REPORT ON GUJARAT LIGNITE RESOURCES AND SCOPE FOR JOINT SECTOR THERMAL POWER AND SSI PROJECTS

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Lignite called "Brown Coal" is a low ranking coal of about 2500 K.Cal/Kg, constituting 1.4% of the known energy source in the country. Lignite production during January 1997 is 19,00,000 tonnes. Tamil Nadu and Gujarat are the two states engaged in the lignite mining. Neyveli Lignite Corporation, Govt. of India undertaking and G.M.D.C., a Gujarat Government undertaking are the two public sector organisations engaged in the lignite exploitation in the country.

The word lignite equates with low ranking coal used for exclusively carbonised fossil wood. Present subbituminous coal was formerly called black lignite.

The ASTM classification established 8,300 B.t.u. per pound on the moist, mineral-matter-free basis as the upper limit for lignite and brown coal. The ASTM classification makes no distinction between lignite and brown coal. At present it is recognised as brown coal and lignite by the Geo-Scientiest.

Origin of Lignite:

The organic origin of coal from peat is an undoubted fact. It now seems almost certain that a constant feature of the history of the earth, since the origin of vegetable matter, has been the formation of peat; that is, accumulations of plant parts and products in various stages of degradation by chemical and biochemical processes. Some periods of earth history have seen widespread formation of peat over a very long period. Subsequent chemical changes have converted it to various kinds of coal.

Alteration of the original plant material to peat and then coal is a complex process. There are, of course, biological changes that take place in the plant material during the formation of peat. These changes may be rather pronounced if the material is amenable to decay and the plant material is deposited do not favour decay or the plant parts are decay resistant (as certain waxy fractions are for instance), biological decomposition may affect the plant material relatively little.

After the peat has been covered by sand, clay or other sediments, the coalification changes that occur are not affected by biological processes. The first stage in conversion of peat to coal is simply compaction by gravity. This stage is sometimes called diagenesis. Subsequent alterations by which the material is converted to coals of various rank are then called metamorphosis. In the course of alteration to a typical lignite, the original peat loses water, which forms about 80 to 90 percent of raw peat, and volatile matter, which

FORWORD

Gujarat Government has planned twenty-eight power projects during Ninth Five Year Plan period. New power capacity will be increased due to the implementation of 250 MW Akrimota, 375 MW Bhavnagar, 250 MW Mangrol projects based on lignite in the State.

State is fortunate to possess 1072.32 million tonnes of lignite resources in the geographical fold. Exploitation of lignite by GMDC Ltd and its sale to industries has reduced the hassles of getting coal supply from eastern sector.

State Geological programming Board has also accorded top priority for lignite exploration in the potential lignite basins. The Commissionerate of Geology & Mining is actively engaged for the assessment of reserves of lignite in the State.

The State Government has given the highest priority to the development of power sector. Government of Gujarat has recently come out with power policy. On Oct. 1991, Government of India has made changes in the Electricity Supply Act allowing private sector participation in the field of generation, transmission and distribution of power. Power policy proposes to encourage private sector participation in the field of power generation, transmission and distribution.

Commissionerate of Geology & Mining has done extensive exploration in Panandhro, Mangrol, Lakhanka lignite basins. Assessment of proved reserves is in progress by closed space drilling.

Private industrial houses and entrepreneurs who are interested to set up lignite based power plant and SSI units may need the data on the lignite resources of the State. The compiled report incorporates data on the lignite resources, its quality, state power policy and 7 lignite based project profiles.

I hope the report will be useful to the entrepreneurs, industrial houses, mining engineers, geologists and financial institutions who are interested to know the lignite resources of the State. The recommendations and suggestions to update the State lignite resources based data are welcome.

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Constitution of Lignite:

It is a very reactive organic substance. It combines so readily and actively with oxygen that storage in such a way as to prevent spontaneous combustion. The reaction of lignite to many kinds of inorganic and organic solvents is greater than that of bituminous coal. Dilute Hydrogen Peroxide or Sodium Chloride will react with lignite much more rapidly than with the coal. Solution of alkali will instantly react with the lignite. It contains sufficient quantities of carbohydrate derivatives.

Proximate and Ultimate Analysis:

Briefly, proximate analysis consists of a determination of moisture released at 105 degree C, further volatile matter in a reducing atmosphere at 950 degree C, and ash residue at 700 degree to 750 degree C. Fixed carbon is calculated by difference. Conventional ultimate analysis is a determination of S, H, C, N and ash, with oxygen being obtained by difference. Heat energy per pound is determined by combustion in a bomb calorimeter.

In the classification accepted in this country (1) lignitic coal has a heat-energy content of less than 8,300 B.t.u. per pound on the moist, mineral-matter-free basis. In this system of classification, the lower limit of lignitic coal that is, its borderline with peat has not been fixed. Lignitic coal that is unconsolidated is classified as brown coal and that consolidated is lignite. Subbituminous coal, the rank just above lignite, has a B.t.u. content of more than 8,300 and less than 9,500 per pound on the moist, mineral-matter-free basis.

In the formation of peat, a number of processes affecting the mineral-matter content operate: There is probably removal by leaching of some of the inherent mineral matter, and there is certainly the addition of mineral matter to the vegetable substances. This added mineral matter is sometimes called extraneous mineral to contrast it with the inherent or original inorganic part of the plant material. Some of this extraneous mineral matter is erosional detritus-especially sand (silica) and clay (kaolin and other clay minerals). This sort of mineral matter is often mixed with peat rather intimately. As the percentage of clay, for example, rises, the coal containing it approaches or may become a carbonaceous shale. If the deposition of relatively pure peat is temporarily interrupted by deposition of quantities of clay or sand, the result is a parting between benches of the coal bed. Such partings are a handicap in mining. They do occur in beds of Kutch lignite but fortunately are not the rule.

SUMMARY

- Lignite in the country is located in Tamil Nadu, Rajasthan, Gujarat, J&K and Kerala. Total estimated reserves is 29,437.32 M.T.
- Analysis of lignite from different states indicates that Gujarat lignite has 3500-4500 high calorific value and fixed carbon 20-30.
- GMDC is running its prestigious project at Panandhro in Lakhpat taluka of Kutch district. The Corporation produces an average 50 lakh tonnes lignite from Panandhro project. Rajpardi lignite project located in Bharuch district also produces around 5 lakh tonnes of lignite.
- Gujarat Electricity Board has established 210 MW Thermal Power Station at Panandhro utilising lignite as a fuel.
- Gujarat Industrial Power Co. Ltd. has decided to put up 250 MW power plant at Nani Naroli of Mangrol taluka in Surat district.
- Gujarat Mineral Development Corporation is also planning 250 MW Thermal Power Station at Akrimota in Kutch district.
- GMDC sells lignite in three grades. Price of A-Grade is Rs.510/- plus all the taxes extra. B-Grade is Rs.426/- plus all taxes. C-Grade is Rs.108/- plus all taxes. Lignite from Rajpardi is being sold at Rs.780/- plus taxes.
- Lignite as alternate fuel in cement industry has opened good scope in Gujarat, Rajasthan. Desulphurisation of lignite technology is developed by the NCB, New Delhi and CFRI, Dhanbad.
- Following Value-added lignite based project profiles are incorporated in this report :

  1. Caustic Lignite Powder
  2. Lignite based Met-Code
  3. Lignite Briquetting
  4. Oil Well Drilling Mud Chemicals
  5. Lignite Coke for Waste Water Treatment
  6. Lignosulphonate
  7. Carbonisation of Coal (Low Temperature)

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temperature. Coal ash analysis report a softening temperature at which cones of specially prepared ash soften and flow down to a spherical lump in a reducing atmosphere (23).

There is also considerable evidence that the mineral matter of lignite sometimes includes small quantities of uncommon or rare elements in lignite is being investigated in several laboratories.

Lignite Resources:

Lignite in India is located in Tamil Nadu, Rajasthan and Gujarat. Tamil Nadu is estimated to have over 90% of the total lignite reserves in the country.

Estimated Statewise Lignite Reserves in the counrty

State	Area	Estimated Reserves (in MT)
Tamil Nadu	Neyveli	3,300
	Jayankonda	
	Cholapuram	1,150
	Thiruchirappally	1,150
	East of Veeranam	1,340
	Mannargudi	19,500
	Bahur	585
Rajasthan	Palana	
	Birshingsar	
	Kapurdhi	
	Merta	770
Gujarat	Panandhro	
	Mangrol	1,072.32
	Bhuri	
	Surkha	
Others		570
	Total	**29,437.32**

LIGNITE

Introduction

Gujarat Government has planned twenty eight power projects during Ninth Five Year Plan. During 1998-99 the State will continue to face power shortages to the tune of 1917 MW for the year. New power capacity will increase due to implementation of 250 MW Akrimota, 375 MW Bhavnagar, 250 MW Mangrol lignite based power projects in the State. In addition to above, Essar, Gujarat Torrent Power, Reliance, joint sector project will able to generate additional capacity. Due to distance from coal resources and difficulty in hydro power generation, more emphasis is given for speedy implementation of the lignite based power plants in the State Power Policy.

State is fortunate to possess 1072.32 million tonnes lignite resources in its geographical fold. Exploitation of lignite by GMDC and its sale to industries has easened constrains on fuel.

State Geological Programming Board has also given priority for lignite exploration in potential areas. The Commissioner of Geology & Mining department's drilling rigs are deployed for the assessment of reserves in the State.

Multinational companies are attracted to invest in Power Projects, with an automatic approval for 100% equity holding. State Government Power Policy has also attracted foreign power companies to consider joint sector projects. Cement, textiles companies are also allowed for self power generation. With the liberalised policies, GIPCL, Gujarat Power Corporation, GMDC, Torrent, Reliance, Essar have planned power projects in the State. Looking to the requirements of compiled data for State Lignite resources. An attempt is made to have compiled "Status report on Lignite Resources". State energy resources like natural gas, oil and brown coal has attracted large industrial houses in the State. In the end of the Ninth Plan, State will be surplus in energy sector.

The Energy Policy of Govt. of India aims at ensuring adequate energy supplies at minimum cost achieving self-sufficiency in energy supplies and protecting the environment from adverse impact of utilising energy resources in a non-judicial manner. One of the element of the Energy Policy is to accelerate exploitation of domestic conservation energy sources i.e. coal, lignite, hydel, oil and nuclear power.

makes up about 50 to 60 percent of the dry matter of peat, increases. A typical Gujarat lignite, for comparison, is about 35 to 40 percent moisture. The dry lignite is about 45 percent volatile matter in the proximate analysis about 70 percent carbon on ultimate analysis.

Alternation of lignitic coal to coal of higher rank takes place by further operation of the processes that lignite from peat, that is, decrease of moisture and volatile matter, and increase of the percentage of carbon. The thermal value increases as moisture and volatile matter decrease to a maximum of about 15,000 B.t.u. per pound for low-volatile bituminous coal on the moist, mineral-matter-free basis (the upper limit for lignitic coal being 8,300 B.t.u.). As the percentage of carbon increases to semi-anthracite, anthracite and meta-anthracite, the heating value decreases somewhat, to less than 14,000 B.t.u. per pound.

Lignitic coal, then, is simply a stage in the continuous sequence of coal ranks. It is only arbitrarily separated, for reasons of convenience, from peat, the basic carbonaceous material from which all coals have been derived, and from subbituminous coal, which represents the arbitrary next higher step in the progressive dehydration and devolatilization that must take place for increase in rank but which by no means takes place at the same rate for all coals. There is also a purely arbitrary division between coals and certain related carbonaceous rocks. The threshold percentage of clayey mineral matter that a coal must have to cease being a coal and become a shale is commercially determined. If marketable as fuel in a given situation, the rock is coal, otherwise carbonaceous shale.

Geologic information on the occurrence of lignitic coal is generally not to be expected. Formation of the original peat deposit requires the rather special conditions of swamps, or shallow ponds, lakes, or esturies that were littered with vegetable matter in great quantity while the water level maintained itself despite this sedimentation; but once the mass of peat was formed, the necessary geological conditions for lignite to occur are not unusual. The beds must be protected by a cover of sand, clay or other sediment. This can be very shallow only a few feet in some instances or the cover may be thousands of feet or more thick. To remain lignitic in character the deposit must also have been relatively little affected by geologic stress; that is, disastrophic forces.

Panandhro Lignite Project:

GMDC is running its prestigious project in Lakhpat taluka of Kachchh district. GEB has also established 220 MW Thermal Power Station at Panandhro utilising lignite as a fuel. Out of about 200 million tonnes of lignite reserves in Kutch, 100 million tonnes are located at Panandhro. The mining activity was started here in 1974 and substantial expansion was undertaken in 1988, 89 and 90.

Current production from Panandhro Mine is about 50 lakh tonnes per year. This lignite is being supplied not only to GEB's Power Station at Panandhro but also to over 2000 industrial units (textiles, chemicals, ceramics, bricks, captive power etc.) all over the State.

Total capital investment in terms of current fixed assets, at the Project is about 25 crores. Employment strength is 1500 including monthly and daily rated staff.

Production of Lignite during last five years are as under :

Year	Production (in MT)
1992-93	30,05,894
1993-94	35,26,547
1994-95	35,70,010
1995-96	44,47,263
1996-97	47,61,973

Rajpardi Lignite Project:

Large requirement of lignite as solid fuel for South Gujarat industries is partially met by Rajpardi lignite mine of GMDC. As the deposit is comparatively small (About 15 million tonnes) and overburden is much higher compared to Panandhro Lignite Mine, production is limited to about 4.0 lakh tonnes per year.

The mine, situated in Bharuch district, employs about 500 people. Lignite is excavated from depth as much as 60 meters which also requires large volume pumping of water. Total capital investment in terms of current fixed assets at the Project is about Rs.10 crores.

