National Council for Cement and Building Materials

LIGNITE, AN ALTERNATE FUEL FOR CEMENT INDUSTRY

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NCB TECHNOLOGY DIGEST

LIGNITE, AN ALTERNATE FUEL FOR CEMENT INDUSTRY

INTRODUCTION

THE frequent and wide variations in the quality of available coal, its inadequate supplies and transportation bottlenecks necessitate search for alternate fuels for cement manufacture. Lignite is one such possible alternate; it has low ash content and relatively higher calorific value as compared to the coal generally made available for cement manufacture in India. Cement plants located in states far from the coal fields but near to lignite deposits (Fig. 1) can profitably use lignite. In fact successful attempts have already been made by some cement plants with encouraging results in terms of efficient operation, improved quality of clinker and reduction in energy costs. This Technology Digest evaluates lignite as an alternate fuel for cement manufacture and based on NCB's R&D work, suggests the way it could profitably be exploited.

RESERVES OF LIGNITE

The total lignite reserves in the country are estimated at over 6300 million tonnes scattered in Tamil Nadu, Rajasthan, Gujarat, J&K and Kerala, with Tamil Nadu alone accounting for about 78% of the total. State-wise break-up of lignite reserves is as follows :

Tamil Nadu	4930	Million Tonnes
Rajasthan	840	Million Tonnes
Gujarat	380	Million Tonnes
J&K	90	Million Tonnes
Kerala	100	Million Tonnes
	6340	Million Tonnes

CHARACTERISTICS OF LIGNITE

Lignite is characterised by high moisture, high volatile matter (VM), low ash content, and highly reactive nature. The composition of lignite varies from deposit to deposit. In general, run-of-mine lignite could

