TREND REPORT ON POTENTIAL FOR UTILISING NATURAL GAS IN CEMENT INDUSTRY

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1. INTRODUCTION

Coal for cement industry often has to be hauled over long distances, up to even 1500 km for some plants, adding to the energy bill on this account, besides further straining an already overloaded railway infrastructure. Quite apart from this, the tempo of industrialisation is steadily accentuating the demand for coal for thermal power generation and other industries, with inevitable hike in the cost of coal as well as power. Under the circumstances, it is imperative to look, on the one hand, for possible alternate fuels for cement manufacture, and, on the other, devise technological measures for fuel/energy conservation.

A brief review of Indian cement industry's fuel scene will be in order at this point. Coal had all along been its major fuel except for a brief period in the early seventies, when the availability of cheap oil caused a slight shift towards oil. However, with the steep increase in oil prices in 1973, the emphasis reverted to coal as the main source of energy in industries, including the cement industry.

At the same time, the higher price of imported oil gave impetus for oil exploration not only on-shore but also for the highly expensive off-shore drilling which became attractive under the changed circumstances. These explorations revealed new areas in different parts of the country, both for crude oil and natural gas.

2. NATURAL GAS RESERVES

The liquid and gaseous hydrocarbon reserves in the country, based on the explorations of Oil and Natural Gas Commission (ONGC), are currently estimated at 17.0 billion tonnes. The Indo-Soviet Joint geological study concluded that more than 75% of India's ultimate hydrocarbon reserves are in the form of natural gas. The total gas reserves as of now are of the order of 906 billion cubic metres, which is expected to rise to 1231 billion cubic metres by the end of the century. However, only about 10% of the gas reserves has so far been established. ONGC has projected a stepping up of the country's

natural gas production from 20 million cubic metres per day (mcmd) in 1984-85 to about 40 mcmd by the end of the Seventh Five-Year Plan, i.e., by 1989-90 and 130 mcmd by the turn of the century. It will thus be clear that natural gas is emerging as an important alternate energy source on the country's commercial energy scene. An area-wise break-up of the production potential of natural gas, based on reserves proven as yet, is given in Table 1 which puts the figure at about 66 mcmd. Out of this, it is estimated that 25 mcmd will be used for production of fertilisers (gas-based plants/units), 15 mcmd for power generation and the remaining for replacement of liquid fuels in boilers, as cooking fuel in homes, and in other industries.

TABLE 1

PRODUCTION POTENTIAL OF NATURAL GAS BASED ON PRESENT PROVEN RESERVES*

No	Area	Production potential, mcmd
1	Western off-shore	53.00
2	Gujarat on-shore	3.18
3	Assam on-shore	3.00 + 6.00 +
4	Krishna-Godavari off-shore	0.36
5	Cauvery off-shore	0.13
6	Tripura on-shore	0.30
7	Jaisalmer on-shore	0.98

* *Chemical Weekly*, vol. XXXI, No. 35 (13 May, 1986); pp 33-34 (based on ONGC Report)

+ From Oil India Limited

3. CHARACTERISTICS OF NATURAL GAS

Natural gas normally contains C_1, C_2, C_3, C_4, C_5 and C_5 + hydrocarbons with small amounts of CO_2, N_2, H_2S and water. Its calorific value varies depending upon the composition. When the percentage of C_1, is high, it is of the order of 8800 k cal/Nm^3 (at 15°C and sea level). With higher percentages of higher hydrocarbons this value can go up to 14000 k cal/Nm^3.

4. SCOPE FOR USE IN CEMENT INDUSTRY

Cement production is expected to increase from 36.7 million tonnes (MT) in 1986-87 to 49 MT by the end of Seventh Five-Year Plan, and the demand for coal by cement industry during this period is expected to increase correspondingly from 13 MT at present to 17.5 MT, along with the requirement for captive power generation. In this background, cement units located nearer gas fields/the proposed natural gas grid could consider use of natural gas as fuel in place of coal. Indeed, cement plants in Soviet Union, Pakistan, etc., are using natural gas as fuel.