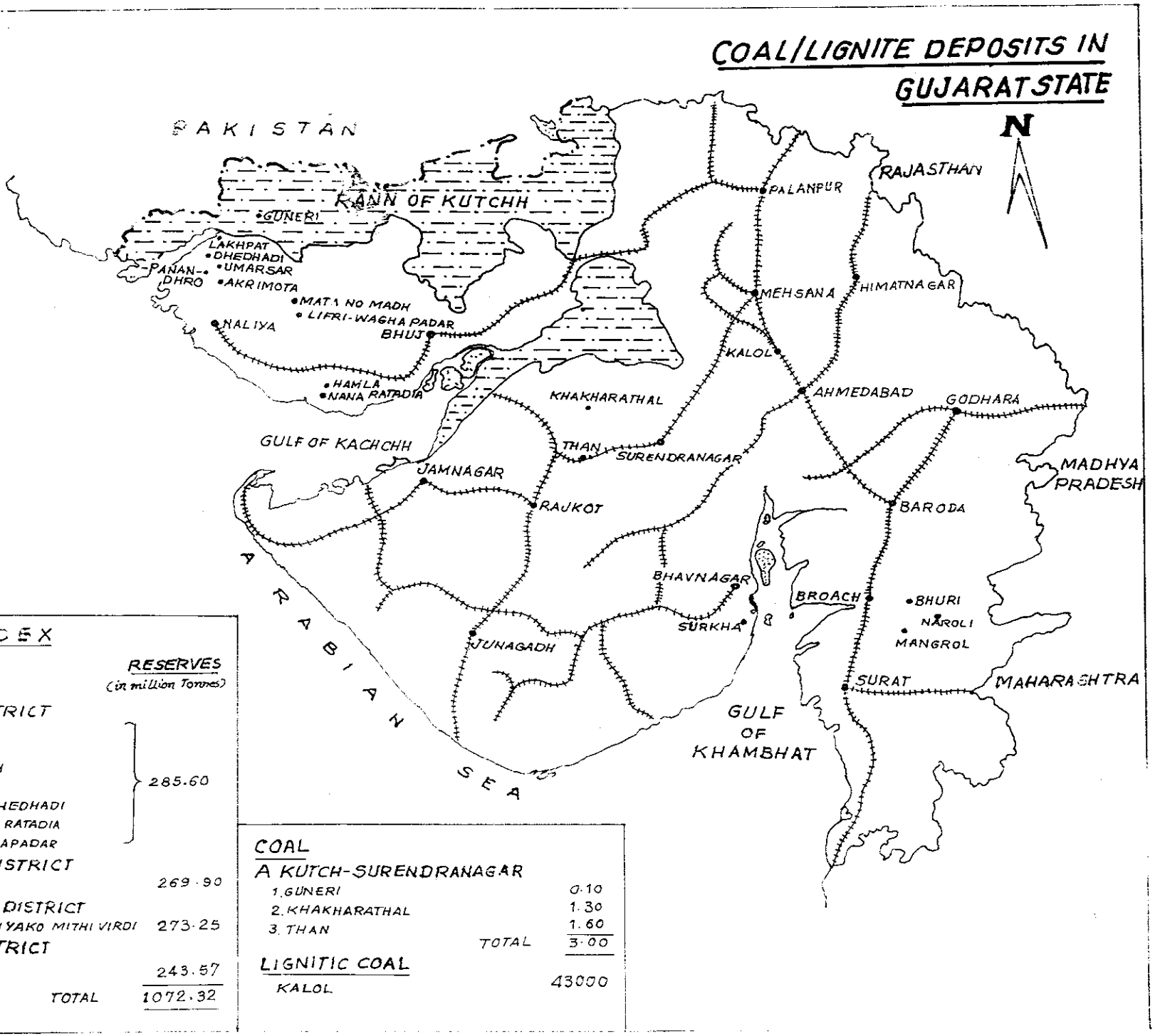
Other extraneous mineral matter has been precipitated from solution into cracks and spaces in the coal after formation of peat was well advanced or even after formation of the coal beds. In lignite, gypsum (selenite) and iron pyrite are the most abundant minerals of this sort. Calcite also occurs. The calcite and gypsum presumably owe their origin to factors of solubility and crystal formation. The pyrite, on the other hand, perhaps was precipitated by action of microorganisms. Certain bactria, for example, in the course of their physiological processes can cause precipitation of iron sulfide from solutions containing sulfur and iron pyrite and other extraneous mineral matter may occur as finely disseminated crystals or sizable concretions in lignite. Pyritic nodules an inch or more in diameter also occur. In many places concretions called sulfur balls, which range from about 1 inch to 6 or more inches in diameter are found in the lignite beds.

Ash Versus Mineral Matter:

When coal or other organic material is burned, a residue, largely of mineral matter, remains. It will be noted that, in speaking of percentage composition above, ash and mineral matter were used as essentially equivalent, that is the percentage of ash in a substance was taken to be equivalent to the percentage of mineral matter in the substance. This is not strictly true because the process of heating and oxidation volatilizes some inorganic compounds (minerals) and oxidizes others changing their weight. Perhaps more important, the process of ashing coal changes the chemical nature of the mineral matter so that analysis of ash composition do not show the true composition of the mineral matter in the coal. For example, pyrite, a characteristic component of lignite, is oxidised on ashing to volatile oxides of studying the exact composition of mineral matter is probably X- ray diffraction analysis, although petrographic analysis with a microscope is satisfactory where crystals of large enough size exist. Either of these methods permits study of the original mineral matter. X-ray diffraction analysis can detect very small quantities of mineral matter but satisfactory results with lignite demand either very long exposures with whole lignite or some physical method of concentration of the mineral matter (for example float and sink techniques), because the organic mass of the lignite has a strong dilution effect.

However, detailed ash-composition data do provide in part the bais for estimating original mineral constituents. In addition, the composition and consequent chemical and physical characteristics of coal ash as such are of considerable importance in coal utilization. The ash characteristic most commonly determined for utilization purpose is the ash-softening

COAL/LIGNITE DEPOSITS IN GUJARAT STATE



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	RESERVES (in million Tonnes)
LIGNITE	
A-KUTCH DISTRICT	
1. PANANDHRO	285.60
2. AKRIMOTA	
3. MATANOMADH	
4. UMARSAR	
5. LAKHPAT-DHEDHADI	
6. HAMLA-NANA RATADIA	
7. LIFRI-WAGHAPADAR	
B. BHARUCH DISTRICT	
1. JHAGADIA	269.90
C. BHAVNAGAR DISTRICT	
1. BETWEEN KOLIYAKO MITHI VIRDI	273.25
D. SURAT DISTRICT	
1. MANGROL	243.57
TOTAL	1072.32

COAL	
A KUTCH-SURENDRANAGAR	
1. GUNERI	0.10
2. KHAKHARATHAL	1.30
3. THAN	1.60
TOTAL	3.00
LIGNITIC COAL	
KALOL	43000

Lignite Bearing Areas:

In NW Rajasthan i.e. Bikaner, Nagaur, Barmer, Jaisalmer districts 7000 Sq.Kms. area is lignite bearing promising area. Systematic exploration carried out by various Geological agencies have resulted in locating 1000 MT lignite reserves in the above district. Further exploratory efforts are under progress. Details of potential deposits are tabulated as under:

Estimation of Reserves of Lignite in Rajasthan

Sl. No.	Area	Reserves	Moisture Content	Ash	Quality (%) FeC	V.M.	C.V. K.Cal./ Kg.
1.	Palana	23.57	30-50	3.56-8.04	21.25	20.8-35.60	3200-3500
2.	Barsingsar	70.24	42-47	2.4-10	20.6	23.28	3000
3.	Gurha (Group)	71.80	40-49	25	12.23	22.26	2000-3000
4.	Mandal-Charanan	15.00	43.8	12.77	18.54	22.94	2667
5.	Bitchnol		[Under exploration by MECL and seems to be promising].				
	Total	*180.61*					
	Barmer District						
1.	Kapurdi	150.40	40-60	5-20	13-26	21-25	2000-3800
2.	Jalipa	350.00	35-50 [Exploration continued]	5-20	15-25	20-30	2000-3500
3.	Giral	61.00	45 [Exploration continued]	18.72	17.38	19.11	2414
4.	Jogeshwar	34.52	- [Lignite horizons are deep seated]	-	-	-	2500
5.	Bhadka	9.46	-	-	-	-	2790
	Total	*605.38*					

During February 1997, Tamil Nadu produced 12,71,000 tonnes while Gujarat produced 5,40,000 tonnes lignite. Compared to January 1997, there is a -8% change in the production of lignite during February '97.

Gujarat Resources:

Lignite resources of the State are confined in Kutch, Bhavnagar, Surat and Bharuch district. Commissioner of Geology & Mining, Government of Gujarat has carried out detailed exploration in the above districts.

Districtwise Lignite Reserves in Gujarat

District	Lignite Bearing Area(in sq.kms.)	Reserves of Lignite (in MT)		
		Proved	Inferred	Total
Kutch	82.51	254.13	31.47	285.60
Bhavnagar	42.65	121.91	151.34	273.25
Bharuch	13.18	19.90	250.00	269.90
Surat	21.74	182.33	61.24	243.57
Total	**160.08**	**578.27**	**494.05**	**1072.32**

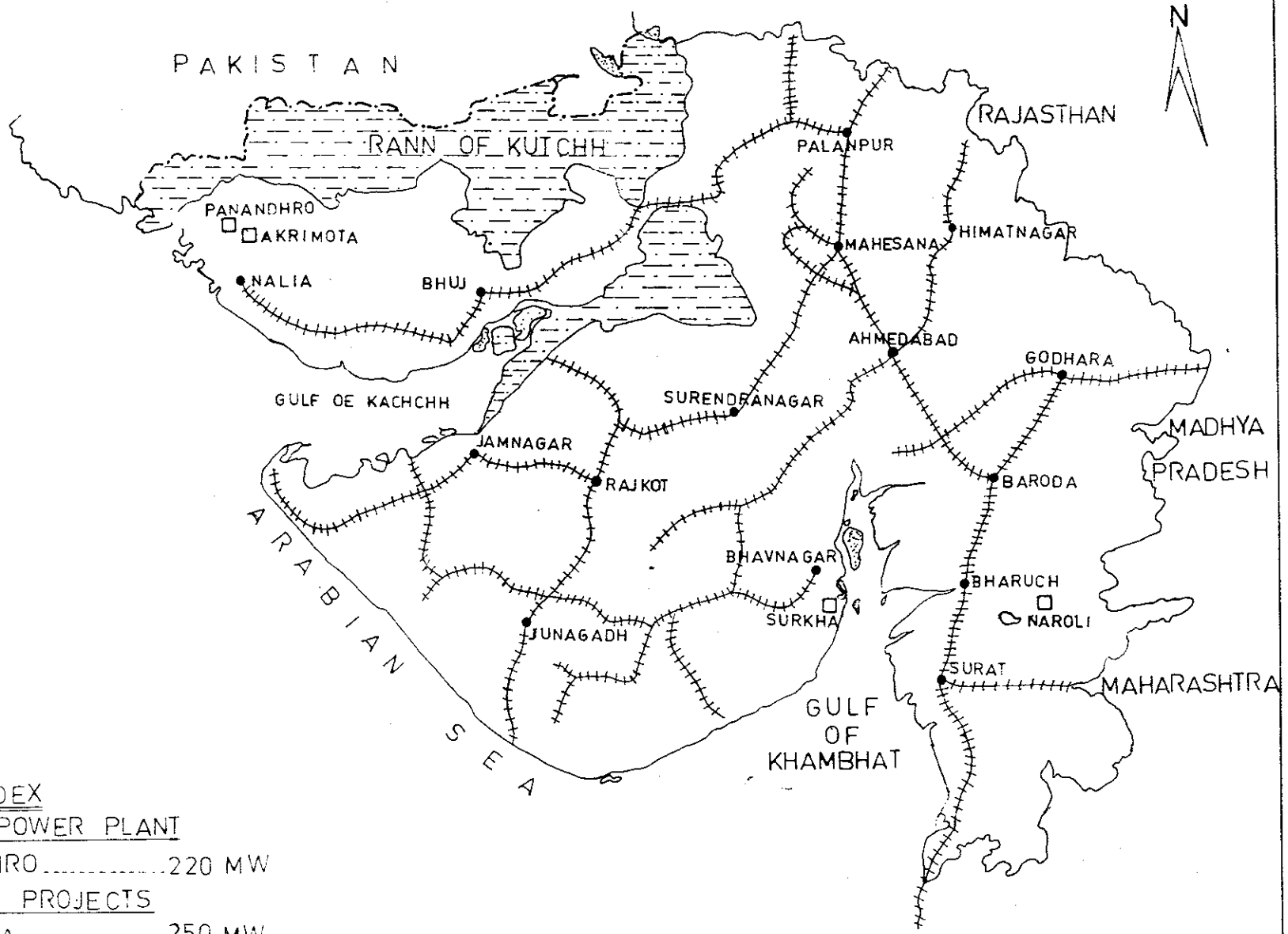
Source: Commissioner of Geology & Mining, Govt. of Gujarat

Exploration activity is still in progress in the Surat basin to augment the resources. At present estimated reserves of lignite is 1072.32 MT. Geological Survey of India is also exploring lignite resources in Surat district. Findings of lignite close to the Pakistan border in Kutch district has also given hope for the further exploration in the Kutch territory. The Central Geological Programming Board has been requested to take up the further exploration work in the border of Kachchh. The assessment of proved reserves from the estimated category is in progress.

GMDC Lignite Projects:

Gujarat Mineral Development Corporation commenced lignite project in Panandhro in Kutch in 1974. They have also opened second mine at Rajpardi in Bharuch district in early '80s.

EXISTING & PIPELINE LIGNITE BASED POWER PROJECTS



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EXISTING POWER PLANT

- PANANDHRO ..... 220 MW

PIPELINE PROJECTS

- AKRIMOTA ..... 250 MW
- NAROLI ..... 250 MW
- SURKHA ..... 375 MW

are the by-products during mining of lignite and operation of a thermal power plant.

Lignite is wined by open cast mining, deploying bucket wheel escalator and conveyor system. The deposit have certain unique features peculiar to this area:

1. Hard abrasive overburden strate which presence severe strenuous duty conditions for the mining equipment and requires advance feasibility preparation.
2. Sticky and marshy surface clays occurring in lignite field.
3. Presence of ground water aquifer under pressure.
4. Cyclonic and monsoonic climate and
5. Comparatively higher overburden to lignite ratio.

Due to above peculiar feature, NLC struggled hard for technological innovation. With vast experience in the lignite mining, NLC has now gained expertise in lignite mining and its utilisation. In addition to lignite mines, NLC Complex has fertilizer plant, carbonisation plant, lignite briquetting plant and thermal power station. Tamil Nadu lignite forms the most important energy source on which Tamil Nadu relies heavily.

Exploration Activity:

The State Directorate of Geology & Mining has been actively exploring for lignite since the formation of the State. Exploratory activity has resulted findings of new lignite basin of Bhavnagar, Mangrol and Bhuri. On the basis of indicated occurrences of lignite seam by ONGC, State Department of Geology & Mining launched detailed exploratory programme in the Bharuch/Valia sector. Wide space drilling has conferred existence of the lignite seam in Surat/Bharuch open lignite basin. After the finding of new lignite basins and sizeable reserves to cater needs of proposed thermal power station of GIPCL and Gujarat Power Corporation, Commissioner of Geology & Mining has intensified its exploration programme for the lignite investigation. All drilling rigs are deployed for the detailed assessment of lignite reserves.

Geological Survey of India has created separate "Task force Committee" for the lignite investigation. On the basis of recommendations, Dy. Director General (Western Region), GSI has included lignite exploration programme

Due to limited reserves here, production will be maintained at the current level and no major expansion is envisaged.

Production of Lignite during last five years are as under :

Year	Production (in MT)
1992-93	3,22,583
1993-94	3,68,858
1994-95	3,65,871
1995-96	4,93,800
1996-97	4,23,526

Gujarat Industrial Power Company Ltd - Mangrol Lignite Project:

GIPCL has decided to put up 250 MW Power Plant at "Nani Naroli" of Mangrol taluka in Surat district. GIPCL has been granted mining lease of 1536 hectares of land for exploitation of lignite in the Mangrol taluka. GIPCL has opened exploratory mining in "Vastan" area of Surat district. The capital cost of the project is in the tune of Rs.1200 crores. The plant will go commercial in August 1998.

