Utilization of lime

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SUMMARY

An integrated Pulp and Paper mill consumes about 450/500 kgs of Lime per ton of paper. The Paper Mills in the country have not much selection of this commodity for reasons of economy. In spite of this constraint, it is felt that certain steps can be taken to improve the overall performance of this commodity. Based on exhaustive experiments and long experience, it has been observed that judicious selection of quality to the extent possible and certain procedures/ precautions adopted for mode of packing transportation, storage and consumption can have an overall impact on effective utilization of this raw material.

This paper discusses briefly these aspects and also presents a comparative study on the quality of lime available from various possible sources.

Pulp and Paper Industry consumes about 450-500 kgs of Lime of 65/70% purity per ton of paper. The paper units scattered all over the country cannot always be selective for its procurement due to consideration of freight and long lead time, which otherwise results in high inventory and consequent deterioration in its available CaO content during storage. For few mills to have their own Kilns at their site to solve the above problems, transportation cost of limestone becomes prohibitive and here again the mill cannot be selective for limestone quality. Hence, keeping the practical aspects into consideration, the mill feels contented with whatever quality of lime it gets. Can something be not done to improve upon the situation? Based on exhaustive experimentations and long experience, certain steps to be taken for judicious selection of quality, mode of packing in transportation, storage and consumption which can pay rich dividends, have been discussed.

QUALITY

Quality of lime available in the major areas varies considerably with respect to its purity and proportion of Silica, Oxides of iron and Aluminium and Magnesia etc. A comparative study from some of the sources is shown in table-I. In general, the purity of lime is found to vary from 50 to 85% but the high purity lime usually has a demerit of deterioration at a faster rate; whereas lime with high silica and Magnesium content poses the difficulties in its processing. Certain qualities have poor slaking characteristics due to low porosity. Similar is the behaviour of limestone which have different burning characteristics and to the extent possible, should be burnt separately. Analysis from few sources is given in table-II.

It is of common knowledge that lime deteriorates in its purity and lumps turn into powder when exposed to atmosphere and humidity, which depends upon the extent of exposure. Hence, an effort has to be made to reduce this exposure as discussed in foregoing paras.

PACKING & TRANSPORTATION

Whenever lime is transported from long distant sources by road or rail, it is advisable to get the same packed in polythene lined gunny bags. The doors of the wagon, as well as, the top of the material should be covered in an airtight manner with thick polythene sheets. The same mode of

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packing can also be applied to lorries. The additional cost is adequately compensated by preserving its quality. Supplies in open wagons should be avoided. Nevertheless, under unavoidable circumstances an adequate covering with tarpauline becomes a necessity in order to prevent deterioration in transit as it takes quite long time, especially in the present context.

Studies indicate that with and without the above modes of lime packing, the reduction in calcium oxide percentage goes down by 3.0-5% and 10-15% respectively depending upon the transit period.

UNLOADING & STORAGE

Packing in polythene-lined gunny bags, besides protecting the material from deterioration, helps and eases the operation and wastage during unloading. Also storage is facilitated and the keeping quality is improved. A detailed study on the keeping quality of lime with and without polythene-lined bags indicated (table-III) a very high difference in the two packing modes, the prior being much better.

TABLE—1 COMPARATIVE ANALYSIS OF LIME FROM DIFFERENT SOURCES WHEN RECIEVED AT THE MILLS.

Sl. No.	Particulars %	Katni	Maihar	Jukehi	Sutna	Piduguralla	Dronachalam	Shell L me
1.	Loss on ignition	4.0-6.0	3.8-5.0	3.5-5.0	4.5-5.0	10.0-12.0	6.0-8.0	9.0-11.0
2.	Acid insolubles	2.0-2.5	4.0-4.5	4.0-4.5	6.5-7.5	8.0-10.0	3 0-6.0	0.5-1.5
3.	R_2O_3 (Al & Fe)	1.0-1.5	4.0-5.0	4.0-5.0	5.8-7.0	4.0-5.0	2.0-4.0	1.0-1.5
4.	Cao	90-92	84-86	83-86	79-81	72-74	82-85	85-87
5.	Mgo	0.8-1.0	1.0-1.5	1.0-1.5	1.4-1.5	1.5-2.0	0.5-1.0	0.3-0.5
6	Available CaO	77-82	72-78	72-78	63-72	55-65	65-70	72-74

NB : Lime with a purity around 85% has been found from Limestones from certain areas in Katni and Dronachalam as well as shell when burnt properly.