The advantages of using natural gas in place of high ash coal as fuel in rotary kiln are many. The foremost among them are as follows :

(i) Freedom from ash contamination and hence scope for exploiting marginal grade limestones, implying, in turn, setting up of cement plants in areas, e.g. north eastern region, Assam. This will improve thermal efficiency by about 1.5% and increase production by 5-8%. And then there is scope for increasing the addition of pozzolana in portland pozzolana cement (PPC) by about 7.5%.

(ii) Complete elimination of coal grinding, resulting in saving of electrical power to the extent of 7-11 kWh per tonne of cement.

(iii) Ease and better control in pyro-processing leading to better quality of clinker.

(iv) Avoidance of transport of high ash coal over long distances and the resultant saving and relief to railways.

As against this, there will be a very small increase in cost due to the need for addition of siliceous material (clay) to compensate for the ash from coal which is absorbed in the cement clinkers.

There can be yet another advantage, if cogeneration of power is resorted to by utilising natural gas first in gas turbines to generate power, and then using the exhaust/bled gases from the turbine in the rotary kiln along with fresh/virgin natural gas to boost the temperature inside the kiln to the required level. Such cogeneration could provide the required captive power to the cement plants in question and to that extent relieve them of the uncertainties of power supply from State Electricity Boards. Incidentally the cement plants can avail themselves

of the special incentives offered by the Government of India for captive power generation. However, it must be added that detailed developmental work is necessary to realise the total advantage of using natural gas in the manner mentioned above.

Table 2 lists the cement plants in India, which, prima facie, have the potential for using natural gas. Locations of cement plants vis-a-vis sources of natural gas, both on-shore and off-shore, and the proposed national gas grid are depicted in Fig. 1. Understandably these are situated in Gujarat (Saurashtra), Assam and Andhra Pradesh. Likewise, Table 3 lists mini cement plants of 200 tpd capacity, which, being nearer to gas fields, also have the potential for using natural gas in place of coal. The units among these in Andhra Pradesh are near Narasapur-Razol gas field.

TABLE 2

CEMENT UNITS NEARER GAS FIELDS

No	Unit and Location as in map	Cement Production Capacity, Lakh Tonnes/Year
1	Porbandar Cement Works, Porbandar	2.0
2	Saurashtra Cements and Chemical Industries, Ranavav	8.63
3	Shri Digvijay Cements, Sikka	10.25
4	Andhra Cement Co., Nadikudi	2.50
5	Andhra Cement Co., Vijayawada	2.40
6	Kistna Cement Works, Kistna	2.16
7	Bokajan Cement Works, Bokajan	2.00
8	Mawmluh Cherra Cements, Mawmluh Cherra	2.84