Gujarat Power Corporation Ltd.:

Gujarat Power Corporation has been granted area of 1355 hectares in Surkha block of Bhavnagar district. Government has also granted mining lease for an area of 750 hectares in Kharsaliya block. Corporation is planning to put up 375 MW Power Station in the Bhavnagar district.

Rajasthan Lignite Resources:

Lignite was encountered during the sinking of a well in Palana Village of Bikaner district in the year 1896. Since then exploratory works in the area has been carried out from time to time with various intensity by the State Government. Government of Rajasthan alongwith other agencies like MECL, GSI, NLC, CMPDI is doing untiring efforts to search for lignite deposit in the north-western Rajasthan and to evaluate the known deposits.

In line of above liberalisation, Cement companies like "Sanghi Industries" has come forward to use lignite as a fuel instead of coal for clinker manufacturing and power generation. Other Cement companies like Ambuja Cement, Siddhi Cement, Narmada Cement, Digvijay Cements, etc. are utilising lignite with coal for fuel generation. Due to the reduction in Custom duty on coal, Cement companies have started utilising Australian and Johannesburg coal. The reduction in Customs duty from 20% to 10% has encouraged coastal based cement plants to utilise imported coal. The landed price of imported coal at Okha is Rs.1800/MT. Considering the requirement of the coal by the eight major Cement companies in the State, demand for the lignite blending can go high in coming years.

Lignite application other than the power is for chemicals, fertilizers and in drilling mud. With the increase of oil exploration activity, demand for mud chemicals may go high. Profiles for the Mud Chemicals, Causticised Lignite, Lignite Briquetting and Metcoke from lignite are prepared and enclosed separately.

Lignite Pricing & Policy:

Lignite is considered as low ranking coal. The royalty of the lignite is not fixed by the Government of India. The rate of royalty is considered as 10% of the pits mouth value. Lignite from GMDC mine has gross caloric value of 3000 to 3500 K.Cal./Kg. and its price is normally bench-marked against the landed cost of domestic C and D grade non-coking coal. At financial year 1997 prices for a consuming unit in Gujarat, lignite was 18% cheaper than domestic coal and 30% cheaper than imported coal.

GMDC sells lignite to the consuming industry in three categories:

1. Semi mechanise products
2. Mechanise products from Bucket wheel elevator
3. Waste Powder Lignite

All three categories of lignite pre-dominant parameters is calorific value, fixed carbon and ash content. Sale price per metric tonne of lignite from Panandharo and Rajpardi mines with broad specification is mentioned below:

Sl. No.	Area	Reserves	Moisture Content	Ash	Quality (%) FeC	V.M.	C.V. K.Cal./ Kg.
Nagaur District							
1.	Merta Road (Mira Nagar Hansiyar)	83.20	45	14.63	17.75	24.63	2684
2.	Mokala	36.56	45	12.0	18.81	25.89	2837
3.	Indawar	12.00	45	11.21	18.40	25.27	2770
4.	Kasnau Igyar	56.70	45	12.00	20.13	23.75	2800
	Total	*188.46*					
	Grand Total	**974.45**					

Tamil Nadu Lignite Resources:

The discovery of an important lignite field at a depth of 50 to 80 meters below ground over an area of 500 Sq.Kms. has lead to the development of a large industrial complex around Neyveli in South district. The field is estimated to contain about 3300 MT of lignite of which 200 MT have been proved by intensive drilling. The other lignite area reserves are Jayakonda Cholapuram 1150, Thiruchirappally 1150, East of Veeranan 1340, Mannargudi 19500 and Bahur 585 million tonnes.

Neyveli Lignite proximate and other analysis is as follows:

Field	Analysis on dry basis					Analysis on DMF basis				
	Moist %	Ash %	Sulphur (S)	Phos (P)	VM	CV	C	H	N	O
						(Kcal/Kg.)				
Neyveli (Tamil Nadu)	10.30	3.5-7.5	0.5-1.2	0.001-0.002	52-60	6460-6610	70-73	4.6-5.5	0.6-1.0	22-26

From the proximate and ultimate analytical detail, it is considered good for generation of thermal power. The Corporation during January 1997 has produced 13,77,000 tons of lignite for its power and LECO plant. Corporation produces LECO and one lakh tonne of urea fertilizer. China-clay and flyash

Application of Lignite for Industrial Use:

Lignite is mostly used for the power generation. Other than power it is used for organic chemicals and briquetting. Lignite briquette is used for domestic fuel. Advanced countries like USA has developed technology to derive petrochemical products from lignite. Smokeless coke can be also manufactured from the lignite.

Use of Lignite as an Alternate Fuel in Cement Industry:

Introduction

Deterioration in the quality of coal due to mechanised mining operations, difficulties in coal movement over long distances to cement plants located far away from the coal fields, its inadequate supply due to insufficient rail/road infrastructure have necessitated the need for alternate fuel for cement manufacture. In this context, lignite has been considered one promising alternate fuel for cement plants located near the vicinity of lignite deposits. States such as Tamilnadu, Gujarat and Rajasthan are fortunately endowed with good lignite deposits. The cement plants located in Tamilnadu have been using lignite from Neyveli alongwith coal. The opening of new lignite mines at Neyveli and exploitation of lignite in Gujarat and Rajasthan have further brightened extensive scope for the use of lignite as a fuel in cement industry. The technology evaluates use of lignite as an alternate fuel in Indian cement industry and recommends important technical ways and means to economically exploit the lignite, particularly from Gujarat and Rajasthan for the cement plants in these States.

Reserves of Lignite:

The important known deposits of lignite in India are confined to the States of Tamilnadu, Rajasthan, Gujarat, J&K and Kerala. The total geological reserves of lignite have been assessed over 24 billion tonnes. About 90% of these occur in the State of Tamilnadu alone. State-wise break-up of lignite reserves in the country is given below:

in Surat/Walia sector. They have also deployed one drilling rig for the assessment of lignite seam in the basin. In addition to this, Geological agencies like Central Ground Water Board, ONGC, engaged in the drilling activity in the South Gujarat reported lignite occurrences in the boreholes. Exploration programme of C.G.M. is in progress.

Demand & Supply:

Lignite is an energy mineral similar to coal and it is largely used for power generation and as fuel for process boilers in manufacture of chemicals and textiles. It is also used as a substitute for coal in clinker manufacturing by cement producers and as a fuel in the production of ceramics and bricks. However, lignite, like coal, is a bulk commodity and its transportation is costly. As a result, inter-state movement of the mineral is limited and a major proportion of lignite mined is consumed locally. Therefore, demand-supply forces are more regional, and as far as GMDC is concerned, the main drivers for lignite demand are the availability and cost of coal in Gujarat.

Demand for lignite in Gujarat has seen a 10% CAGR over the last five years due to increasing substitution of coal with lignite. Given the high cost of transport (Gujarat itself has no coal deposits and sources most of its coal from Madhya Pradesh in Central India) and the poor quality of domestic coal, consuming units in the State have found it more profitable to substitute domestic coal with either imported coal or lignite. However, lignite is priced at a 15% discount to imported coal (the discount has come down from 30% due to a 10% cut in import duty on coal in the recent budget). The landed cost of imported coal increases with the distance of the consuming unit from the nearest port. Increasingly more users have switched to lignite. A case in point is the new cement unit of Sanghi Industries coming up in the Kutch region in Gujarat, which is expected to use only lignite instead of coal for both clinker manufacturing and power generation. Given the growth in requirements by downstream users, the estimated CAGR of lignite demand to be 11% over the next five years.

As the sole merchant seller of lignite in Gujarat, GMDC will be the only beneficiary of the increase in lignite demand and can sell whatever it produces. However, its monopoly status is being challenged by new consuming units in the State, which are seeking permission for captive mining of lignite. At present lignite mining for captive power generation by the Cement companies is opened by the Government of India. Power generation by private sector is allowed by the Power Ministry, Government of India.

The analysis of lignites from different deposits in the country is shown in Annexure-IV.

The analysis of ash from lignite indicates that it, generally contains relatively higher CaO and lower SiO_2, Al_2O_3 as compared to ash from coal.

Advantages:

- The amount of ash entering into the kiln, when using lignite as fuel in place of coal, is reduced both on account of relatively low ash content in lignite and less fuel consumption due to higher calorific value (on dry basis).
- The landed cost of lignite per unit heat is much lower than the landed cost of coal particularly for the cement plants located far off coal fields and near to lignite deposits.
- The use of lignite allows use of marginal grade limestone and avoids purchase of costly sweetner as well. Also, for a given raw mix the quality of clinker is considerably improved.
- The present load on Railways in transporting coal will be considerably reduced as lignite will mostly be carried by road.
- The plants near to lignite deposits can profitably exploit lignite deposits and will not depend much on coal or wagons for transport.

Technological Constraints:

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. Various technical limitations are discussed hereunder:

1. High Moisture Content:

High moisture in lignite leads to its sticking to the surfaces of crushing and grinding equipment. The material does not flow smoothly through chutes. This also causes choking and jamming of mill diaphragm leading to reduction of mill output.

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 due to cooling effect thereby increasing the specific heat consumption considerably. The load on ID fan is also increased due to high volume of exhaust gases including water vapour from the kiln.

		Ex.Panandharo	Ex.Rajpardi
1. Raw Lignite	*A Grade	Rs.510/-	Rs.780/-
	*B Grade	Rs.426/-	-
2. Waste Power Lignite	*C Grade	Rs.108/-	-
Extra :			
1. Royalty(as applicable)		Rs.2.50	Rs.2.50
2. Taxes		As appalicable	As appalicable

Note:

A-Grade : Semi mechanised products
B-Grade : Mechanised products from Bucket wheel elevator
C-Grade : Waste Powder Lignite

Source: GMDC (as on 1/9/98)

The changes in the landed cost of imported coal will have greater effect on lignite prices. The imported coal is less expensive than the domestic coal. Due to decline in import duty in recent Budget, the landed cost of the imported coal has reduced considerably. State Government Lignite Policy emphasises more application on the Power side. Sale of lignite in the consuming industry by the GMDC is the only source in the state as of now.

Policy:

Lignite is reserved for the public sector for mining. State Government or any of its companies (directly or through the formation of Joint Sector Companies) can take up the exploitation of the lignite deposits in the State.

Government of India is of the view that exploitation of lignite may be for power generation as well as for industries like Cement, Textile, etc. Government of India recent announcement about opening Coal & Lignite for the Private Sector has given a change to the energy sector.

State Power Policy is formulated for the power plant and it is incorporated in this book as Annexure-I.

The vertical roller mill with a dynamic separator is preferred to ball mill for grinding lignite. During grinding, the moisture comes down to a level of around 10% or even below. Gases from the drying and grinding installations are vented out through open top ESPs. The entire system is made air-tight so that no external air can enter the system. The following considerations may be kept in view in the drying and grinding installations.

i) Ducts should have 60 degree slope at the entry of the cyclones.

ii) Open top ESP is to be employed for venting gases.

iii) The angle of repose for conical portion of cyclones and ESP should be more than 70 degree.

Safety Measures/Monitoring Devices:

The prime safety measures to be adopted during fuel preparation should be preventive as well as technically sound as it is highly reactive fuel. Preventive strategies like use of inert gas for drying and spark extinguishing measure are directed to eliminate one of the ingredients of an explosion. Safety measures like containment, explosion venting, explosion suppression and explosion isolation either alone or in combination are necessary to minimise or eliminate damage due to explosion pressures. Monitoring devices for continuous monitoring of oxygen. CO and temperature should be mounted at critical points in drying, grinding and storage circuits.

So long as the oxygen content does not increase beyond 8%, the plant is operating in inert mode and safe condition exists as explosion limit for lignite gas mixture is 10% oxygen. Whenever the oxygen content of kiln preheater gas is near to the unsafe limit, i.e. above 8%, steam inertisation system should be adopted to lower the partial pressure of oxygen in the gas and bring down the oxygen content well within the safe limits.

When CO exceeds the safety limits or whenever there is unusual increase in temperature, there is a possibility of partial combustion or fire in the system. Under such conditions, CO_2 injection is resorted to, the system may be operative either manually or automatic. The plant (coal mill section) is shutdown automatically at the time of CO_2 injection. It is very essential to maintain the temperature of gas between mill/dryer outlet and ESP inlet within safe limits i.e. around 80 degree C. In order to control the temperature, water is sprayed, in the atomised form, using high pressure water pump, inside the mill or dryer to bring down the temperature.

State	Reserves (in Million Tonnes)
Tamilnadu	2,180.00
Rajasthan	1,431.00
Gujarat	1,072.32
J&K, Kerala & Others	570.00
Total	**29,437.32**

In Tamilnadu, lignite occurs in Neyveli, Bahur, Jayamkondam, Mannargudi, Kudikadu and east of Veeranam. Out of six potential blocks of lignite, two blocks are already under exploitation. In Rajasthan, lignite occurrence has been established in Barmer, Bikaner, Nagaur and Jaisalmer districts. At present, Giral deposit in Barmer district is being exploited. In Gujarat, lignite deposits have been found in Kutchchh, Bhavnagar, Bharuch and Surat districts. Panandhro and Rajpardi lignite fields in Kutchchh and Bharuch districts are presently being exploited.

Characteristics:

Lignite is characterised by high moisture, high volatile matter (VM) and low ash content. The composition of lignite varies widely from one deposit to another. The moisture content of run- of-mine lignite varies generally from 30 to 55%. On dry basis, the lignite is found to contain 45-60% VM and 10-25% ash against coals which have low VM(24-32%) and high ash content (30-35%). Lignite, particularly from deposits in Gujarat and Rajasthan, contains upto 9% sulphur (on dry basis). The sulphur content in lignite from Neyveli, (Tamilnadu) vary from 0.5 to 1.5%.

Sulphur in lignite is present in organic combination as part of the substance and in inorganic combination as pyrite or marcasite and as calcium sulphate forms. The organic sulphur is chemically - bonded to the hydrocarbon matrix of the lignite while inorganic sulphur is embedded in the lignite mainly as loose pyrites. While pyritic sulphur content covers a wide range, the organic sulphur content is usually low. Lignite from the mines pre-dominantly contains fines with a maximum size of 200 mm. It is friable in nature and has the tendency to crumble into small pieces on drying.

lignite by three different schemes. The combustion properties of the product obtained in these three schemes is mentioned below:

The raw lignite used had 10-13% ash and 43-45 V.M.

B. Drilling Mud Additives:

Lignite contains considerable percentage humic acid and other oxidation compound as much as 40-50% in some cases. Content of humic acid is increased in air dry or weather lignite oxidation. Thus oxiginated compound of lignite can be solubilized with caustic alkali. Caustic lignite is an inexpensive excellent additive for reducing the fuel loss and rheological properties of drilling mud.

Normally the lignite is soluble and executed better in additive. "Nyveli Lignite Corporation, Research and Development Wing" has developed a technology for the caustised lignite mud additives on a laboratory scale.

Oil & Natural Gas Commission, Indigenous Development Group, at Dehradun has also developed certain lignite based products such as chrome lignite and resinated lignite.