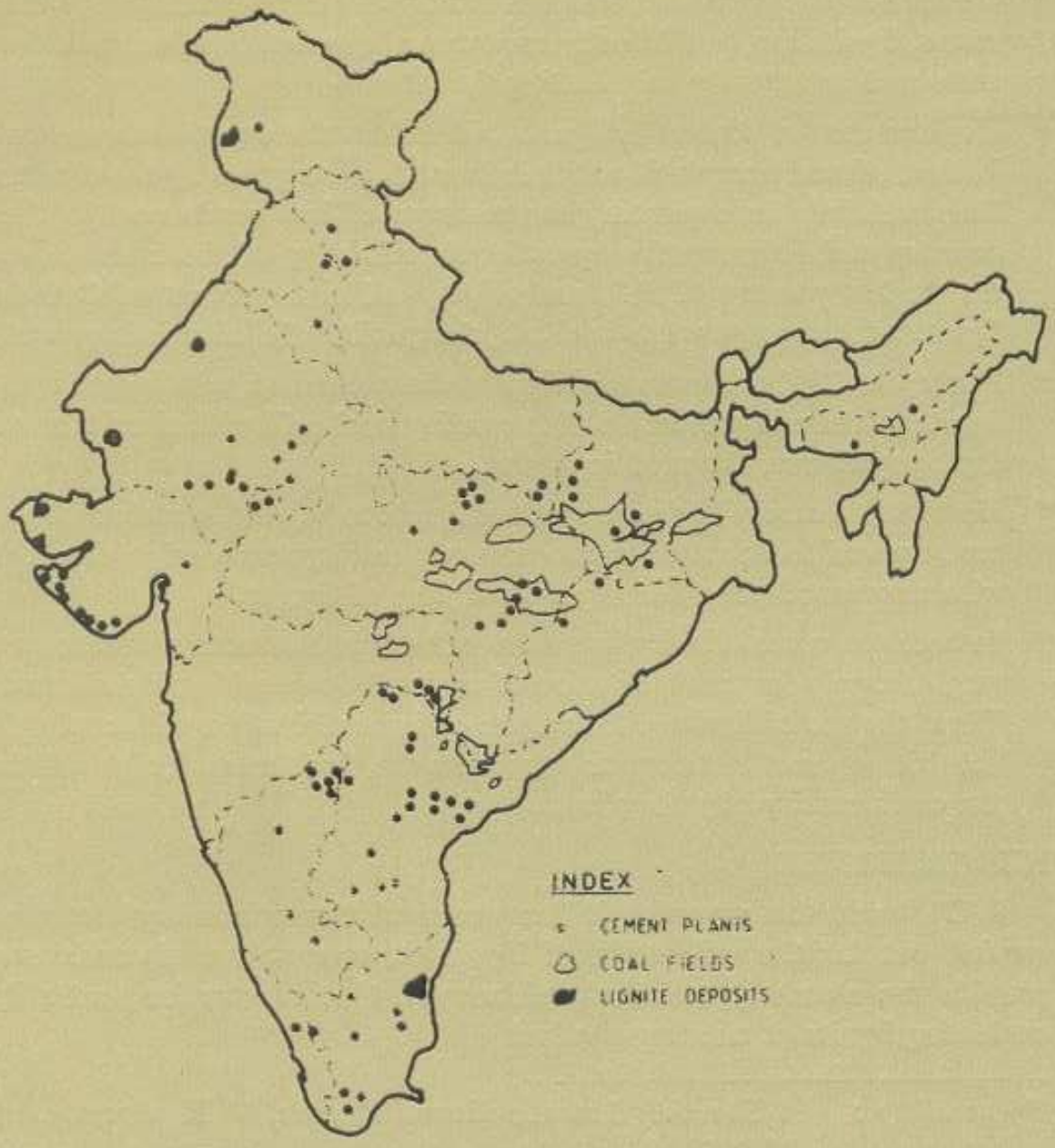

Fig 1 Coal and lignite deposits as well as cement plants in India

contain 30-50% moisture, 20-30% VM and 3-10% ash. On air dried basis, it contains 45-60% VM and 5-20% ash against coals which have low VM in the range of 24-32% and high ash content of 30% or more. Lignite predominantly contains fines with a maximum size of 200 mm.

The analysis of lignite ash indicates that it contains high CaO, MgO and low Al_2O_3, SiO_2 as compared to ash from coal. The analyses of lignites from various deposits in the country are shown in Table 1.

ADVANTAGES OF USING LIGNITE

The amount of ash that enters the kiln when using lignite as a fuel, is reduced both on account of low ash content in lignite and less fuel consumption by virtue of its higher calorific value. This makes it possible to use marginal grade limestone, thus conserving high grade limestone. Further, it improves the quality of clinker for a given raw mix. Other advantages that can be obtained by using lignite as a substitute fuel are :

* Utilisation of available lignite deposits
* Improvements in productivity
* Reduction in load on railways for transportation of coal
* Less dependency on availability of coal
* Exploitation of low grade limestone reserves

PROBLEMS IN THE USE OF LIGNITE

Use of lignite as a fuel in cement manufacture has certain inherent problems owing to its high moisture content, high volatile matter and high sulphur content. High moisture in lignite leads to its sticking to the surfaces of crushing and grinding equipment. This also causes choking and jamming of mill diaphragm leading to reduction of mill output. In plants, where combined grinding of coal and lignite has been adopted, the output of the mill gets reduced by 20-25% depending upon the percent of lignite addition. The other problems associated with the combined grinding are :

* Coating formation in mill grinding chambers;
* Clogging of grates in the mill;
* Increase in grinding media consumption due to corrosion effect of high moisture in the mill feed;
* Variation in the proportion of coal/lignite not possible in the kiln firing.