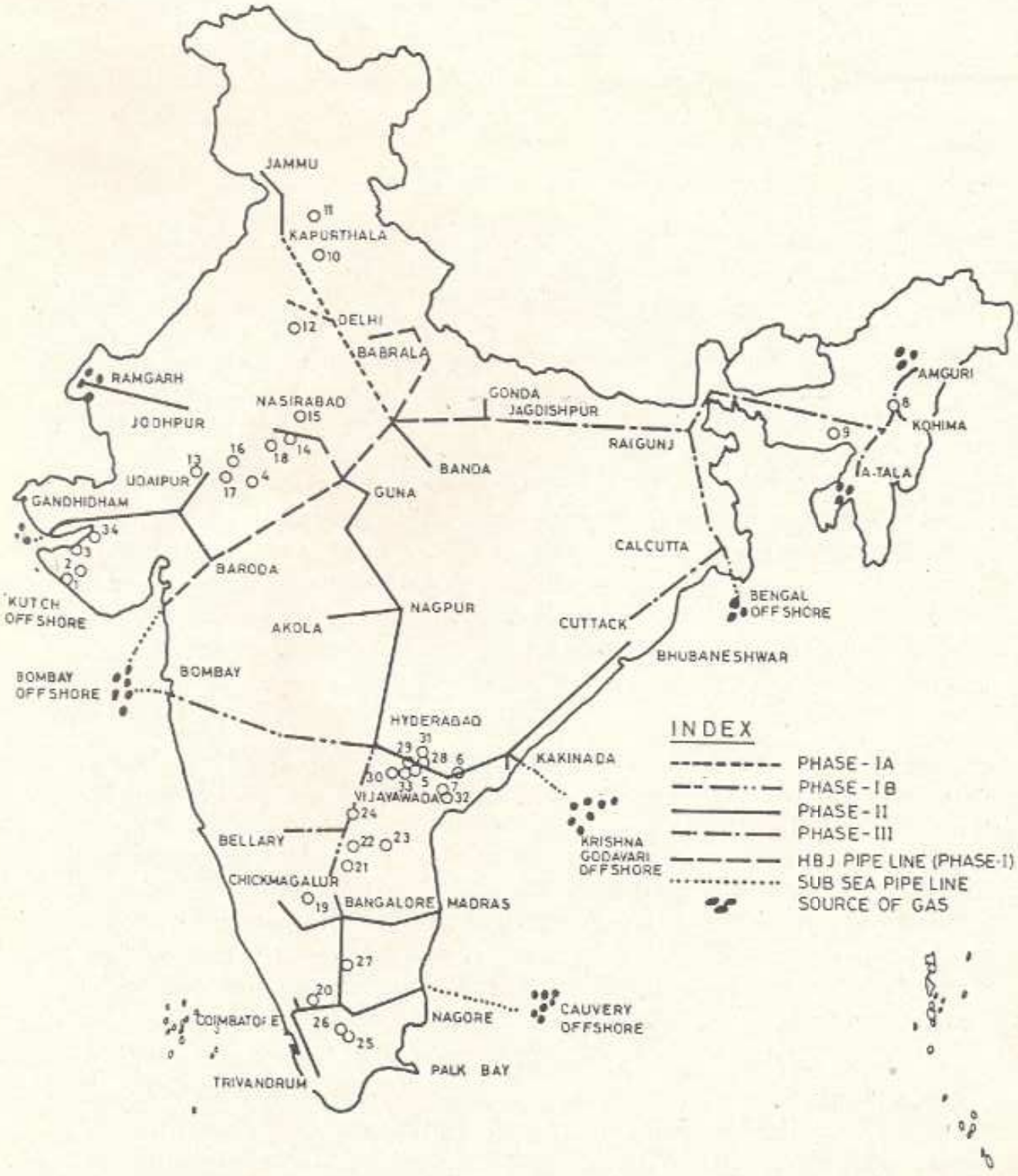

FIG. I NATIONAL GAS GRID WITH LOCATION OF CEMENT PLANTS

TABLE 3

ROTARY-KILN MINI CEMENT PLANTS (OF 0.66 LAKH TONNES ANNUAL CAPACITY) NEARER GAS FIELDS

No	Unit and Location as in map
28	Coromandel Cement, Nalgonda, A.P.
29	Deccan Cements, Nalgonda, A.P.
30	Kakatia Cement, Nalgonda, A.P.
31	Nagarjuna Cements, nalgonda, A.P.
32	Parthasarathy Cements, Guntur, A.P.
33	Suvarna Cements, Nalgonda, A.P.
34	Kamdar Cement, Veraval, Gujarat

At the next stage, that is, when the natural gas grid, planned by ONGC covering the length and breadth of the country, comes into being, many more cement plants, particularly those handicapped by deficient cement grade limestone reserves and/or located far away from coal fields, but proximate to the gas grid, also can start using natural gas as fuel. A list of such units is given in Table 4.

The requirement of natural gas for cement plants of 200, 600, 1200 tpd capacities, both for dry and wet processes, and for 3000 tpd capacity dry process is depicted in Fig. 2. This has been worked out on the basis of requirement of thermal energy of 1000 and 1500 k cal/kg clinker for dry and wet process plants respectively and an average calorific value of 10000 k cal/Nm^3 of natural gas. Accordingly, the total gas requirements for the plants listed in Tables 2 and 3 will be about 1.22 mcmd for pyroprocessing in the kiln. In the case of the units in Table 4, it will be of the order of 3.760 mcmd.

The potential for using natural gas in cement plants can be easily gauged from the foregoing. As regards conversion from coal to natural gas, that would entail no extensive changes except for burners suited to use natural gas. In fact, once steady and full supply of gas to the cement units is ensured, the storage, handling and preparatory sections for coal can be dispensed with.

