cliffs,N.J, 1952, P 77] already shown that hydrogen sulphide ion has much greater reducing power, due to less anionic strength of the carbonate compared to sulphate and chloride and has effect to help in better removal of the lignin during delignification stage.

Approach

There are following two methods in practice to mix make up

Table -1 (Typical Composition of Green liquor and White Liquor)

S.No.	Component	Green liquor concentration, g Na_2O/l	White liquor concentration, g Na_2O/l
1	NaOH	15.5	68.2
2	Na_2S	18.6	17.6
3	Na_2CO_3	71.3	16

caustic in white liquor.

- Regular basis - Continuous dosing of dilute caustic in white liquor
- Batch basis - Supply a separate batch for a particular digester.

Both the above methods have adverse effect on sulphidity as shown in the table-2 below.

Table - 2 (Effect of Caustic Dosing on Sulphidity)

Particulars	UOM	W/L	WWL	Caustic	Mixed Liquor
NaOH	gpl	68.2	15.5	465.0	67.43
Na_2S	gpl	17.6	0.1	0.0	16.72
Na_2CO_3	gpl	16.0	0.0	0.0	15.20
TTA	gpl	101.8	15.6	465.0	99.35
Volume of liquor	**m^3**	**97.5**	**2.0**	**0.50**	**100.0**
NaOH	MT	6.5	0.031	0.23	6.7
Na_2S	MT	1.7	0.000	0.00	1.7
Na_2CO_3	MT	1.5	0.000	0.00	1.5
Total		9.7	0.0	0.2	9.9
Causticizing Efficiency	%	81.0			81.6
Sulphidity	%	20.5	0.6	0.0	19.9
AA	gpl	85.8	15.6	465.0	84.1

To maintain sulphidity uniform and at higher level, it is proposed to mix Green liquor along with Caustic in White Liquor as shown in the following table-3. In this method the all liquor provided to the pulp mill is having the same level of sulphidity for the cooking.

Table 3 (Proportion of various Liquor in Mixed Liquor)

Particulars	UOM	G/L	W/L	WWL	Caustic	mixed/L
NaOH	gpl	15.5	68.2	15.5	465.0	67.81
Na_2S	gpl	18.6	17.6	0.1	0.0	17.19
Na_2CO_3	gpl	71.3	16.0	0.0	0.0	16.98
TTA	gpl	105.4	101.8	15.6	465.0	101.98
Volume of liquor	**m^3**	**2.5**	**95.0**	**2.0**	**0.50**	**100.0**
NaOH	MT	0.039	6.5	0.031	0.23	6.8
Na_2S	MT	0.047	1.7	0.000	0.00	1.7
Na_2CO_3	MT	0.178	1.5	0.000	0.00	1.7
Total		0.264	9.7	0.0	0.2	10.2
C. Eff.	%		81.0			80.0
Sulphidity	%		20.5	0.6	0.0	20.2
AA	gpl	34.1	85.8	15.6	465.0	85

Effect of the Mixed Liquor on the Lignin Removal

Hydrosulphide absorption to the wood chips results into the better penetration of liquor to dissolve the lignin at temperature(i.e.<140 °C) and this speed the bulk delignification. Therefore it is better to maintain higher sulphidity The rate of the delignification increases as the cooking temperature increase to 140°C. In this phase the high concentration of OH^- ion compared to HS^- ion leads to bulk delignification. The concentration of the OH^- leads in the residual delignification. The residual alkali is maintained to prevent the re-condensation of the lignin.

The degradation of the carbohydrate in the early cook is reduced by lower initial alkali concentration by making ML which is rich in the HS^-/OH^- ratio during impregnation and the lignin condensation reaction in residual delignification is reduced by maintaining higher alkali recovered from causticization .

Impact Analysis

Expected impact on cooking is due to higher concentration of carbonates

Effect on cooking

Carbonate is not having the direct impact but at initial cooking time carbonate dissociate into the CO_3^- ion which is helpful in providing uniform buffer at basic PH. This is helpful for the dissolution of the lignin. But the carbonate presence increase small cooking time due to increase in the time of residual delignification.

Effect on Pulp Washing:

Pulp washers normally recovers 98% of the cooking chemicals added in the digesters. The increased dead load may affect the washing operation due to increased carbonate in cooking liquor. Slight more care is required to have better washing at pulp washers.

Effect on Evaporators

Increased dead load may have some impact on Evaporators' operation due to increased carbonate in the liquor. However quantity of increased carbonates is too less to have very high impact.

Cost Saving

No doubt, technology always pays back provided one can afford it. But small

adjustment in process with affordable investment can be tried to achieve the proportional benefits. The expected benefits with the proposed process are as under table-4.

Table-4 Expected benefits listed below.

Unprocessed Green Liquor	m^3	2.5
LP Steam/m3 of G/L	Kg	50
LP Steam Saved	MT	0.125
Cost of Steam	Rs/MT	1200
Annual Savings	Rs,Lakh	0.495
Lime / m3 of GL	Kg	60
Lime Saved	Kg	150
Cost of Lime	Rs/Kg	6
Annual Savings	Rs,Lakh	2.97
Extra W/L Produced	m^3	0.9
Annual Savings	Rs,Lakh	1.5
Total Savings	Rs,Lakh	5.0

Conclusion

The Modified Conventional Causticizing will definitely reduce the load on the causticizing section and will result in increased production due to more white liquor generation without very huge investment. The actual saving potential in terms of steam, lime and chemicals will depend on individual mill's conditions and requirements.

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