R.L. BAHETY
GEORGE JOSEPH
DR. KABRA

REBURNING OF LIME SLUDGE—OUR EXPERIENCE

INTRODUCTION

In pulping process, specially kraft, the recovery and recycling of the soda chemicals for reuse is the most essential for obvious economical reasons. In the process sodium hydroxide is derived by the action of lime on sodium carbonate formed during the process. This chemical conversion is accomplished during recausticizing process.

Mavoor Pulp Plant

Gwalior Rayons Pulp Division is located at Mavoor near Calicut (Kerala) and the mill produces rayon grade pulp using bamboo and other hardwoods as raw material. Daily production of the mill is about 190 Tons and about 85–90 Tons of active alkali as Na_2O is required for the process. Originally the mill was designed to manufacture rayon grade pulp from bamboo, however bamboo having been flowered and partly exausted in the forest, the mill started using other hardwoods after careful studies of available species. The recausticizing system of the mill is supplied by Ms. Dorr Oliver. The Lime Kiln was supplied by Ms. Metex Co-operative Corporation (Finland).

Recausticizing Process

The Chemistry of the Causticizing reaction is simple and conversion of the sodium carbonate to sodium hydroxide can be presented by the following equation.

$$Na_2CO_3 + Ca(OH)_2 = 2\,NaOH + CaCO_3$$

This causticizing reaction proceeds by virtue of the smaller solubility of calcium carbonate as compared to calcium hydroxide. The solubility of calcium hydroxide in water is reported to be 10^{-2}g moles/lit. and that of calcium carbonate in water is 2×10^{-4}g moles lit. Even though this chemical reaction is very simple the process involves number of unit operations, such as thickening, clarification, filtration, washing, classification, maxing, calcining, material handling. The process is a closed circuit involving solid as one cycle and liquor as another. The solid after recausticizing is in the form of calcium carbonate usually known as lime sludge.

For economical running of any pulp mill it is not only necessary to convert sodium carbonate to required sodium hydroxide but also use lime sludge again after reburning. In addition to this economical advantage, the problem of disposal of lime sludge cannot be overlooked by the mill.

Problems in reburning lime sludge

Theoretically speaking recausticizing should be a complete closed system and no lime stone or lime shell should be required from out side. Unfortunately reburning of lime sludge is not so simple and the mill must scrutinise all causticizing steps in order to achieve successful reburning of the sludge to its maximum efficiency. The important problems facing reburning of sludge are:

(i) Higher soda content;
(ii) Acid Insoluble accumulation in the sludge
(iii) Low dry content of the sludge;
(iv) Under or over burning of the sludge;
(v) Dust formation;
(vi) Ring formation in the Kiln.

Approach to the problem

Our mill even though originally designed for reburning sludge found it difficult to do so for all the problems mentioned above. The typical analysis of the sludge originally produced is given in Table I. The two lime mud washers and an Oliver Filter failed to produce lime sludge low in soda content so that it could be reburned in the kilm. Mill authorities called for technicians to go into the problem and suggest possible measure to achieve originally planned reburning of the sludge. The problem was viewed in different directions and possible solutions suggested were:

(a) Addition of one more Oliver Filter;
(b) Addition of one more Lime Mud Washer;
(c) Use of additives in order to improve sludge settling.

Finally after weighing the pros & cons it was decided to go ahead in putting additional lime mud washer. Even after this additional mud washer it was noted that soda content in the sludge had not gone down to the desired level and the problems were

(i) Load on white liquor clarifier was high;
(ii) Sludge settling in mud washers was poor.

Due to overload of white liquor clarifier, mud of low consistency was pumped out, with the result more alkali was carried to filter. In order to overcome these difficulties quality of lime was improved and temperature of white liquor slurry fed to white liquor clarifier and mud washers

R.L. Bahety, Technical Superintendent
George Joseph, Chief Recovery Superintendent
Dr. Kabra, Chief Chemist Gwalior Rayons Pulp Division, Mavoor.

TABLE I

CHEMICAL ANALYSIS OF LIME SLUDGE

Character	A	B	C	D
Dry content	45–50	45–50	55–58	55
Free alkali as Na_2O	1.5–3.0	1.5–1.9	0.5–0.7	0.4–0.5
Free Lime	0.1–0.3	0.1–0.3	0.5–0.7	0.5–0.7
Acid Insolubles	7–10	7–10	2–3	3–5
$CaCO_3$	75–80	75–80	85–90	83–88
Mg as MgO	0.8–1.2	0.8–1.2	0.8–1.2	1–1.4

A = When 100% bamboo in use, only two lime mud washers
B = Sept '66 100% bamboo—Three lime mud washers in operation
C = 60% bamboo and 40% wood. Third lime mud washer working.
D = 60% bamboo and 40% wood. Sludge, reburning 55-60%

TABLE II

ANALYSIS OF BURNT LIME

Character	A	B	C
Available CaO	75–85	75–85	75–85
Acid Insoluble	3–5	1–2	3–5
Mg as MgO	0.8–1.2	0.8–1.2	1–1.4

A = When 100% bamboo in use. No reburning of sludge
B = 60% bamboo and 40% wood—40% sludge reburning
C = 60% bamboo and 40% wood. Sludge reburning about 50-60%

was increased. Steady quantity of wash water was added to mud washer.

For better settling of mud flocal TN-40 was tried and found to give better results. With the help of all these measures alkali content in lime sludge was reduced to a desired level so as to make it suitable for reburning. Oliver filter efficiency was improved to get higher dry content in the sludge.

After these improvements sludge reburning was started in December 1967 starting with 40% sludge. We have found that dry content of the material after chain is to be maintained between 85–90% and free alkali of lime sludge to be maintained between 0.4–0.5%. Our experience has shown that free alkali below 0.4% gives rise to dust nuisance in the kiln. Initially sludge reburning was done on alternate days and as process was established sludge reburning was increased and to-day Mavoor plant is reburning 80–90% of the sludge. In Table I and Table II analytical results for lime sludge and burnt lime are presented for comparison. It may be pointed out here that normally silica content of lime feed mud is expected to be between 0.5 to 1% in foreign countries. However for Indian Hardwoods and especially bamboo this figure reaches as high as 10%, since causticizing reaction is also accompanied by desilication process converting sodium silicate to insoluble calcium silicate. Thus when 100% bamboo is used for pulping it is suggested that desilication process by means of lime addition to weak black liquor should be given considerable thought. Here at Mavoor due to shortage of bamboo the mill has shifted to other hardwood species which has resulted in low silica content in black liquor and thus silica problem in lime sludge was automatically solved.

Conclusion

1. Reburning of lime sludge eventhough practiced in foreign countries is not found possible in our country due to various difficulties. Mavoor has taken steps to overcome these difficulties and to-day we are successfully reburning 80% of the sludge.

2. Reburning of sludge is not only economical but most essential to avoid white mountain accumulating on factory site.

3. Our experience shows that lime sludge with free alkali of 0.4 to 0.6% and silica content of 3–5% gives less problems during reburning.

4. Dry content after chain conveyor is to be maintained between 85–90%.

5. Temperature of liquor slurry to white liquor clarifier and mud washers is to be kept between 95–100°C for better settling.

6. Settling aids give better settling of the sludge.

7. If only bamboo is used in the process desilication process by means of lime addition to black liquor is recommended to avoid silica build up in the lime sludge.

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