TABLE 4

CEMENT UNITS LOCATED NEARER THE PROPOSED NATURAL GAS GRID

No	Unit and Location as in map	Cement Production Capacity, Lakh Tonnes/Year
10	Bhupendra Cement Works, Surajpur	4.05
11	Gagal Cement Works, Gagal	5.60
12	Charkhi Dadri Works, Charkhi Dadri	2.39
13	Udaipur Cement Works, Bajajnagar	4.00
14	Lakheri Cement Works, Lakheri	3.22
15	Jaipur Udyog Ltd., Sawaimadhopur	10.00
16	Birla Jute Manufacturing Co., Chittorgarh	9.00
4	Nayagaon Cement Works, Nayagaon	4.00
17	J K Cement Works, Nimbahera	11.40
18	Mangalam Cements, Morak	4.00
19	Mysore Cements, Ammasandra	5.10
20	Madukkarai Cement Works, Madukkarai	3.77
21	Coromandel Fertilisers, Kalamalla	10.00
22	Priyadarshini Cements, Tadpatri	4.00
23	Yerraguntla Cement Works, Yerraguntla	4.00
24	Panyam Cements and Mineral Industries, Panyam	5.31
25	Madras Cements, Thulukkapatti	5.25
26	Tamil Nadu Cement Corporation, Alangulam	4.00
27	India Cements, Sankaridurg	6.00
35	Vikram Cements	5.00