ONGC has developed a technology for resinated lignite which is available for commercialization to the entrepreneurs. For transfer and commercializa-tion of technical know-how, ONGC Marketing Dept. situated at 7th Floor, Jeevan Bharti-2, Cannought Circle, New Delhi has to be contacted for an agreement with remittance of transfer charges of Rs.10,000/- in favour of ONGC.

Industrial Extension Bureau (iNDEXTb) has prepared a project profile on Caustised Lignite involving Rs.22/- lakhs cost for the establishment of unit.

Entrepreneurs who are interested to go for chrome and resinated lignite products can procure the technology from the Marketing Division, ONGC by registering themselves with Marketing Department.

C. Organic Chemicals:

Lignite contains considerable percentage of humic acid and other organic radicals. These organic radicals can be utilised for the production of commercial organic components like Tar, Phenol, Pheno Raffin products. Nyveli Lignite Corporation is operating carbonizer plant handling 3,80,000 tonnes of raw briquetting. The plant is provided with 9 Lurgi internally beated carbonisers of the eight cell type with 2 shafts at 8 mtr. length of each.

The other problems associated with the use of high moisture lignite are as follows:

- Coating formation in mill grinding chambers.
- Clogging of grates in the mill.
- Increased grinding media consumption in case of ball mills or high wear rate of liners in case of roller mills due to corrosion effect of high moisture in the mill feed.

2. High Volatile Matter:

Due to high volatile matter, lignite is considered to be a highly reactive fuel. While air drying, it has the tendency to crumble into small pieces. With decrease in particle size, the rate of oxidation increases with the consequent generation of considerable quantum of heat, which when not dissipated, leads to spontaneous combustion and explosion. Hence, special care is needed during drying, grinding, storage and handling of lignite to safeguard against chances of possible explosion. High volatile matter also results in shorter flame in the burning zone which, though considered good for higher production rate, is difficult to control and requires constantly close monitoring during pyroprocessing.

3. High Sulphur Content:

High sulphur content in lignite leads to build-ups and coating formation. Kiln inlet and the two lowest stages of cyclone preheater are particularly more sensitive to plugging and material build-ups. Sulphate rich coatings also tend to form at points where false air enters the kiln system and/or at locations of higher turbulence. Excessive high sulphur recirculation results mainly from reducing reactions with the fuel.

Rational Utilisation of Lignite:

Separate Drying and Grinding:

In view of limitations in drying high moisture lignite during grinding as well as making use of solar energy, it is considered necessary to adopt supplementary method of drying lignite in a dryer. The heat from waste inert gas, if available, will be ideal for drying lignite. Fortunately, in dry process cement plants, such waste inert gas is available in the form of preheater exit gas with oxygen content ranging 3-5%.

The gas liquor coming from the Carbonisation Plant is subject to solvent extraction process using isoprenyl Ether. The crude phenol obtained in this plant is stored and subsequently processed for different fractions.

Middle Oil Distillation Plant

Middle oil, a condensation production from Carbonisation plant is a mixture of Neutral oil, Tar acids, Cresols and Xylenols.

The middle oil is subject to fractionation in this plant. Fractions coming within the range of 220 degree C are composed of tar acids, rich in hydrocarbon and neutral oil and these are recovered.

The fraction which are obtainable above the range of 220 degree C are separately collected. Provision exists for distillation of components in the region of 220 to 290 degree C.

Phenol Separation Plant

The raw phenols collected in the Phenosolvent Plant is processed here for recovering monohydroxy phenol.

Steam at 12 atm and 25 atm are utilised in this plant for the stripping process.

Pheno Raffin Plant

The fraction of the middle oil boiling under 220 degree C, the monovalent phenols from Phenol Separation Plant and running from Phenol Fractionation Plant are all handled in this section.

The undesirable foreign matter which is associated with carbonisation process are subject to fluctuations depending upon the operating condition and quality of lignite. These foreign matters are completely removed in this section by suitably varying the operating parameters. The Middle oil is completely dephinolised and the monohydroxy phenols refined..

Phenol Fractionation Plant

The mixture of phenols from the previous section is handled here. They are fractioned for the production of Carbolic Acid, Ortho Cresol, Meta-para Cresol and Xylenol.

Organic compounds manufactured above can be planned by establishing carbonization.

Desulphurisation:

Sulphur from lignite may be partly removed by physical or chemical methods or in combination of both techniques. The physical methods are generally used to remove pyritic and non- pyritic (sulphate) sulphur. Organic sulphur is difficult to be removed by physical techniques and therefore, chemical treatment is considered essential to remove largely the organic sulphur from lignite. The physical separation is based on the specific gravity differences between lignite and the heavier sulphur compounds. Litnite matter does not undergo any chemical reaction or change in its structure. It is simply ground to a specified fineness which permits liberation of sulphur from lignite. In chemical method, chemical treatment is given at specified operating and process conditions in a fluidised bed reactor where lignite structure changes during chemical reaction.

Three techniques viz. selective crushing and screening, steam-air treatment in fluidised bed reactor and ferric sulphate treatment followed by pyrolysis were tried for partly removal of sulphur from lignite. The results of experiments of chemical treatment with particular fraction of lignite are highly encouraging with sulphur reduction of around 60%. The lower size fraction of lignite containing high pyritic and sulphate sulphur can be treated with ferric sulphate solution and then pyrolysed at 400 degree C for effective desulphurisation upto 75%.

Prevention of Coating/Build-up:

In order to prevent coating or build-up 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.

NCB Expertise:

NCB, with the expertise it has acquired from the extensive in-depth studies carried out for the desulphurisation of lignite, particularly from Gujarat and Rajasthan, for cement manufacture, can provide the complete know-how and necessary technical guidance to the industry for economic exploitation of lignite, even with high sulphur content, as an alternate fuel for the cement industry.

A. Lignite Briquetting:

Lignite can be converted in smokeless fuel suitable for use in domestic hearths by briquetting techniques. Briquetted products can be prepared from

With the above favourable situation, multinational companies can show interest for the prospecting in the potential lignite bearing areas in Kutch and Bharuch district. The findings of lignite in the Pakistan has also inferred continuation of lignite seams towards Kutch region. State Government can invite experienced drilling contractors for the extensive drilling in the Bharuch & Kutch region. For the fast and speedy assessment of the lignite reserves, following action plan is suggested:

Action Plan for the Speedy Assessment:

1. Experienced private drilling contractor can be given blockwise areas for the drilling under the supervision of experienced officers of Commissionerate of Geology & Mining. The Commissioner of Geology & Mining may prepare detailed exploration programme alongwith the terms and conditions for tenders.

2. Drilling machines alongwith the accessories may be given on hire to the private contractors.

3. The funding of the exploration can be borne by GEB, GIPCL & GPCL who are the beneficiaries of this entire drilling activities.

Suggested exercise will speedily assist the lignite reserves and highlight the underneath lignite seams occurring in continuation of the Pakistan lignite deposits.

Desulphurisation of Lignite

The major known deposits of lignite in India are confined to the states of Tamilnadu, Gujarat, Rajasthan, J&K and Kerala. The lignite is found to contain 45-60% VM and 10-25% ash. The sulphur content in lignite from Neyveli, Tamilnadu vary from 0.5 to 1.5%. Such lignite can be effectively blended with coals and is being used in all Southern cement plants. Lignite from deposits in Gujarat and Rajasthan however, contain very high sulphur upto 9-10% and pose operational problems in the kiln during pryoprocessing. Such lignites require desulphurisation before use.

For reduction of sulphur from lignite, both physical or chemical methods or in combination of both techniques may be tried. The physical methods are generally used to remove pyritic and non-pyritic (sulphate) sulphur. Organic sulphur is difficult to be removed by physical techniques and therefore, chemical technique is considered suitable to remove the organic sulphur from lignite.

It is capable of producing very good carbonised briquettes by careful control of temperature especially in the initial stages of carbonisation. The carboniser equipped with a secondary gas cooling cycle which brings down the temperature of coke (Leco). These briquettes are finally discharged at a temperature of 80-90 degree C. The properties of Leco is mentioned below:

Properties Of Leco

Item	Content %
Proximate Analysis	
Moisture	5.0 - 7.5
Ash	11.0-14.0
Volatile Matter	10.0-14.0
Fixed Carbon	65.0-70.0
Calorific Value	
Kilocaloric per Kg.	6250-6020
Ultimate Analysis	
Carbon	70.5-76.5
Hydrogen	2.1-2.9
Oxygen & Nitrogen	26.7-19.7
Sulphur	0.7-0.9
Micum Drum Test	
Total material retained on 10 mm. screen is 70-80%	

Source: Papers presented during the Symposium on Utilisation of Lignite held on 19th November, 1978 published by GMDC.

Nyveli Lignite Corporation also operates following organic chemicals plants for the production of tar, phenol, carbolic acid, orthocresol, xylenol.

Tar Product Plant

This plant is designed to make carbolic acid, cresol, meta and para cresol and xylenol.

Phenosolvent Plant

This serves a double purpose of removal of phenolic effluents and recover the same as valuable phenol.

D. Inorganic Chemicals:

"Central Salt and Marine Research Institute", Bhavnagar has carried out laboratory scale tests for the production of calcium sulphide from gypsum where lignite is used as reducing agent. With Panandhro Lignite reduction of Gypsum can be obtained at about 800 degree C - 900 degree C with lignite in proper molar ratio. Calcium sulphide is widely used in luminous paints, medicines, reagents and in the preparation of calcium hydrosulphide which is mainly used as insecticide. The process know-how and technology can be obtained from the Institute by the interested entrepreneurs.

Central Fuel Research Institute has carried out industrial applications of the Panandhro Lignite after conducting pilot plant tests. The report indicated that it can be used for briquetting, carbonisation and in the production of Ammonia.

Detailed techno-economic feasibility report was prepared by consultancy firm for the establishment of high pressure briquetting and carbonisation. For the process adoptation CFRI & Consultancy firm have not arrived at a final solution. The matter is still to be finalised by the experts in field in abroad or in India.

Techno-economic feasibility report for the establishment of briquetting and carbonisation with the results of industrial application tests are satisfactory. Small medium scale units for the manufacture of products narrated can be encouraged with the help of technologies developed by the Research & Developed Wings of the Oil & Natural Gas Commission, Neyveli Lignite Corporation and Central Salt & Marine Institute.

Assessment of State Lignite Deposit:

Systematic geological exploration of tertiary formation of State revealed presence of lignite in Kutch, Bharuch, Bhavnagar and Surat Districts. Commissioner of Geology & Mining has launched exploration schemes for the prooving of the lignite deposits. The work is in progress. Geological Survey of India has also initiated detailed drilling work on lignite occurring in Bharuch district. For assessment of the lignite reserves for the proposed lignite based thermal power stations, extensive drilling work is required.

Modifications and amendments in the present Mineral Concession Rules of Government of India and announcement of liberalised Mining Policy has attracted foreign mining companies from Australia, South Africa and Canada for the mining projects in India. Investment opportunities for private participation in power sector has been also allowed by the Ministry of Power.

Three techniques viz. selective crushing and screening, treatment with steam and air in fluidised bed reactor and ferric sulphate treatment followed by pyrolysis have been tried for part removal of sulphur from lignite. The chemical technique of steam air treatment is found to have a potential of removing large percentage of organic sulphur from lignite. The results of experiments of steam-air treatment with different lignites in a fluidised bed reactor on a bench scale study are highly encouraging with sulphur reduction to the extent of 45-60% (from 9% to 4%) at 60% yield as given below :

Reduction of Sulphur Content by Air/Steam Treatment of Lignites

Sulphur (%)	Lignite Samples		
	A	B	C
Total sulphur in lignite feed	10.51	8.44	5.43
Total sulphur in product char	4.00	3.00	3.00
Total sulphur removed	62.00	64.50	44.80
Pyritic sulphur in lignite feed	3.39	1.75	1.95
Pyritic sulphur in product char	1.12	1.19	0.97
Pyritic sulphur removed	67.00	32.00	50.30
Sulphate sulphur in lignite feed	2.54	1.58	1.23
Sulphate sulphur in product char	1.92	1.51	0.97
Sulphate sulphur removed	24.40	4.43	21.10
Organic sulphur in lignite feed	4.58	5.11	2.25
Organic sulphur in product char	0.96	0.30	1.06
Organic sulphur removed	79.00	95.70	52.90

CAUSTIC LIGNITE POWDER

Introduction:

Oil & Natural Gas Commission, Oil India, Hindustan Oil Corporation are engaged in oil exploration in the country. With the increase in oil well drilling in off shore and on shore mud chemicals and treatment materials are in good demand. In western Indian Oil & Natural Gas Commission activities are concentrated in Rajasthan, Maharashtra, Gujarat. Minerals utilised in additives and treatment are Bentonite, Kaoline, Lime, Barytes, Mica flakes and Lignite. Causticised lignite is an inexpensive, excellent additive for reducing the fluid loss and rheological properties of drilling mud particularly, where tanin thinners do not work due to high temperature degradation.

Normally, the lignite is soluble in caustic soda, it is a better mud additive. Lignite is far more thermostable than CMC, where as CMC become less and less effective if the well temperature exceeds 120 degree C lignite can perform it function upto 200 degree C and above. At present lignite powder and caustic soda is purchased by ONGC and solution is prepared at drill site by mixing lignite powder and caustic soda in proper ratio in huge big mixture. To avoid time for the charge preparation ready made desired specification caustic lignite powder will be more preferred.