TABLE 1

ANALYSES OF LIGNITES FROM DIFFERENT DEPOSITS IN INDIA
(As Received Basis)

Particulars	Tamil Nadu			Gujarat		Rajasthan			J&K	Kerala
	Neyveli	*Bahur*	*Jayakondan*	*Kutch Dist*	*Broach Dist*	*Barmer Dist*	*Bikaner Dist*	*Nagaur Dist*		
Moisture, %	45-55	45-60	45-55	32-36	18-20	30-50	40-46	40-50	30-36	30-36
Ash, %	3-12	3-12	3-12	6-10	10-14	5-10	10-25	5-15	35-37	23-26
Volatile Matter, %	20-23	19-25	20-26	30-33	36-40	20-30	22-26	20-25	15-20	24-27
Fixed Carbon, %	17-21	17-20	15-20	24-27	24-27	15-25	15-23	15-20	12-15	15-19
Calorific Value, kcal/kg	2200-2800	2200-2800	2200-2800	3500-4000	3600-4000	2000-3500	2000-3000	2500-3000	1800-2000	2500-2800

These difficulties have necessitated to dry and grind lignite separately instead of combining with coal.

In case of direct firing system, where coal mill vent air is used as primary air, the moisture content driven off during drying of lignite also enters the kiln. This lowers the flame temperature thereby increasing the specific heat consumption considerably. The load on ID fan is also increased due to high amount of exhaust gases from kiln.

Lignite, because of its high volatile matter and being reactive fuel, requires special care during drying, grinding, handling and storage.

Lignite when exposed to sun and while air-drying, has the tendency to crumble into small pieces. The rate of oxidation, therefore, increases with the consequent generation of considerable quantum of heat. This heat when not dissipated leads to spontaneous combustion and explosion.

High sulphur in lignite leads to build-ups and coating formation at the kiln inlet/riser ducts of bottom cyclones which necessitates the kiln stoppage for removing build-ups or coating.

SEPARATE DRYING AND GRINDING OF LIGNITE

It is preferable to dry lignite in two stages, first in the dryer followed by drying and grinding in the mill itself. Many types of dryers, such as tray dryer, rotary dryer, flash dryer, etc, are available for drying wet combustible materials. Inert gases are used for drying purposes. Waste heat available in dry process cement plants in the form of preheater exit gases which are almost inert containing 3-5% O_2, are suitable for drying lignite. If the availability of preheater exit gases is limited, on account of heat required for drying raw materials attempts could be made to dry the raw materials with cooler gases, reserving preheater exit gases for drying lignite. The vertical roller mill with a dynamic separator is used for grinding lignite. During grinding, moisture comes down to a level of 15%. The pulverized lignite dust is collected in the cyclone and then stored in a separate lignite bin. Gases from drying and grinding installations are vented out through open top ESPs. The typical drying and grinding circuit for lignite is shown in Fig 2.

SAFETY ASPECTS AND MODIFICATIONS TO OVERCOME THE PROBLEMS

The modifications that are required in the drying and grinding installations are :

i) The ducts in the mill circuit, such as at the entry of cyclones should have 60° slope to prevent self ignition of fines;

ii) The conical portion of the cyclones and ESP should be designed so as to have repose angle of more than 70°;

iii) Pulverised lignite bins should be provided with CO_2 inertisation system;

iv) Open top ESP should be used in the mill circuit;

v) Explosion flaps should be provided at critical points;

vi) Water spraying facility should be provided for washing at the inside of ESP.