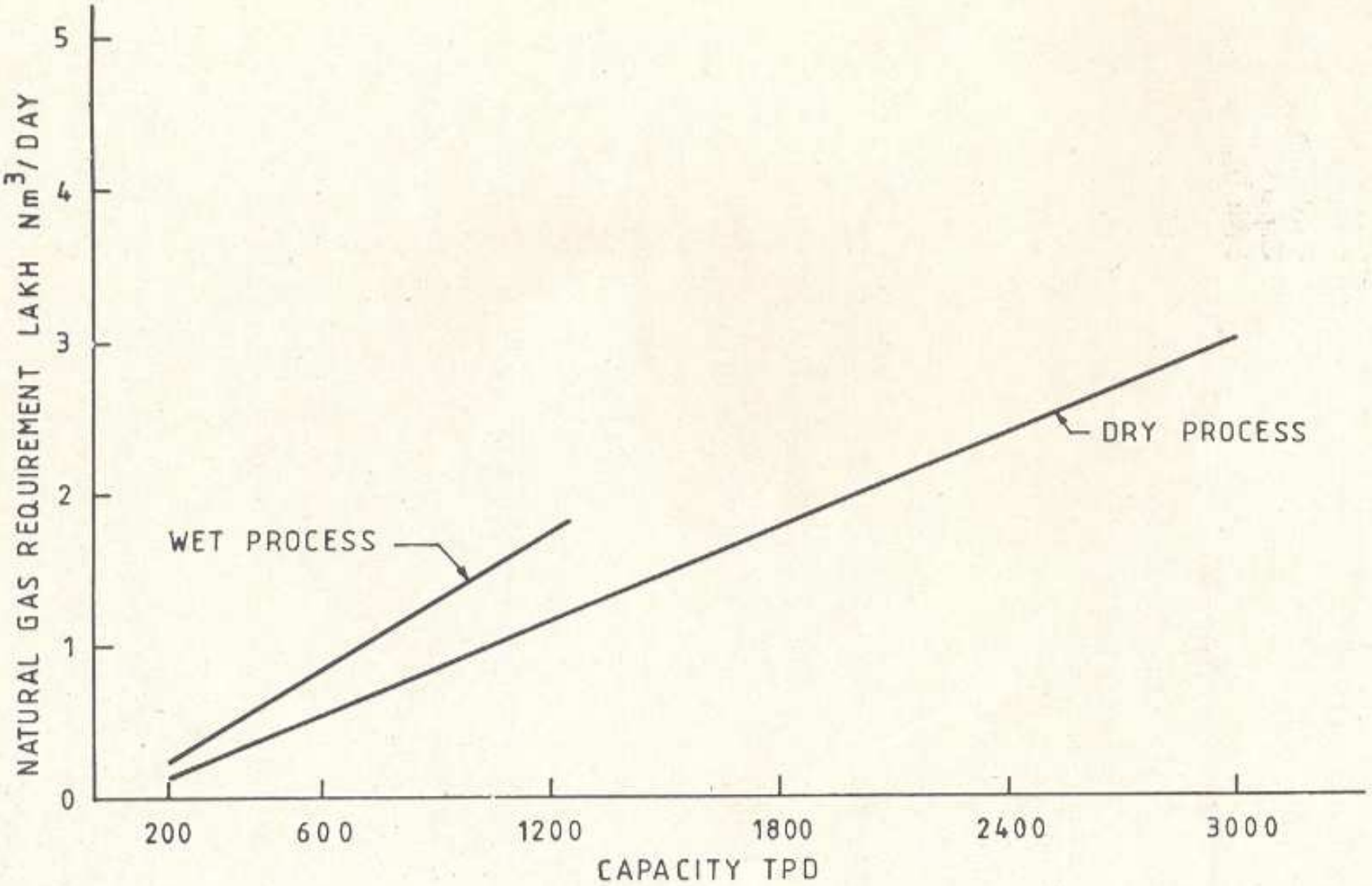

FIG. 2 REQUIREMENT OF NATURAL GAS IN CEMENT PLANTS OF DIFFERENTCAPACITIES

TABLE 5

COMPARATIVE COST OF USING NATURAL GAS AND COAL AS FUEL IN CEMENT PLANTS

Plant capacity : 1200 TPD (Wet) and 3000 TPD (Dry)

Heat consumption : 1000 k cal/kg of clinker (Dry process)
1500 k cal/kg of clinker (Wet process)

Calorific value of coal : 4000 k cal/kg of coal

Calorific value of natural gas (average) : 10000 k cal/Nm^3

Cost of natural gas : at Rs. 1000 per 1000 Nm^3 and at Rs. 2000 per 1000 Nm^3

Particulars	1200 TPD Wet Process				3000 TPD Dry Process			
	Tamil Nadu	Gujarat	Andhra Pradesh	Assam	Tamil Nadu	Gujarat	Andhra Pradesh	Assam
Coal consumption, tonnes per day	450	450	450	450	750	750	750	750
Price of coal per tonne in Rs.	800	600	500	400	800	600	500	400
Cost of coal per day in '000 Rupees	360	270	225	180	600	450	375	300
Natural gas consumption in '000 Nm^3 per day	180	180	180	180	300	300	300	300
Cost of natural gas per day in '000 Rs.								
i) At Rs. 1000 per 1000 Nm^3	180	180	180	180	300	300	300	300
ii) At Rs. 2000 per 1000 Nm^3	360	360	360	360	600	600	600	600