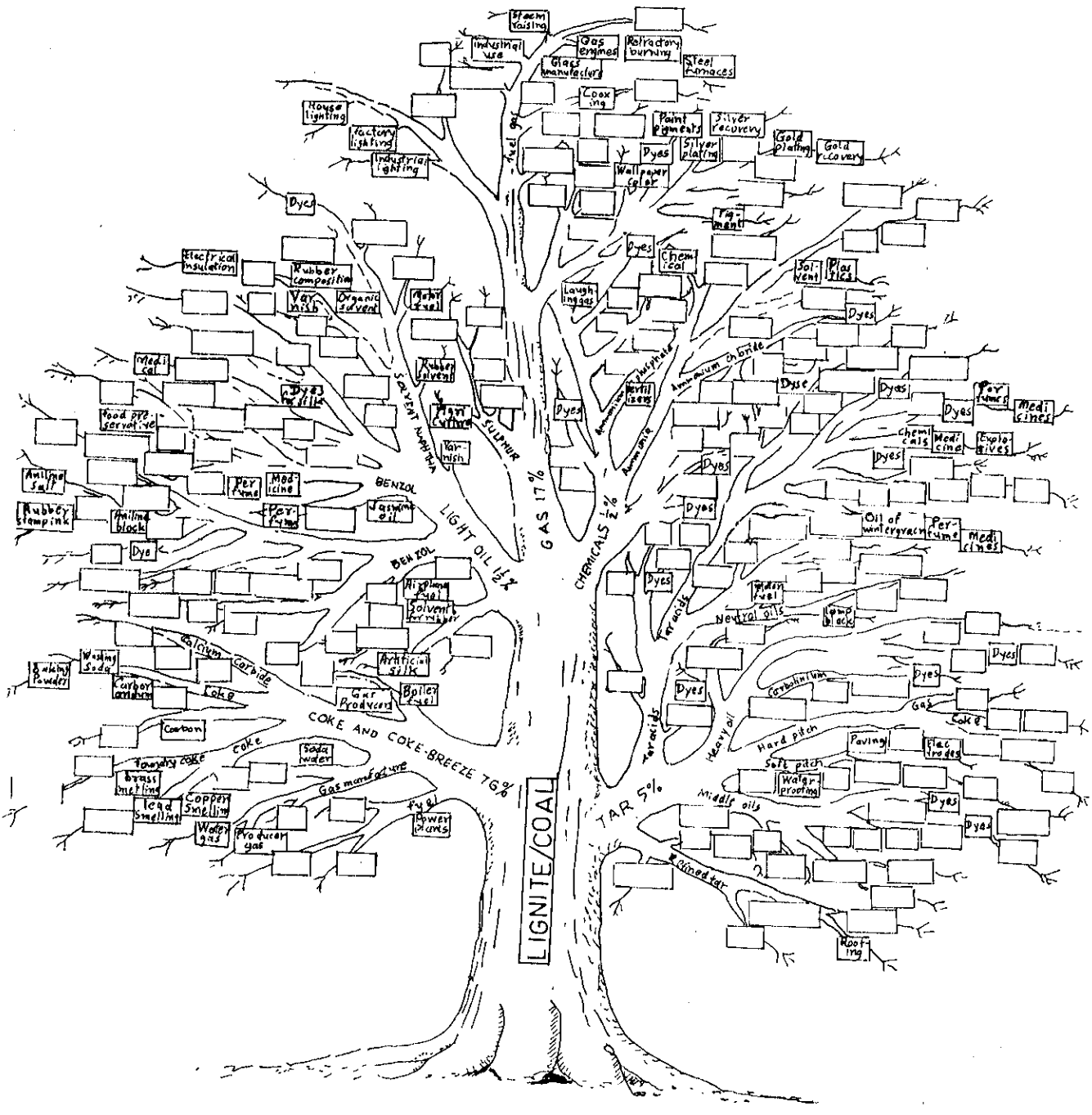
Market Demand:

Mud Chemicals are in demand. In all, Oil and Natural Gas Commission has started extensive use of lignite in drilling mud in the western region from 1967, Several shallow and deep wells has been drilled with sodium lignite in various projects of western region. Due to high price cost of barytes and its depleting resources in Andhra Pradesh, product is in good demand in projects. At present, no separate unit exists in the State. However, mud chemicals and additives unit of Hindustan Macobar at Panoli supplies the requirement of the Commission.

Manufacturing Process/Technology:

Lignite with moisture content maximum 15 can be grinded to 70 mesh powder. Dry lignite powder with 2.5% caustic soda solution should be dissolved with the help of high speed stirrer. Prepared solution may be aged for 24 hours at 32 degree C. The lignite powder to caustic soda solution may be in 2 to 3:1. The mixture after heating, cooled, dried and crushed to required size.

LIGNITE/COAL PRODUCTS TREE



i) Apparent viscosity (cp) (Fan V.G.)	should not be more than 25.
ii) Gel 10 (lbs/100 sq.ft.) 10	should not be more than half of 2(b)
iii) API F/L (ml 30 minutes)	10 (MAX)

Project Size:

The project envisages to manufacture 100 tonnes per month of caustic lignite powder with an investment of Rs.22.00 lakhs as under:

		Rs. Lakhs
1	Land & Building	2.50
2	Plant & Machinery	10.00
3	Working Capital	9.00
	Total	22.00

Utility:

1	Power (per annum)	3000 KWH
2	Water (per annum)	30,000 KL/day
3	Man power	4 (Skilled) 3 (Unskilled)

Suggested Locations:

Lignite is available to consuming industries from Panandhro and Bhuri mines of Gujarat Mineral Development Corporation. It is desirable to locate the unit in Lakhpat taluka or in Jhagadia taluka of Kutch and Bharuch district.

Government Policies/Key Elements:

- Procurement of lignite has to be done with GMDC on long term basis.
- Tie-up with ONGC Project Managers is essential.

List of Plant and Machinery Suppliers:

1. JN Marshall Pvt. Ltd.
   Bombay-Poona Road
   Kusarwadi, Poona 411 018

Project Profiles

LIGNITE BASED MET-COKE PLANT

Introduction:

Systematic geological exploration of tertiary formation of Gujarat revealed the presence of lignite deposits in Kachchh, Bharuch, Bhavnagar and Surat districts of the State. Efforts are still on to locate deposits of lignite in the State. Recently photogeological study in Dakor region of Kaira District has revealed presence of lignite basin. Experimental drilling works have found 250 million tonnes of lignite around Dakor area. At present State has 506 million tonnes of inferred reserves of lignite, out of which Surat & Bhavnagar reserves is 279 million tonnes. Gujarat Mineral Development Corporation at Panandhro mines (Kachchh) produces 2000 tonnes lignite per day. During 1991-92 2.8 million tonnes lignite is sold by the Corporation. Rajpardi Mines in Bharuch District produces 1000 tonnes lignite per day.

Gujarat Electricity Board has established 140 (70 x 2) M.W. Power Station at Panandhro in Kachchh District. Gujarat Power Corporation is assigned the work of power generation from the solid fuel in Private and Joint Sector. Private sector power generation plants are given prime attention to mitigate the shortage of power generation. Due to absence of coal in the geographical fold of the State, it has to depend either on lignite or natural gas. Surat and Bhavnagar lignite basins are earmarked for the private sector power generation. With this State Policy Private Sector can think of erection of coke project based on the lignite resources of Surat and Bharuch Districts.

Market Potential:

State is far off from the coal fields of Thana and Ranigunj. Coal is hauled by rail traffic for power plants, cements, fertilizer, textile industries. At present coal is sold at @ Rs.1800 per tonne in the market. Quality of coal desired by the industries are not fed by the coal India.

All the eight major cement plants, sodaash plants, fertilizer units needs coal for their kiln.

All the textiles units boilers are operated on the coal supply. Considering cement, fertilizer, chemical units and steel plants requirements of coal, it is beneficial advantages and profitable to produce coke from the lignite. It is import substitution.

The Neyveli Lignite Corporation has prepared the powder by treating crushed lignite with sodium hydroxide (90:10-15% w/w) in agueous medium. Technology is available with NLC, Neyveli (Tamil Nadu).

Plant and Machinery:

1. Pulveriser
2. High Speed Stirrer
3. Reaction tank with basic lining fitted with stirrer
4. Boiler

For the production of powder, the specifications of lignite powder desired by ONGC Laboratory Market Potential is given below:

1. Moisture content, percent by mass: 15 (Max.)
2. Performance Test:

a) Preparation of Sodium Lignite Powder Solution: Take 50 gms of 70 mesh powder of lignite (On dry basis) and dissolve in 350 ml. of distilled water containing 10 gms of caustic soda (AR/GR) grade with the help of Hamilton Beach Mixer, stirring at high speed for 30 minutes. Transfer it into 500 ml. volumetric flask. Age this solution for 24 hrs and make the volume to 500 ml. Mix the solution thoroughly to make it homogenous before use.

b) Preparation of base mud: Prepare a bentonite suspension containing a maximum of 7.5 gms. bentonite per 100 ml. distilled water by stirring with laboratory stirrer (3000-4000 rpm) for 15 minutes. Age it for 24 hrs at 30 + 2 degree C.

i)	Apparent Viscosity (dp)	35 + 5
ii)	Gel 10 (lbs/100 sq.ft.)	90 + 10
iii)	API F/L (ml30 minutes)	20 + 25

c) Take 1 litre (1000 ml) of above gas mud mentioned in (b) and add 200 ml of thoroughly mixed solution of sodium lignite, mentioned in (a) with stirring. Stir it for 15 minutes with Hamilton Beach Mixer at high speed. Finally re-loaded the mud upto 1.50 - 1.53 specific gravity. Adjust the pH of this mud to 8.5 - 9.0 with 6 N HCL. This mud should have the following properties at 30 + 2 degree C.

Analytical Data of South Gujarat Liginite:

Lignite:

Proximate Analysis		*Ultimate Analysis*	
Moisture	18.30%	Carbon	50.36%
Ash	13.40%	Hydrogen	4.03%
Volatile Matter	38.90%	Sulphur	0.36%
Fixed Carbon	30.20%	Nitrogen	0.78%
Calorific value (K.Cal/Kg.)	4587		

Ash Analysis:

SiO_2	- 10.27 to 49.96%	Fe_2O_3	- 5.36 to 20.32%
Al_2O_3	- 9.42 to 30.60%	CaO	- 5.83 to 26.75%
TiO_2	- 0.64 to 3.15%	SO_3	- 1.89 to 24.02%.

Plant & Machinery:

The major Plant & Machinery required for the project may be required to be imported.

List of Machinery:

I	Crashers with Screens	II	Drier
III	Carbonizer	IV	Decanter
V	Calciner	VI	Cooler
VII	Biner	VIII	Mixer
IX	Curingoven	X	Coker
XI	Briquetting Machine	XII	Dust Collector

Location of the Plant:

The plant can be located at Jagadia or Rajpipla on the basis of lignite basins. Captive mines can be developed on the lignite basin of Vastanand Bhuri basins. It will be prestigious project. All incentives of prestigious project will be available as per State Government Industrial Policy.

Machinery Supplier:

Davy Pittsburgh, one Oliver Plaza, Pittsburgh, Pennsylvania 15222 Company U.S.A. can be turnkey job for the erection.

2. Ashish Engineering Works
   8/323 E Dr. BA Road
   Bombay 400 019

3. Agarwal Fabrication Pvt. Ltd.
   3, Wilson Garden, Pune - 1

List of Raw Material Suppliers

Lignite: *Ex . Mine Price: Rs.357.00 per tonne*

1. Gujarat Mineral Development Coprn.
   Khanij Bhavan, Opp. Nehru Bridge
   Ashram Road, Ahmedabad 380 009

Caustic Soda: *Price Rs.10.00 per Kg.*

1. Gujarat Heavy Chemicals Ltd.
   P B No. 28
   Prakash Commercial Complex
   Rajmahal Road, Veraval 362 265

LIGNITE BRIQUETTING

Introduction:

State is blessed with good lignite resources. Gujarat Mineral Development Corporation operates two prestigious lignite projects in Kachchh and Bharuch Districts. Exploration activity has also underearthed two new lignite basins in the Bhavnagar and Surat Districts. State has 220 million tonnes proved reserves. New prospecting results have also inferred 212.67 million tonnes lignite reserves in Bhavnagar and 24.41 million tonnes in Surat District.

Central Fuel Research Institute, Dhanbad, Bihar has carried out feasibility study on the utilization of Panandhro lignite deposit. To reduce the pressure on the forest wood. It is worthwhile to encourage suggested product for domestic fuel in convenient form.

Nyveli Corporation is operating briquetting plant and producing commercial domestic fuel "Leco" in market.

Central Fuel Research Institute has carried out testing on Panandhro Lignite for the briquetting. Results are satisfactory. Corporation has expanded its production capacity by mechanisation of its Panandhro mine by deploying bucket wheel elevator.

Corporation intends to raise its production upto 6000 tonnes per day in near future. Bhuri mine is also producing 1000 tonnes lignite per day manually.

New explored basins have also 245,08 million tonnes inferred reserves.

Market Potential:

Environment authority gives thrust to protect forest canopy. Deforestation by the tribal community for domestic fuel in forest area needs alternate source for the fuel. Cheap and convenient form of domestic fuel prepared by N.L.C is in market in Tamil Nadu State.

Cheap and convenient form of domestic fuel will be a blessing to rural people.

The product can take good market in Hotel Kitchen, Restaurant where bulk fuel is required. Special design "Chula" can be fabricated for the mass requirement of fuel for the special ceremony lunch and dinner dishes for cooking. Product can be supplied in 20 Kg. bag.

Process:

Metallurgical coal is not available in the State. According to Davy Pittsburgh F.M.C. process coke produced is high grade high temperature metallurgical coke made from a wide range of coals, including non-coking bituminous types. It possesses superior blast furnace characteristics and can be used in place of conventionally made coke. Non coking, high volatile coals having low ash and sulphur contents adapt best to the process. So Surat & Bharuch lignite can serve the coke plant raw feed. Crushed lignite is dried, carbonised calcine at successively higher temperatures as it grows in a continuous stream through a three- bed fluidized system. Calcinate is cooled, the tar is dried and converted to binder and fuel gas is recovered. The calcinate and binder are recombined in a mixer which feeds a double-1 briquetting machine to produce "green" briquetter. These are cured on a moving grate in an Oxygen-containing atmosphere and are then devolatized in a coker to realise the product.

Project Size:

The project envisages to manufacture 5 (Five) lakh tonnes per year with approx. 25000 to 45000 tonnes (Benzene ion single reng Aromatic) and co-generation (20 to 40 MW) with an investment of say Rs.400 crores.

Item		Rs. in Crores
I	Mine & Land & Civil Work	50
II	Intangible Investment	45
III	Plant & Machinery	248
IV	Working Capital	14
VI	Know-how fees & Royalty	13
VII	Miscellaneous	6
	Total	**400 Crores**

Raw Materials:

One tonne of coke requires approx. 1.5 to 2.3 tonnes of lignite. So plant requires 12 lakh tonnes per year considering huge requirement it is advisable to operate captive mine. For the plant feed, low sulphur, high volatile lignite 78.99 M.T. reserves have been estimated by the State Directorate of Geology & Mining in Vastan & Jhagadia basins of Surat Districts.

1.	2.	3.	4.
9 to 13	Dryer	Drying medium flue gas at 850 - 900 degree C generated by burning fine lignite having 10% moisture. Feed moisture : 40% Product moisture : 9-10% During drying, disintegration of coarser size by the fan blade is to be achieved.	3 x 25 t/h
14	Cooler	For cooling dried fine lignite to 40 degree C from 80 degree C.	3 x 16 t/h
15	Bunker	For storage of dried dust	3 Nos.
16	Conveyor F	For converting dried dust lignite from the bunker(15) to briquetting press redler conveyor.	
17	Briquetting	Press pressure - 15 tonnes/ sq. in size of fed: x 25 mesh (B.S.) feed moisture: 8-10% Product size suitable for carbonisation in internally heated low temperature carboniser for giving carbonised product suitable for domestic cooking purposes. Ring roll type press is preferred.	3 x 15 t/h
18 & 19	Conveyors	Belt conveyors for transportation of green briquettes of carbonisers.	3 x 25 t/h
18	a Bin	Mild steel bin for storage of briquette.	1/2 hr. 3 Nos.

Consultancy can be provided by Centre for Environmental & Energy, R&D. Commercialisation Services Box 8103, University Station, Grand Forks, North Dakota 58202 U.S.A. Phone (701) 77-3132 Fax (701) 77-2339.

Key Elements:

1. Gujarat Power Corporation, Centre Point, Panchavati, Ambawadi, Ahmedabad 6 and Gujarat Mineral Development Corporation may be approached for Joint Sector or Associate Sector Plants.
2. Foreign technology tie up and process know-how consulting charges have to be negotiated.
3. Machineries have to be imported.
4. For captive mining State Department of Geology & Mining exploration reports can be utilised.