TABLE – 2 COMPARATIVE ANALYSIS OF LIMESTONE FROM DIFFERENT SOURCES

Sl. No.	Particulars %	Maihar	Jukehi	Sutna	Piduguralla		Dronachalam
					White/grey variety	Black variety	
1.	Loss on ignition	40.41.0	40.0-42.0	39.0-41.0	39.5-41.5	30-32	40.0-42.5
2.	Acid insolubles	5.0-6.0	3.0-4.5	5.8-7.0	2.5-6.5	26-28	2.5-4.0
3.	R_2O_3 (Al & Fe)	2.0-2-5	1.5-2.0	2.5-3.2	1.0-2.0	1-2	1 0-3.0
4.	Calcium as CaO	50-51	51.5-53.0	49.5-50.0	50.0-53.0	36-39	50-53
5.	Magnesium as MgO	1.0-1.5	0.6-1.0	1.0-1.5	0.4-0.6	1-2	0.0.5
6.	Purity of stone	90-92	92.5-94.0	88 90	90-93	65-70	92-95

TABLE—3 KEEPING QUALITY OF LIME WITH AND WITHOUT POLYTHENE LINED BAGS

Particulars	CaO % when received	CaO % with bags		CaO % without bag	
		After 15 days	After 3) days	After 15 days	After 30 days
Sample I	73.6	67.6	61.2	60.2	50.4
II	66 0	62 0	57.6	54.8	48.6
III	70.4	66 8	61.6	52.6	49.8
IV	68.8	65 0	60.0	51.4	50.2
V	70.0	65.8	61.2	50.8	47.8
VI	70.8	66 0	60.8	51.6	49.4
AVERAGE	70.0	65.4	60.0	53.6	49 4
%Deteriorat on		6.57	14.14	22.86	29.14

Series of experiments on bench scale have shown that with a lapse of 15-20 days, when lime is exposed to atmosphere at 30°C and 65% RH, the available Calcium oxide content gets reduced by about 16-25% depending upon the initial purity of lime—the higher the purity, the faster the rate of deterioration. Deterioration in quality would lead to handling and processing of higher quantity of inerts with obvious disadvantages.

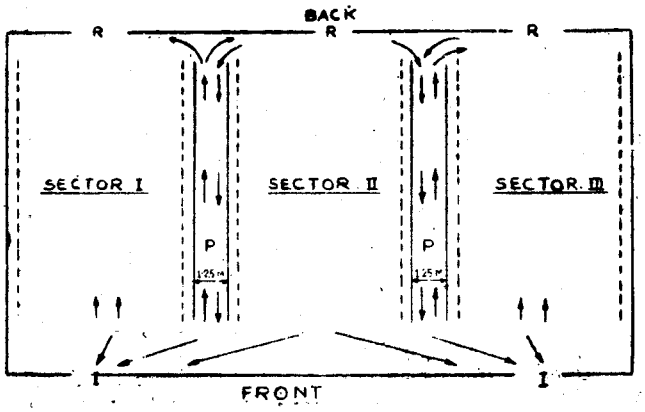
The Mills, which neither have their own kilns nor nearby sources of lime, have to maintain adequate inventory with them. This, at times, goes very high. Under such circumstances, proper storage plays a significat role and if it is neglected, it brings about drastic deterioration in lime quality. Hence the following steps have been proposed :

i) In case of bags, the height of the stack should not exceed the point when bags at lower level start tearing off.

ii) The stock, especially when it is in loose form, should have an adequate polythene covering to avoid direct contact with atmosphere.

iii) Stacking should be arranged in such a manner so that first come first serve principle is followed. A symbolic sketch of such arrangement is given in Fig. I.

iv) Stacks should be at certain distance apart from the wall to prevent its direct contact with lime.



In this context, also the role played by the godown cannot be undermined. If it is not properly constructed and maintained, nothing much can be done. A few requisites of an ideal godown are as under :—

a) As far as possible, it should be away from moist and humid places in the Mills.

b) There should be no windows and ventilators. There should not be any leakage from the roof.

c) The openings for receipts and issues should be of minimum possible size and provided with air-tight doors/shutters. They should be kept open as and when required only.