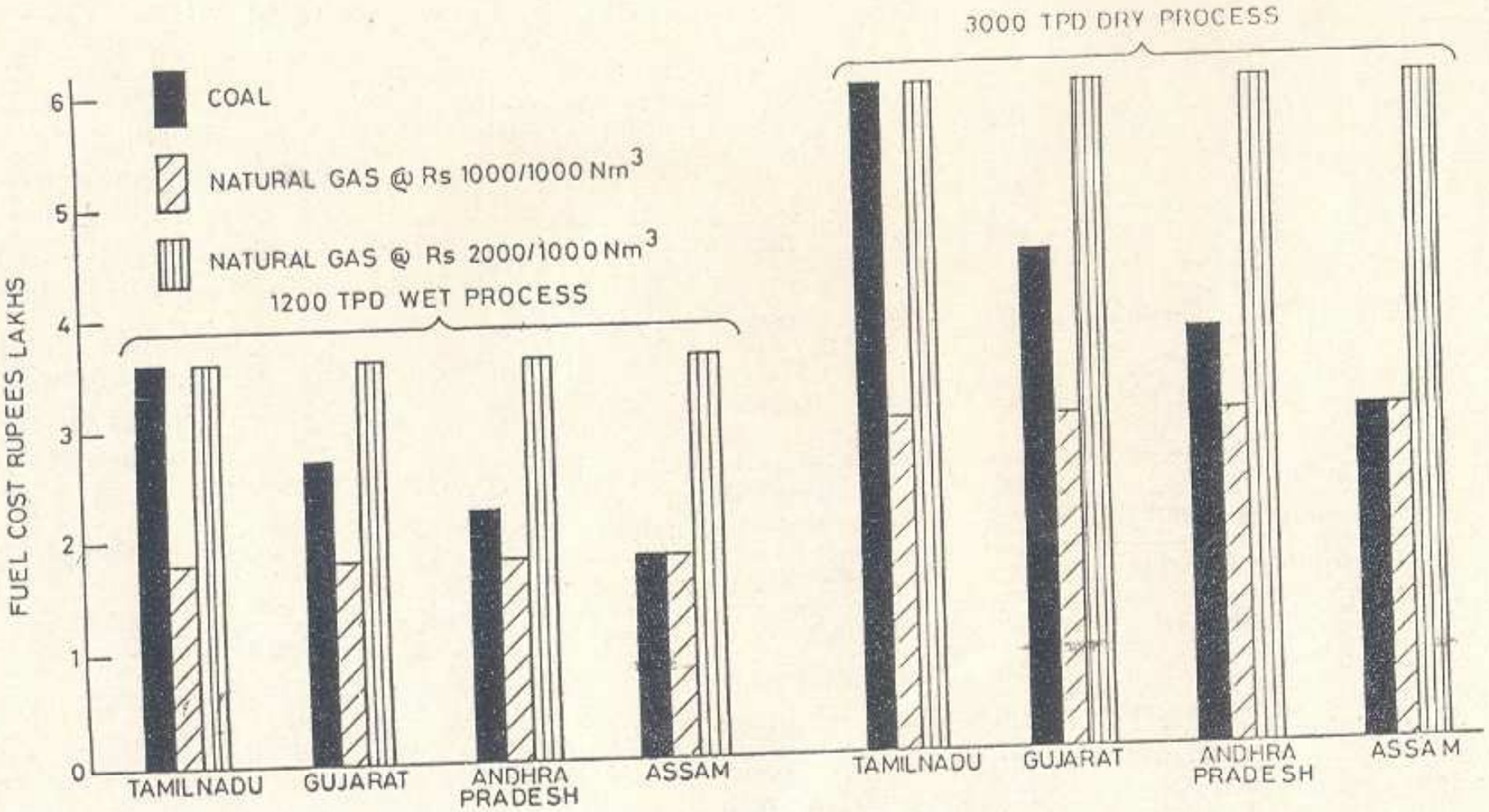

FIG. 3 COMPARATIVE COSTS OF NATURAL GAS AND COAL AS FUEL FOR CEMENT PRODUCTION

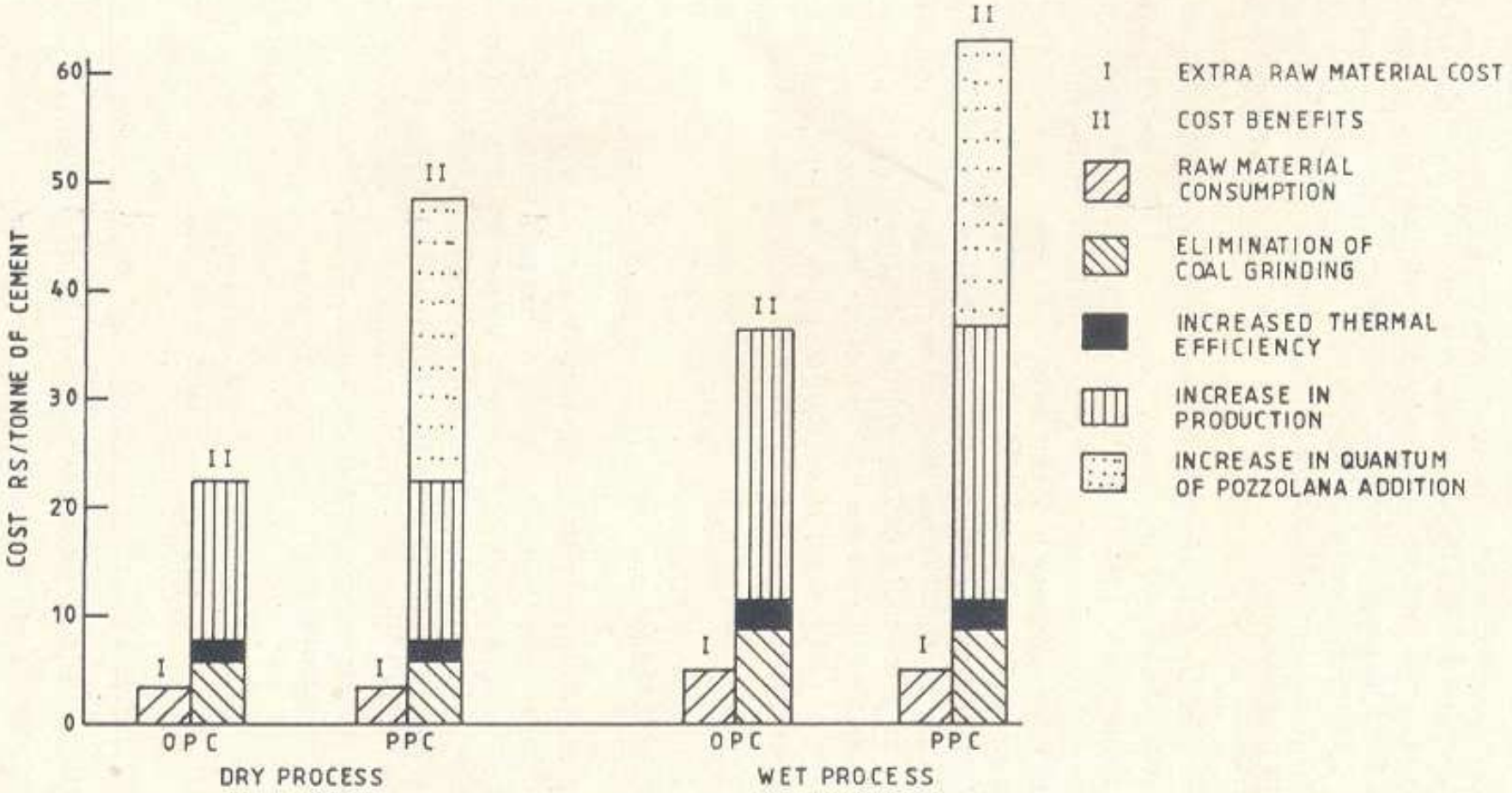

FIG.4 BENEFITS OF USING NATURAL GAS IN PLACE OF INDIAN COAL IN PYROPROCESSING

5. ECONOMICS

One of the major parameters to be considered is the cost of conveying natural gas from the gas fields to the cement units. In this connection, the figure worked out in respect of the HBJ pipeline and ONGC's estimates for the pipeline planned during subsequent phases @ Rs. 0.40-1.40/1000 cu m/km, could serve as a broad guideline. The ultimate cost of transportation will, no doubt, depend on the terrain, length and size of the pipeline, etc.

A tentative comparison of costs between using coal and natural gas as fuel for 1200 tpd wet and dry process plants, and 3000 tpd dry process is given in Table 5 and Fig. 3. On the bases mentioned therein, use of natural gas would work out to be economical, or, at any rate, equal to that of coal when its price is of the order of Rs. 400/- per tonne and that of natural gas at Rs. 1000 per 1000 Nm^3. Sensitivity analysis has shown that at a gas price of Rs. 2000 per 1000 Nm^3, the use of gas in place of coal will cost 33.3% more at a coal price of Rs. 600 per tonne and will cost equal at a coal price of Rs. 800 per tonne. The use of gas will have other advantages as mentioned earlier. The other benefits of using natural gas (in place of coal) in terms of money value is given in Fig. 4. With cogeneration of power, it would become more attractive.

6. CONCLUSION

Increasing availability of natural gas in different areas of the country in future and its emergence as an important alternate energy source, hold out possibilities of its use in a number of cement plants. To start with, cement plants located nearer to the gas fields in Andhra Pradesh, Saurashtra, Assam and nearer to the HBJ pipeline in Rajasthan (and in U.P.) could benefit from this; at a later date, those located nearer the national gas grid and deficient in the supply of good quality limestone can utilise the natural gas.

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