Domestic market for rural and tribal communities have to be covered with the product. Plant can be located in Lakhpat taluka or in Jhagadiya taluka in Kachchh or in Bharuch District.

Government Policy Key Element:

- Certificate from Gujarat Pollution Board must be taken for discharge in sulphurous fumes in the air.
- For the raw lignite contract agreement has to signed with G.M.D.C.
- Technology is available with Central Fuel Research Institute or Nyveli Lignite Corporation.

List of Plant and Machinery Suppliers:

The Indian Sugar & General Engineering Corporation
Yamunanagar - 135 001 (Hariyana)

List of Existing Units:

1 Neyveli Lignite Corporation
(A Govt. of India Enterprise)
Neyveli House
135 Periyar EVR High Road
Kilpauk
Chennai-600 010

Process/Technology:

The most familiar and widely used method for converting lignite into domestic fuel consists of crushing the lignite to small size, careful drying to a particular moisture level, binderless briquetting using high pressure and carbonisation at regulated rate of the briquettes to yield the product. Raw lignite from the mine is crushed to 4.6 mm dried to a moisture of 6-48 per cent, cooled to about 40 degree C and then briquetted a 10-20 tonnes/sq. in pressure without using any binder. The briquettes are carbonised at 600-650 degree C. The methods suitable for drying lignite are:

a) Steam drying

b) Flue gas drying

The dried lignite has to be cooled to 38-50 degree C for briquetting.

Pressing of dried and cooled lignite (briquetting) is done at high pressure without using any binding agent.

Plant & Machinery:

Item	Description	Specification	No. required No. & capacity provided
1.	2.	3.	4.
1	Conveyor	Rubber belt conveyor	1 x 150 t/h
2	Twin roll crusher	Cogged type required	2 x 60 t/h
3	Conveyor	Belt conveyor	2 x 75 t/h
4	Ground storage	7 days storage	12000 t
5	Underground pocket	RCC construction provided with shaking feeder of capacity 3 x 20 t/h	3 x 75 t
6	Conveyor	Rubber belt conveyor	3 x 25 t/h
7	Crusher	Hammer Mill Feed size : 50 mm - 0 Product size : 5 mm - 0 Feed moisture : 40-50%	3 x 25 t/h
8	Conveyor	Rubber belt conveyor	3 x 25 t/h

range of 5 mesh to 80 mesh. Manganese Dioxide, Kaolin, Attapulgite clay, Caustic Soda are the other raw materials required for the product.

Mud chemicals and treating chemicals have market in ONGC drilling projects in India. The requirement is likely to increase as more and more drilling activity both on-shore and off-shore takes place.

Some of the items manufactured are (1) Resinx (2) Diesel M (3) Drilling Detergent (4) Lubricant Defoamers (5) Corrosion Inhibitors (6) Foaming Agents.

Manufacturing Process/Technology:

The process of manufacture consists of coupling, complexing, curing, reduction reactions homogenlity and/or particle size distribution of the various raw materials resulting in the final product designed to import the specific properties required of the product in the particular mud system that would most benefit drilling conditions.

The technology for indigenous manufacturing of items has to be imported from the listed manufacturers.

The patent raw materials will be supplied by the joint collaborator.

Plant and Machinery:

A *Indigenous*

1 Table Mixer

2 Storage Tank

3 Heating Tank

4 Blend Y

5 Filter press

6 Speed Rheometer

B *Foreign Machinery*

1 Portable roler oven of 230V alongwith agening cells.

2 Gaskets and accessories.

3 A Beach blender running on 230 V with three variable speeds.

4 Viscometer of 115 V-60 HZ with six variable speeds alongwith transformer and accessories.

1.	2.	3.	4.
18	b Grizzley	25 mm aperture	3 x 15 t/h
20	Carbonisers	Internally heated with tar 3 x 360 t/d recovery system. Temperature of carboni-sation 600-650 degree C. Lurgi type carboniser is preferred, the description of which is given in Chap.1.	
21 & 22	Conveyor	Belt conveyor	3 x 15 t/h
21 a	Grizzley	13 mm aperture	3 x 10 t/h
23	Bunker	For storing caroonised briquettes (product)	3 x 100 t

Project Size:

Project envisage to produce 500 t/d briquettes or 165,000 t/a (4% moist) with a cost of Rs.1800 lakh.

		Rs. in Lakhs
1	Land and Building	1,21,90,000
2	Plant and Machinery	15,76,94,000
3	Working Capital (3 month basis)	1,08,73,000

Gujarat Mineral Development operates two mines at Panandhro and Bharuch in Kachchh and Bharuch Districts. It is required to have 1630 t/d or 537800 t/y (40% moisture) raw lignite for the plant.

Utilities:

Electricity	KwH x 106	24.5
Steam 3.5 ata	tonne	31.940
Raw water	m3 x 10	1227.5
Cooling water	m3 x 10 3	898

Utility

1	Power	150 KW
2	Water	25,000 litres/day
3	Manpower	50(10 Supervisory 40 Non supervisory)

Suggested Locations:

The plant can be located in backward district of Kachchh or in the Nandesari, Vapi or Panoli.

Lignite, Bentonite, Kaolin, Soda ash are available in Kachchh. So it is advisable to locate in the district.

Government Policy/Key Elements:

- No Objection Certificate from Gujarat Pollution Control Board.
- The foreign collaboration approval from Secretariat for Industrial Approval, Ministry of Industry, New Delhi.
- Certain raw materials are to be imported.

List of Plant and Machinery Suppliers:

1. Haliburton Services
   1415, Lousisisana Street, United Bank Plaza,
   Suite - 2300 Houston, Texas Tz 77002, USA.

2. Imco Services
   2400, West Loop South, Houston, Texas - 77027,USA.

3. Reed Tool Company
   PO Box 2119, Houston, Texas 77001, USA

4. Massina Incorporated
   3612, Noble Suite 101, Dallas, Texas 75204, USA

5. Milchem Inc.
   PO Box 22111, Houston TX 77027, USA

6. Dowell Schlumberger Services and Products
   PO Box 2964, Dubai, UAE

OIL WELL DRILLING MUD CHEMICALS

Introduction:

A variety of chemicals and minerals are required by Petroleum Industry for successful drilling, production and transportation of Crude Oil and Gas. These chemicals range from simple products like common salt to complex derivatives of natural compounds, microbial products, synthetic macromolecules and specially processed minerals, drilling deeper objectives in geologically hostile environment and obtaining production from depleted reservoirs pose problems and require speciality chemicals and minerals to accomplish the objectives of safe and fast drilling, achieving maximum production, transporting the crude oil and gas through long distance pipelines and mitigate the problem of corrosion in marine and other aggressive environments. Oil & Natural Gas Commission has concentrated its drilling operation in western region. Several shallow and deep wells have been drilled with sodium lignite mud in various projects. Lignite is purchased by ONGC in powder from packed in polythene lined gunny bags. Sodium lignite is found to be a good emulsifier of hydrocarbon oils in drilling muds.

Lignite is found to be a comparatively inexpensive chemical to control the rheological and fluid loss property of drilling mud.

Drilling mud parameters can be well maintained with the use of sodium lignite. Such mud has the advantage over other thinners in respect of flash flocculation caused by direct treatment with alkalies.

Market Potential:

In all projects of ONGC in drilling mud, sodium lignite is used in preparation of lignite at every drill site. With the use of lignite solution cost of drilling fluid is reduced. In addition to above, a variety of minerals are required by ONGC and Oil India Limited for oil well drilling such as bentonite barytes, muscovite flakes, kaolin, mananese etc.

Bentonite is used in oil well drilling as a drilling fluid, ingredient as a viscosifier and filtration control ingredient. It is also used to prepare aqueous mud and obtain light weight cement slurry. Bentonite is required by ONGC/OIL in several thousand tonnes per annum in powder form (100 mesh) Baryte in powder from (300 mesh) is used as a popular weighing material for drilling fluid and cement slurries. Muscovite flakes are required by ONGC in the

Lignite

Gujarat Mineral Development Corporation
Khanij Bhavan, Opp. Nehru Bridge, Ashram Road
Ahmedabad 380 009

Kaolin

Eklera China Clay Works
7 Ravi Chambers, 5th Floor, Near Relief Cinema
Ahmedabad 380 001

B Imported

Patent raw materials will be made available by the foreign manufacturer who supplies the technology.

List of some of the Existing Units:

1. Hindustan Magcobar Chemicals Ltd.
   87, Sampatrao, Productivity Road
   Baroda 390 005
   (Plant: Panoli, Dist. Bharuch)

2. Triveni N.L. Ltd.
   Kailash, 2nd Floor, 26 Kasturba Gandhi Marg
   New Delhi 110 001
   (Plant: Ankleshwar, Dist. Bharuch, not in production)

5 Hamilton Beach Blender 3 speed.

6 High Temperature High Pressure filter press 230V system including necessary pressure guages.

Raw Materials:

Sodium Dichromate (325 MT), Caustic Soda (950 MT), Lignite (1000 MT), Attapugite clay (150 MT), Kaolin (75 MT) Sod Hexa Metaphosphate (5MT), Xylene (15 MT), Manganese Dioxide (125 MT), Toluene (50 MT), T-Amy Akohol (25 MT), Butanol (35 MT), Lime (75 MT) indigenous raw materials are required.

Imported raw materials are also required as per the suggestion of manufacturer of the items. Following solvents are also needed.

1. Kerosene
2. Diesel
3. Heavy Aromatic Naphtha
4. Isopropyl Alcohol
5. Methanol

Project Size:

The project envisages to manufacture of 10,000 tonnes with an estimated cost of Rs.250.00 lakhs as under:

		Rs. Lakhs
1	Land	27.00
2	Building	41.00
3	Plant & Machinery	55.00
4	Technical know-how fee	36.00
5	Training	10.00
6	Misc. Fixed Assets	14.00
7	Preliminary Expenses	5.00
8	Preoperative	17.00
9	Contingencies	15.00
10	Margin Money	30.00
Total		**250.00**

The project cost is given on the basis of product mix items, technology and capacity given by the Dresser Magcobar Industries, Texas 77265 USA.

Crushed lignite can work as a raw feed to the coke plant. One tonne of coke requires 1.5 tonnes of lignite.

Raw Material:

The lignite can be available from the Rajparadi Lignite Mine of G.M.D.C. on a long term basis by signing M.o.U with Corporation.

Project Size:

The full size commercial plants can be scaled up from the outcome of the pilot plant results. The pilot plant with capacity of about 701/hr. Pilot plan can be purchased from the "Tebodin B.V." company of Netherlands. The commercial plant can be scaled for 1000 liter/hr. with an investment of Rs.5 crores.

Location:

State Government Power Policy gives importance for the power generation. Lignite can be used as a fuel for the thermal plant. Rajaparadi Lignite is available to the industries. The plant can be located in the Jagadia taluka of Bharuch district.

Government Policy:

- Power Policy 1995 will be applicable. Entrepreneurs has to approach Energy & Petrochemicals Deptt. in the Sachivalaya.
- For Joint Sector "Gujarat Power Corporation Ltd." is to be contacted.

7. Dresser Magcobar Industries
HQ, Dresser Tower, PO Box 6504 Houston
Texas 776265 USA

8. BJ-Hughes Inc.
5500, Northwest Central Dy., Houston
Texas 77092, USA

9. Hughes Drilling Fluids
10777 N.W. Free Way, Ste 700 Houston
Texas 77022 USA

10. Drillsafe International GMBA
PO Box 1320 Enschede, Str. 24,4460
Nordhorn, West Germany

11. Croda Drilling Aids Ltd.
1 Camberwell Green, London SE- 5, UK

12. Nevisco Well Services Ltd.
900 Norcen Tower 715-5th Avenue,
Sweategory, Alberta T2F2X6 Canada

13. Serlachius Pulp Mill
PO Box 436, SF 33101, Tampare 10 Finland

14. N L Baroid, PO Box 1675, Houston
Texas 77251, USA

List of Raw Material Suppliers:

A Indigenous

Minerals can be procured from the open market and other organic materials can also be procured from IPCL and refinery.

Bentonite

Ashapura Mine Chem.
C/1, Mittal Court, Nariman Point
Mumbai-21.

LIGNITE COKE FOR WASTE WATER TREATMENT

Introduction:

Environment and pollution control measures taken by the Central & State Government have compelled industries to discharge their waste water after treatment. Industrial estates created by States need serious efforts for affluent treatment. Gujarat Industrial Development Corporation has planned common effluent treatment plant on a co-operative basis. The product can be utilised for absorption. Major application of lignite is for power generation. Special application for value added product of lignite will be manufactured by the technology developed by Tebodin B.V. of The Netherlands.

Manufacturing Process/Technology:

The treatment process is based on the absorptive properties of lignite cokes. The cokes effect is similar to that of activated carbon. Lignite coke is cheaper than activated carbon. So product can replace where activated carbon utility is established. At the center of the plant there is a reactor in which the effluent is brought into intense contact with cokes, as a result of which a wide range of contaminants is bound to the cokes. The pollutant laden cokes are then separated in a plate separator, where they settle and the treated waste water is discharged. The separated pollutant laden cokes are then thermally regenerated and reactivated in small rotary kiln. This is undertaken within the plant, thus making it unnecessary to transport the cokes off-site for regeneration. A small proportion of the coke is combusted and disposed of as ash. The remainder is used again for waste water treatment. Fresh cokes are added to replace the material lost by combustion. The absorption capacity of regenerated cokes is 5 to 10% higher than fresh cokes. "Tebodin B.V. Consultant & Engineers" Laan Van Nieuw Oost-Indie-25 PO Box 16029, 2500 BA The Hague The Netherlands has developed technology and pilot plant is available.

Market Potential:

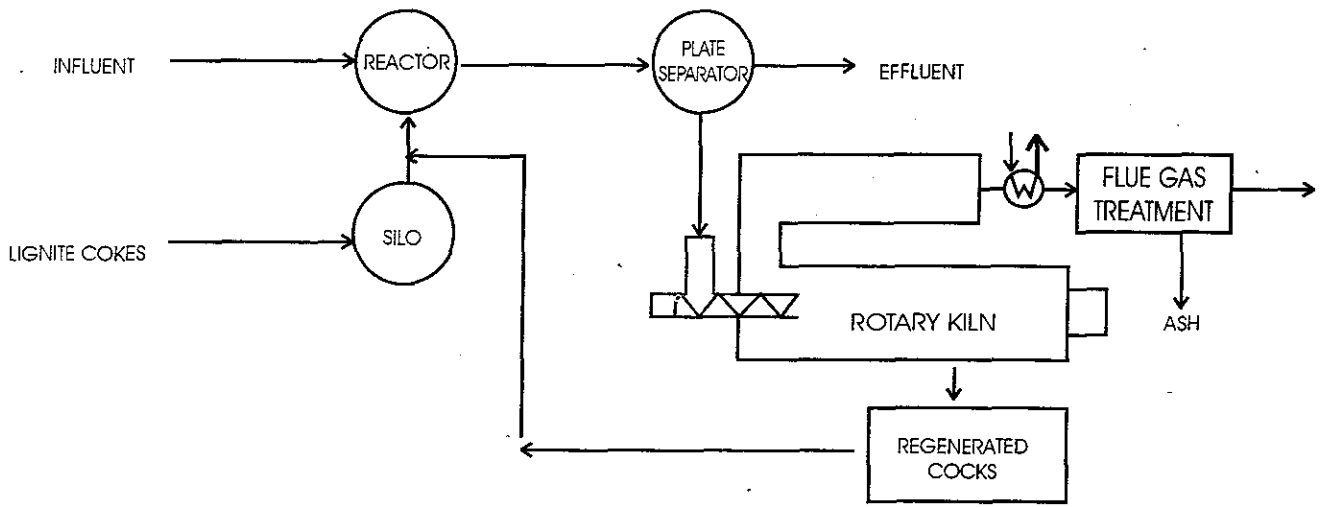
State industrial estates and chemical units, water intensive projects are required to release waste water after treatment as per Pollution Board norms. Waste water treatment and recycle of water lignite coke will be required. It can be produced by "Davy Pittsburgh F.M.C." process from the lignite.