From the above, an inference can be drawn that the deterioration in quality would depend upon the mode of packing, transit period, method of storage, design of godown and the lead time between receipt and consumption.

CONSUMPTION

First come first serve principle, as explained before pays rich dividends, especially in case of high inventories. The lime stored at incorvenient places like backside of the godown, wallside or at the bottom layer of the stacks is completely deteriorated because of its long storage period.

Size of lumps of lime plays an important role. As the bigger size lumps do not react fully within the available reaction time, most of these are thrown out of the system unreacted. Experience has indicated that for effective utilization, the size of lumps in range of 10 to 15 mm is ideal. Unburnt stones should be segregated before the feeding point of lime in the plant, else their presence will pose a risk of jamming at the crusher and even damage the equipments.

Air slacked or carbonated lime powder, having a Calcium oxide content of 45-55% leads to poor clarity of white liquor, besides its higher consumption. A bench scale study of lumps Vs powder form of lime for getting white liquor with same causticizing efficiency, the results, as shown below, leads to similar observations as that of lime with higher purity Vs lower purity as discussed later.

Use of Lime : Lumps Vs. Powder

	Particulars	Powder	Lumps
i)	Available CaO % in Lime	52.0	72.0
ii)	Temperature of Reaction (°C)	100/102	100/102
iii)	Time of reaction (min)	60	60
iv)	Causticizing efficiency (%)	81.0	81.3
v)	Clarity of white liquor after one hour settling (ppm)	746.0	643.0
vi)	Lime required in kgs/kg of white liquor	1.28	0.92

Another important factor for the effective utilization of lime is the temperature during causticizing and green liquor concentration. A minimum temperature of 97-98°C and concentration of 115-120 gpl. as Na_2O may be considered optimum. Below this temperature and beyond this concentration, chances of unreacted material going out of the system increase. Obviously, these conditions might vary from mill to mill.

Experience has shown that lime dosage is also an important factor. Excess lime by 1.0% or so over the equilibrium quantity can cause higher turbidity in white liquor and lower filtration rate. Efficient washing of the cake is also impared and the cake moisture runs higher. Varying lime feed dictated by the variation in temperature is poor practice as it can result in excess liming leading to the above disadvantages. Stacking temperature control should be obtained through the regulation of green liquor temperature only.

HIGH Vs. LOW PURITY LIME

Long exhaustive trials with lime of 60 and 70% purity led to the following conclusions :—

(i) with high purity lime, one ton of white liquor requires 0.85 T against 1.00 T of 60% purity, thereby reducing the consumption by 15.0%.

(ii) Handling of wet filter cake, slacker and classifier grits are reduced to the extent of 30%.

(iii) The capacity of the causticizing plant increases by 10-12%.

(iv) Alkali loss in filter cake as NaOH is reduced from 0.40 to 0.27%.

(v) The clarity of white liquor, rate of settling and compactness of the sludge are improved.

BLEACH LIQUOR PREPARATION

Quality of lime plays an important role in the preparation of bleach liquor also. Excessive impurities like overburnt and underburnt lime lumps, silica and iron etc. present in the lime lower down the capacity of the plant and erode the equipments. With the available CaO content going down, the consumption increases resulting in poor settling and increased sludge and chlorine loss.

The study indicates that lime consumption and sludge quantity reduce by about 15% and 35% respectively when lime with 70% purity is used against 60%. The clarity of liquor in case of low purity lime, is poor with the related disadvantages like slow brightness development of pulp, higher chlorine demand, lower viscosity, increased ash content and lower beating characteristics etc. as observed by some workers in the field. High alum requirement during sizing and tendency for scale formation are the other disadvantages.

CONCLUSION

Lime varies in quality in wide range from source to source and in the prevailing conditions in our country, one cannot be selective. Nevertheless, with proper packing and covering during transportation, scientific stacking and storage methods and its consumption, a significant improvement in the direction of effective utilization of lime can be achieved. The lime with higher purity results in lower consumption of lime, decreased quantity of sludge and other wastes, reduced residual Alkali content in the lime sludge and White/bleach liquor of better clarity. Besides, the plant capacity is increased. The economics for the use of high purity lime has not only to be judged on the face value of its cost but after taking into consideration all relevant advantages—tangible as well as intangible. Especially, if it is of great importance to the plants where adequate causticizing or bleach liquor capacity does not exist.

ACKNOWLEDGEMENT

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