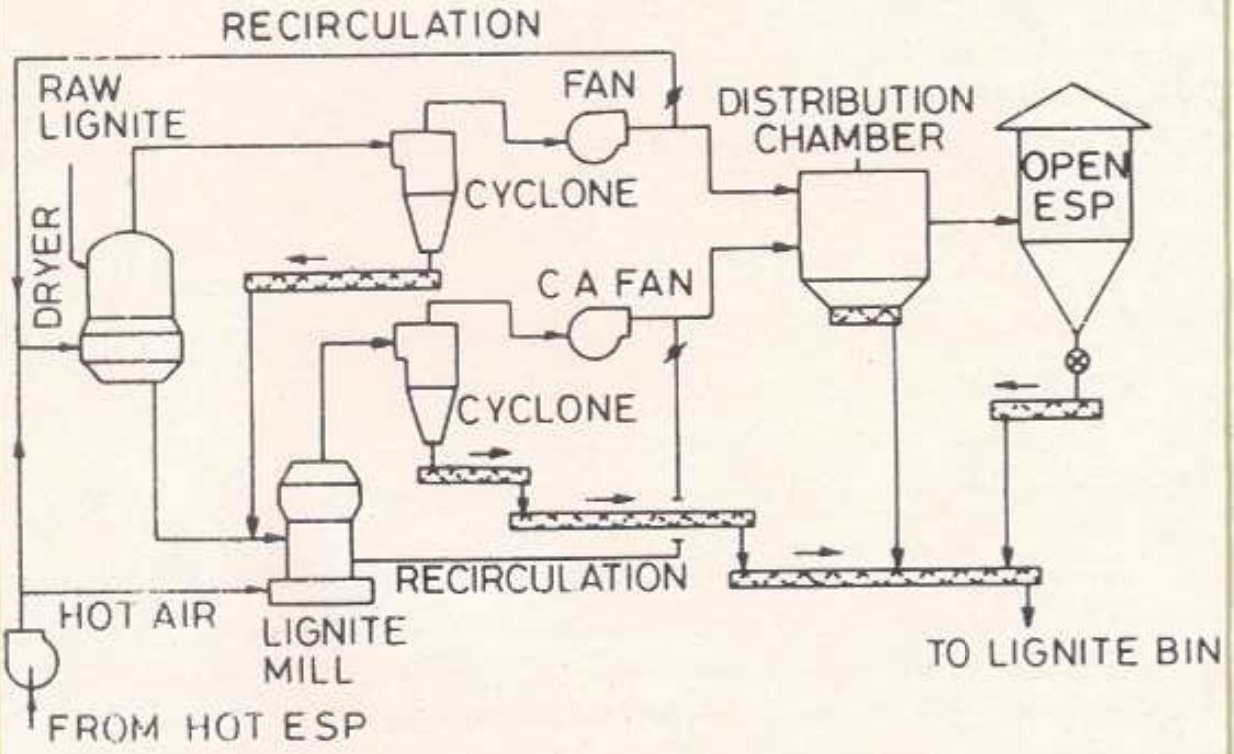

Fig 2 Grinding circuit of lignite mill with dryer

In order to avoid the coating or build-ups at the kiln inlet/riser ducts of bottom cyclones of preheater, the alkalies in the raw mix and lignite blend should be kept such that total alkalies/sulphur ratio is around 1.0, i e :

$$0.8 < \frac{Na_2O/62 + K_2O/94 - Cl_2/71}{SO_3/80} < 1.2$$

Also the use of air blasters at critical locations, ie, riser ducts of 3rd and 4th cyclones as well as at kiln inlet help in breaking the coating or build-ups.

CONCLUSIONS

Based on in-depth studies carried out at NCB, the following conclusions can be drawn :

* Because of its low ash content and availability in abundance in certain states, lignite can be efficiently used as a single fuel or in combination with coal by partially substituting the later.
* Replacement of coal with lignite will reduce the overall ash content in the fuel and hence will result in low ash absorption by the clinker. This will help in exploiting the reserves of low grade coal in the country and improve the operational efficiency of the kilns. Also, due to low percent of SiO_2 and Al_2O_3 and high percent of CaO in lignite ash as compared to coal ash, the quality of clinker is improved.
* For up to 25% utilisation of lignite, the combined grinding of coal-lignite mixture is preferable. The existing coal mill with simultaneous drying system can be used in that case.
* However, in case of higher amount of lignite to be used, certain changes are required to be made in the raw mix and system design together with new installation for separate drying of lignite.
* In both the cases, the strain on the railway infrastructure in terms of wagon supply for transportation of coal will be considerably reduced. Thus, the use of lignite either alone or in combination with coal will help the cement industry to overcome the problems of high ash in the coals received by the plants.

NCB EXPERTISE

NCB, with the expertise it has acquired through indepth studies carried out for the utilisation of lignite in cement manufacture, can provide the necessary technical guidance to the industry for profitably exploiting lignite as an alternate fuel.

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