List of Existing Manufacturers:

1. Reed Inc., Chemical Division
   10-16 Boul Des Capucins
   P O Box 2025, Quebec
   Quebec Canada G1K 7N1

2. National Lead Company
   Baroid Division
   Box No. 1675
   Houston Tx 77001

LIGNITE COKE FOR WASTE WATER TREATMENT



SOURCE : TEBODIN B.V. NETHERLANDS

Scale of Investigation:

The work on the process has been carried out on a pilot plant scale of 25 tonnes of coal per day.

Raw Material:

The main raw material required is high volatile non-coking coal. India has vast reserves of such low grade coals.

Equipment:

Major items of equipment are coal crushing, screening and handling unit, carbonisation unit, dust separators, tar separators storage tanks, pumps, boiler etc. These are indigenously available. However, some items like stainless stell fans and special castings may have to be imported.

Capital Investment:

The investment required for a plant having a capacity of 900 tonnes of coal per year is estimated at Rs.86 million.

Employment Potential:

The plant can provide employment for about 500 persons.

Status:

The process has been licensed to one party and the project is in an advanced stage of implementation.

LIGNOSULFONATE

Introduction:

It is dispersing agent in concrete and carbon-black-rubber mixes, extenders for tanning agents, oil well drilling mud additives, ore flotation agents, industrial cleaners. It is light-tan to dark-brown powder, no pronounced odour, stable in dry form and relatively stable in aqueous solution. "Lignosol" compounds are mixtures of lignosulfonates and wooden sugars. The product is a metallic sulfornate salt.

Market Potential:

Due to increase in oil well drilling activity by O.N.G.C., Hindustan Oil Exploration Company, Jindal Drilling Company at offshore and inland for oil and gas exploration. Mud additives are in good demand. Special chemicals are required for mud formulation. Drill sites at mud ponds chemicals are added as per the site requirements for mud circulation. Government of India in its new policy for Oil & Gas has allowed private sector companies for oil exploration.

Manufacturing Process/Technology:

O.N.G.C. Drilling Division, Dehradun offers the technology to the entrepreneurs. The chemical can be manufactured as an additional item by the existing unit.

Raw Materials:

Lignite powder can be procured from the Rajapardi Lignite project of G.M.D.C.

Project Size:

Product can be manufactured by the existing Mud Chemical Units as an additional item.

Suggested Location:

The unit can be located in the Chemical zone. The ideal location will be Jagadia or Wagara in the Bharuch district.

Wanakbori (1260 MW), Utran (39 MW), Ahmedabad Electricity Company (510 MW), Gandhinagar (660 MW), Dhuvaran (588 MW), Panandhro (140 MW), Sikka (240 MW) and Kadana (120 MW). As on 30.09.1995, the total derated installed capacity in the State was 6238 MW. It may be added here that in addition to this there is a capacity of 1306 MW from captive generating sets put up by different Companies within State. The State's per capita annual electricity consumption is 650 Kwh compared to national average of 345 Kwh.

Projects under different stages of Planning and Implementation:

*	GTEC (Gandhar)			655 MW
*	Reliance, Sikka			500 MW
*	Essar, Hazira			510 MW
*	GMDC, Akrimota			250 MW
*	GIPCL			
	i.	Baroda	160 MW	
	ii.	Mangrol	250 MW	410 MW
*	GPCL			
	i.	Kharsalia	125 MW	
	ii.	Surkha	250 MW	375 MW
*	GEB, Gandhingar		210 MW	
	Wanakbori		210 MW	420 MW
*	AEC 'C' Station			60 MW
*	Panandhro Expansion			75 MW
*	Kadana			120 MW
			Total	**3375 MW**

Sardar Sarovar Project when completed will generate 1400 MW hydro power, from which Gujarat will get 232 MW of power as its share. There will be a further addition of 14 MW from mini and micro hydel power stations based on Narmada canals.

CARBONISATION OF COAL
(Low Temperature)

Introduction:

Fuels commonly used in domestic sector, in India are animal dung, fire wood and charcoal. The demand for domestic fuels is being met from timber obtained by extensive deforestation and from animal dung. Deforestation is causing soil erosion, floods and change in climatic conditions. The use of animal dung as fuel is badly affecting its legitimate use as manure. The process developed envisages avoiding wasteful use of natural resources such as fire wood and charcoal by providing efficient domestic fuel from abundantly available high ash non-coking coals. Semi- coke obtained from high ash coals by low temperature carbonisation can conveniently replace these fuels. The by- product, tar can be used for road tar, and ammoniacal liquor as a disinfectant, in preservation of timber and in many chemical industries.

Process:

Steam coal obtained is crushed and screened to required size. The carboniser consists of three zones: predrying, carbonising and coke cooling zones, arranged one above the other.

Sized coal is charged in the predrying zone from where it moves down the carboniser by gravity. The charge first gets dried and then carbonised at high temperature. The carbonised product moves down to the coke cooler, where it is cooled and discharged for further cooling, screening and packing. The cabronisation gases alongwith combustion gases pass through dust separator and pre-cooler. The gases are then drawn by a hot gas fan and blown through a tar separator where the heavier fractions of tar are condensed. This is known as heavy tar. The lighter fraction are condensed in pipe cooler and separated in automatic settling tank. This fraction contains ammonical liquor and tar oil known as light tar. The non-condensible gases are led to the drier and carboniser burners. Tar and liquor obtained are further processed to get road tar, disinfectant creosote, timber creosote and tar acids.

As per the 15th Electric Power Survey, the total installed capacity in the State by the year 2000 AD should be 11236 MW. Survey assumed a linear 5.7% power demand growth. Gujarat today is on the threshold of an unprecedented industrial boom, exemplified by the fact that Gujarat accounts for a quarter of all industrial approvals in the country. A realistic approach to the power scenario should, therefore, be built on the premise that the demand for power is slated to grow atleast at the rate of 10% in the coming years. Looking to this, the State would be needing a minimum installed capacity of 15,000 MW by the year 2000 AD.

Objectives:

The objectives of the power policy or for that matter any sectoral policy should subserve the overall goals of the State in economic development. Basically, the goals that the State strives to achieve in economic sphere are the rapid development of productive activities in order to create sustainable employment opportunities and thereby reduce the level of poverty, particularly prevailing In rural areas and among the people belonging to Scheduled Castes and Scheduled Tribes and other Backward Classes. It is well recognised now that economic growth is a must in order to share the fruits of development more equitably. In this view of the matter the power policy also has to take into consideration the objectives set in the industrial policy and other sectoral policies. Having regard to these aspects, the following would be the objectives of the power policy of the State:

- To plan and build up adequate capacities in generation, transmission and distribution of power through efficient and cost effective means.
- To achieve optimum utilization of existing equipments and assets through renovation and modernisation.
- To rationalize the tariff structure to ensure reasonable rate of return to power utilities and generate surplus needed for future investment.
- To improve delivery of services and achieve cost effectiveness through technical, managerial and administrative restructuring of the utilities.
- To achieve conservation of energy through efficient utilization and demand side management, and minimising waste.
- To encourage generation of power through non-conventional sources of energy.

Annexure-I

POWER POLICY - 1995
GOVERNMENT OF GUJARAT

The Government of Gujarat has given highest priority to the development of power sector. To give concrete shape to the above issue, the Government has felt the need to come out with a 'Power Policy'. In October, 1991, the Government of India has made changes in the Electricity Supply Act allowing private sector participation in the field of generation, transmission and distribution of power. The State in its new 'Power Policy' proposes to encourage private sector participation in the field of power-generation transmission and distribution which till today was reserved for state public sectors only. Further it will also facilitate setting up of captive power units by different industrial units. Similarly, in the field of distribution of power it seeks private sector participation which will made the distribution and delivery system competitive and efficient. The State seeks to identify its power system needs and the means to fulfill the same through a comprehensive 'Power System Master Plan'. The State will augment long term generation of power by putting up large power plants which have been identified or are to be identified by the 'Power System Master Plan'. For short term augmentation of the State's power generation capacity it seeks to encourage setting up of captive power capacity by industrial units; putting up of short gestation small plants near the load distribution centre besides going for early commissioning and synchronising of projects in the pipeline. In the transmission sector the state power-grid will be maintained by Gujarat Electricity Board who will take the help of private sector in augmenting the capacities of transmission grid. It also seeks to encourage the use of non-conventional and renewable sources of energy and energy conservation while taking care of environmental issues. It also seeks to rationalise power tariff and duty through an Independent Statutory Tariff Regulatory Commission. Policy will be closely monitored by a high power committee.

The State of Gujarat came into being in the year 1960. The total installed generating capacity then was 315 MW. The State receives 1244 MW of power as its share from Central Pool like Korba (360 MW), Kawas (184 MW), Gandhar (185 MW), Kakrapar (125 MW), Vindhyachal (230 MW) and Tarapur (160 MW). Among the major power plants in Gujarat are Ukai (850 MW),

iii) Upgradation of existing transmission and distribution system so as to reduce losses;

iv) Identifying new transmission and distribution systems to be set-up;

v) The locational aspects to remove presently existing regional imbalances in power availability;

vi) To achieve cost reduction in generation and distribution of power;

vii) Feasibility of locating power plants outside the State as well as purchasing power from other States;

viii) Sourcing of funds.

The Power System Master Plan shall be prepared by 30th June, 1996.

A Planning and Monitoring Cell will be set up in the Energy & Petrochemicals Department. This Cell will be responsible for the implementation of the Power System Master Plan. This will also ensure speedy implementation of ongoing and future projects and extend help in obtaining various clearances from different authorities of the State Government.

Generation:

As on today the generation of power is being carried out by Gujarat Electricity Board (GEB) or State sector only. State's power policy proposes to throw open the generation of power to private sector also. The State will encourage healthy, competitive level playing by both State sector enterprises and private sector companies in the field of generation. Government of India has recently waived the mandatory techno-economic clearance of Central Electricity Authority (CEA) for project with capital cost upto Rs.400 crores. This is expected to cut down the gestation period of the project.

The State would provide attractive returns to independent power producers within the ambit of Government of India guidelines. Selection of IPPs will follow competitive and transparent route. Power so produced by IPPs will be purchased at levelised tariff at the bus-bar.

As the part of this privatisation policy, the State has already thrown open the following 4 projects involving an installed capacity of 2490 MW for open competitive bidding.

In order to achieve 15000 MW of installed capacity by the turn of the century, it will be necessary to plan for additional generation capacity of about 3250

Projects under active consideration:

*	Small Thermal/Liquid fuel fired Power Plants 95 x 100 MW)	500 MW
*	Coastal imported coal based power stations (2 x 500 MW)	1000 MW
*	Pipavav Gas/Naphtha Thermal Power Station	615 MW
*	Upgradation of the 54 MW Power Plant at Dhuvaran to 100 MW capacity	46 MW
Total Capacity		**2161 MW**

These projects when completed will raise the installed capacity in the State by 5536 MW taking the total to 11774 MW. This will be over and above the captive power capacity, which in coming years is expected to go up substantially.

In the post-liberalisation era, Gujarat has been witnessing rapid industrial growth. Investment of over Rs.1,00,000 crores is in the pipeline resulting in a quantum jump in the demand for power. While the State must go all out to augment the supply of power, one has to take note of the three basic constraints that the State has to live with:-

a) Constraint of local fuel resources like lignite, coal and hydel;

b) Difficulties in getting coal linkages for the power plants;

c) Long distance from the coal pit-head.

Due to the difficulties in getting coal linkages and long distance of coal haulage, the cost of coal in Gujarat comes to an average of Rs.1436.5 per MT compared to Rs.710 per MT for Maharashtra, Rs.730 per MT for Rajasthan and Rs.400 per MT for Madhya Pradesh. The State's option for hydel resources is also limited.

The State has tremendous geographical advantage for port based power plants using imported coal or liquid fuel like LNG, Naphtha and natural gas. This potential has remained largely unexploited till now. In building the future perspective for power development in the State, this potential is going to play a very important role.

original life span. In the absence of surplus generation capacities, due attention has not been paid to scheduled maintenance, renovation and modernisation of the existing plants. This has resulted in unplanned outages and frequent breakdowns. As a result, availability factor and the Plant Loan Factor of a number of plants are below satisfactory level. It is proposed to increase the operating efficiency of the existing plants through introduction of professional management and renovation and modernisation programmes. The process of renovation and modernisation involves substantial investment. The State proposes to throw open the renovation and modernisation of the existing plants to private sector (joint sector) participation which can help in bringing in more efficient management practices leading to greater availability of power.

In this, the first task is to identify critical components in the plants that require immediate replacement and renovation. Such renovation/extension programmes can extend the life by another 20-30 years at a fraction of the cost of a new plant. By improving the efficiency and utilisation of the plant, the Plant Load Factor can be increased to 75%. Nearly 5000 million additional units can be generated by this method alone in the State. Government will encourage the renovation and modernisation of all plants of State Electricity Board. For this purpose help of private sector will be taken on case-to-case and merit basis.

Private Sector will be allowed to operate/manage the plants wherever necessary.

Captive Generation:

In the context of continuing gap between projected generation and demand for power in the State, the State recognises the need for captive generation of power by Industries. This will be encouraged by the State as a means to augment the power supply. Captive generation will ease the burden on distribution system and also make surplus power available for the State Grid. Private industries including EOU's will be permitted to go for captive generation upto 60 MW without any restriction. For higher captive capacity decision will be taken by the State Government on a case to case basis.

Co-Generation:

The co-generation combines the process of recovering steam and power from the same single fuel source. After the power is generated the waste heat from the exhaust is collected to generate steam. As a result, the utilisation

Approach:

The requirements of financial and managerial resources for the growth in power sector are so vast that the State agencies by themselves will not be able to cope with. The Government of Gujarat, therefore, have decided to encourage and facilitate private sector participation in the fields of generation, transmission and distribution of power supply.

The State's approach in this regard will be to foster a transparent and competitive environment which will provide level playing field both for private sector and for state sector. The private sector participation will be encouraged in the field of generation, management of existing generation system, setting up of transmission lines, transmission and distribution of power in the manner as envisaged in the Government of India guidelines. While achieving competitiveness will be the guiding principle, it is envisaged that there are vast possibilities for co-operative, complementary and participative ventures between private (both domestic and foreign) and state sectors in developing the power sector. Specifically, the following steps will be taken in this regard:

a) Facilitate infrastructural linkages for early completion of all power projects.

b) Take advance action to identify project feasibilities, sites and other preparatory steps to reduce gestation period.

An important aspect of the new approach will be restructuring and optimizing the operations of power utilities by adopting a "profit centre approach" at power station level where increased autonomy with accountability will be given to power station authorities.

Strategy:

Power System Master Plan:

It is intended to prepare a "Power System Master Plan" which will address itself in a systematic manner to estimating the load forecast, calculating the regionwise deficit and formulating ways of bridging this gap. The Master Plan will, among other things, consider:

i) Supply and demand side management;

ii) Identifying optimum new generation which takes into account most suitable mix of various types of fuel for power plants;

The State has a large coastline of 1600 Km. The tidal wave altitude in Gujarat in may places reach nearly 6 mtrs. The technologies for the efficient use of tidal wave is at developmental stage. The State will encourage and provide adequate incentives for harnessing tidal energy.

Other Sources of Energy:

The State has large coal deposits in North Gujarat at a depth of 600 Mtrs. and below. It is difficult to mine the lignite economically. Technologies are available which will extract methane gas from the coal-bed and use this coal-bed methane for running power plants. State will encourage (private/joint sectors) entrepreneurs to take up coal-bed methane projects to harness this resource chiefly for power generation.

The scope for Mini/Micro Hydel Power Projects in rivers and canals of Gujarat is rather limited. However, efforts will be made to harness 100% of the potential by setting up of small Mini/Micro Hydel Power Projects based on river/canal through private/state/joint sector participation.

Transmission:

In order to provide efficiency in transmission, there is a need to upgrade the transmission system. The State recognizes the fact that for every Rupee invested in generation would entail an equivalent amount to be invested in transmission and distribution system.

The State Power Grid will be maintained by the Gujarat Electricity Board. In addition to its own generation, GEB will transmit power of different generating companies for distribution to its own substation in Gujarat or to the substations of private distribution companies. The necessary wheeling charges will be paid by the distribution companies.

Gujarat Electricity Board will accord higher investments in the transmission sector. This will be done by availing funds from international and national funding agencies and other institutional sources. A time bound programme will be laid down by the Gujarat Electricity Board to minimise the transmission losses. Transmission and distribution losses as estimated by GEB are about 20% compared to all India loss of about 24%. This is around 15% in Philippines, 18% in Thailand, 12% in South Korea and 9% in Taiwan.

Gujarat Electricity Board will allow private sector units to set up transmission lines and equipment for or on behalf of Gujarat Electricity Board. This will be done through a transparent bid and follow the Power System Master Plan of

MW. However, with the State's policy of encouraging setting up of captive plants by industries, actual gap may be smaller.

Early Completion and Commissioning of New Units:

A major thrust area identified for augmenting generation is early completion and stabilisation of new units. Owing to factors like multiplicity of commissioning agencies for main and auxiliary equipments. failure of suppliers of equipment/auxiliary to adhere to the delivery schedules and non-completion of projects in time, their synchronisation with the State Grid has not been satisfactory. With the entry of private sector as independent power producers, there will be a need to connect them to the State Grid and synchronise their power plants most efficiently. Guidelines will be laid down by the State Government to ensure that each individual unit takes responsibility for the synchronisation, laying the transmission line, carrying out their work in time so that the power is evacuated by the State Grid as soon as it is made available.

Setting up of Small Power Plants:

In order to provide quick capacity addition to meet the minimum needs of the State Grid it is proposed to build a number of small generating power plants at sub-station level based on liquid fuels. The role of liquid fuel like Heavy Petroleum Stock (HPS), Low Sulphur Heavy Stock (LSHS), Heavy Furnace Oil (HFS). LNG/Natural Gas, Naphtha has been recognised by the Government of India.

Because of the advantage of its long coastline dotted with several ports, Gujarat offers site advantage for port-based liquid fuel power plants both large and small. Liquid fuel is more eco-friendly compared to lignite and coal. This strategy can be extended to put up small plants at sub station level also. Besides, there will be other multiple advantages such as low capital cost, reasonable operating cost, short gestation period, reduction in T&D loss and generation of employment in rural areas. The State Electricity Board has identified such sub- stations in Kutch, Saurashtra and North Gujarat where small power plants can be put up near the sub-station or inside the sub-station premises.

Renovation, Modernisation and Management of Existing Power Plants:

An important area which has not received sufficient attention is the upkeep of existing plants. Some of the power stations in Gujarat have outlived their

Village Level Helpers Scheme:

Since it will be imperative to ensure proper service backup at the village level, a system of having a panel of helpers and linemen at the village level will be set up. They will be trained by GEB/private distributing company and will have access to tools and equipments of GEB/private distributing company. They will be employed by the village panchayats as and when need arises.

Conservation:

Energy Conservation:

The State Government realises the importance of energy conservation as a major thrust of the power policy. There is a need to have a system that encourages energy conservation and provides disincentives for the inefficient use of energy. In order to achieve this:

a) Energy audit will be made compulsory for all major industrial and large commercial establishments;

b) Through suitable directives and fiscal incentives/disincentives, the State Government will actively promote use of energy efficient equipments like compressed fluorescent lamp, energy boosters etc.

c) GEB will periodically carry out consumers' guidance and education programme for energy conservation.

Government is acutely aware of the fact that the horse power- based-tariff in agriculture sector has led to inefficient use of energy by farmers. There is no incentive to install energy efficient pumpsets. Adoption of improved irrigation methods such as sprinkler drip irrigation system will reduce the requirement of energy as well as conserve the ground water resources. The State will take comprehensive steps to induce farmers to adopt energy and water conservation measures.

State is also aware that flat horse power based agricultural tariff has led to high rate of drawal of ground water particularly in North Gujarat. During the coming years to draw the same amount of water and maintain the same level of agricultural production, the State will have to provide for higher and higher energy consumption. This will require creation of additional generation capacities. Government will lay stress on the recharging of ground water/aquifiers, modernisation of existing irrigation system, incentives for better dry land farming which will lead to optimum utilisation of State's resources and reduction in energy consumption in the agriculture sector.

of energy improves from 30% - 35% to 70%. It also reduces the cost of energy as the cost of power is shared between power generation and process steam. The State will encourage the industries to generate steam through co-generation. This will help waste heat recovery and lead to energy efficiency. There will be no cap on the quantum of co-generation that can be done by industry.

Gujarat Electricity Board will consider purchase of surplus power from captive units on mutually agreed terms covering price, timing, quantum and the period of purchase of power.

Non-Conventional Sources of Energy:

The State realises the importance of renewable sources of energy. The State shall endeavour to get the maximum benefit out of the non-conventional and renewable sources of energy which are clean and eco-friendly. The State today has an installed capacity of 64.52 MW wind power generation at various locations like Lamba, Okha, Mandvi, Tuna, Thank and Bamanbore. 16 New locations have been identified with a potential of 5000 MW of power which have a favourable wind speed of 19 to 25 Km per hour. It is intended to rationalise the incentive scheme for wind farms to attract more private investors and also simplifying procedure for allotting government waste land for above purpose.

Large areas of the State have solar insolation of 5.8 - 6.0 Kwh per sq.mt. per day. Vast tracts of land in Banaskantha, Kutch and Saurashtra are ideally suited for tapping solar energy both for generation of power and green house. It is proposed to encourage setting up of suitable solar power stations in North Gujarat and Kutch/Saurashtra.

The State has 19 sugar mills which can generate 200 MW of power from the bagasse. There is also ample scope to generate fuel by bio-generators, using paddy husk and other biomass that are available in the State. State will provide suitable incentives to generate power from bagasse/paddy husk/biomass/agricultural waste.

Gujarat has a large urban population which is expected to cross 50% of the total population by 2000 AD. The organic urban waste generated in the urban areas can be used for generating of energy. This will not only augment scarce energy resources but also go a long way in efficient disposal of the urban waste.

Annexure-II

Estimated Statewise Lignite Reserves in India

State	Area	Estimated Reserves (in MT)
Tamil Nadu	Neyveli	3,300
	Jayankonda	
	Cholapuram	1,150
	Thiruchirappally	1,150
	East of Veeranam	1,340
	Mannargudi	19,500
	Bahur	585
Rajasthan	Palana	
	Birshingsar	
	Kapurdhi	
	Merta	974.45
Gujarat	Panandhro	
	Mangrol	1,072.32
	Bhuri	
	Surkha	
Others		570
	Total	**29,437.32**

the State. Gujarat Electricity Board will pay to the company necessary rental for using their transmission line.

It is proposed to achieve reduction in transmission losses by :

a) Increasing the voltage level wherever feasible;

b) Replacing existing conductors by higher capacity conductors;

c) Reducing the impedance in transmission lines by continued installation of Static Capacitors to an optimum level;

d) Decentralizing generation at peak period by installation of small power plants as per clause 4.4;

e) Better vigilance.

Distribution:

Hitherto distribution of power has been the near monopoly of Gujarat Electricity Board. The new power policy proposes to throw open distribution of power to private sector and joint sectors also.

Distribution will be allowed on territorial basis to electricity distributing companies for their respective franchise area. This will be done through open competitive bidding process. The territories so identified will have a proper mix of various classes of consumers. Gujarat Electricity Board can participate in the equity of new companies entering the field of distribution in terms of its existing assets such as distribution lines and transformers. While handing over distribution to territorial distributing companies adequate care will be taken to ensure that the employment prospect of existing employees of GEB is not affected.

Each distribution centre will be identified as a Profit Centre. The executive of the profit centre will be held accountable for loss, theft as well as be given monetary incentive for better productivity and better management. Use of electronic meters both for HT and LT power consumers including single phase services will be resorted to. Use of low cost unmanned substation will be progressively increased with the 'State-of- the-Art' SCADA Systems. In order to accurately account for the distribution losses, there is a need to enforce the accountability of every unit of power that is generated.

All distributing companies will be required to provide timely release of all connections to various classes of consumers so that the consumers and the industry do not suffer for want of electricity.

Annexure-IV

Analysis of Lignite from different deposits in India

[As received basis]

Particulars	Tamilnadu	Gujarat	Rajasthan	J & K	Kerala
Moisture, %	40-45	25-35	35-50	30-35	30-35
Ash, %	3-12	7-15	10-25	30-35	20-25
Volatile Matter, %	20-25	30-40	20-30	15-25	25-30
Fixed Carbon, %	15-20	20-30	15-25	10-15	15-20
Calorific Value Kal./Kg.	2200-2800	3500-4500	2000-3000	1700-2000	2500-2800
Sulphur, % (Dry basis)	0.5-1.5	1.0-6.0	3.0-9.0	N.A.	N.A.

While putting up new power plants opportunity cost of such energy conservation measures will be taken into account.

Environment Conservation/Protective Measures:

The State is heavily dependent on coal and lignite as a prime fuel for its power plants. The dependence is likely to increase further due to additions in generating capacity as envisaged in the policy. The indigenous coal has a greater ash content. The lignite available in the State has a sizable sulphur content. Government is deeply concerned about the polluting effect of fly ash, sulphur dioxide etc. Suitable steps will be taken for the efficient use of fly ash. Government will encourage the use of environment friendly technologies in power plants like electrostatic precipitators, desulphurisation technologies and other technologies/equipments. The State will encourage the power utilities to generate power from environment friendly sources such as wind, solar, biogas, tidal energy, etc.

*****

1	2	3	4	5	6	7	8
Proximate Analysis (in %)							
A. Moisture	21.555	18.30	32.50	35.40	10-15	27.89	11.71
B. Ash	26.40	13.40	12.50	8.10	10-25	12.72	20.05
C. Vocatile Matter	35.79	38.90	33.10	30.43	30-50	37.98	41.70
D. Fixed Carbon	17.97	30.20	21.8	22.25	15-25	21.90	26.20
E. Calorific Value (K.Cal./Kg.)	4072	4587	3700	4187	3440-5080	4182	4187
F. Sulphur	1.34-6.00	0.22-2.0	-	2.5-5.4	2.5-5.4	2.5-5.4	2.5-5.4
Ultimate Analysis (in %)							
Carbon	29-45.67	50.36	-	61.28	-	-	45.88
Hydrogen	2.62-3.55	4.03	-	4.87	-	-	3.78
Sulphur	4.00-6.07	0.36	-	2.05	-	-	5.40
Nitrogen	0.39-0.60	0.78	-	0.91	-	-	0.50
Ash Analysis (in %)							
SiO_2	5.76-57.48	10.27-49.96	-	16.26	20.6	-	-
Fe_2O_3	5.04-52.50	5.36-20.32	-	37.9	21.3	-	-
Al_2O_3	3.37-37.58	9.42-30.60	-	12.2	11.6	-	-
CaO	0.54-20.69	5.83-26.75	-	11.0	13.0	-	-
TiO_2	0.38-8.25	0.64-3.15	-	-	-	-	-
SO_3	0.29-26.00	1.89-24.02	-	11.4	18.5	-	-

Annexure-III

Districtwise Lignite Reserves in Gujarat

District	Lignite Bearing Area(in sq.kms.)	Reserves of Lignite (in MT)		
		Proved	Inferred	Total
Kutch	82.51	254.13	31.47	285.60
Bhavnagar	42.65	121.91	151.34	273.25
Bharuch	13.18	19.90	250.00	269.90
Surat	21.74	182.33	61.24	243.57
Total	160.08	578.27	494.05	1072.32

Source: Commissioner of Geology & Mining, Govt. of Gujarat

Proximate and Ultimate Analysis of Panandhro, Akrimota, Umarsar, Bharuch, Surat & Bhavnagar Lignite Deposits

Details	Bhavnagar lignite deposits	Surat lignite deposits	Jhgadia lignite deposits	Panandhro lignite deposits	Akarimota lignite deposits	Umarsar lignite deposits	Matanomadh lefri deposits
1	2	3	4	5	6	7	8
District	Bhavnagar	Surat	Broach	Kacnchh	Kachchh	Kachchh	Kachchh
Taluka	Bhavnagar	Mangrol	Jhagadia	Lakhpat	Lakhpat	Lakhpat	Lakhpat
Village	Kharsaliya and (around 35 kms. south east of Bhavnagar)	Vastan and (around 45 kms. north east of Surat)	Jhagadia (25 kms. east of Ankleshwar)	Panandhro (130 kms. north west of Bhuj)	Akrimota (120 kms. north west of Bhuj)	Umarsar	Matanomadh and around (100 kms. north west of Bhuj)
Area in Sq.Kms.	60.00	11.84	3.18	8.2	3.14	15.00	20.00
Reserves in Million Tonnes	OBR Reserve	OBR Reserve	OBR Reserve	OBR Reserve	OBR Reserve	OBR Reserve	OBR Reserve
	Upto 1:10 78.17	Upto 1:10 11.08	1:9 19.91	1:4 94	Upto 1:5 35	1:10 13.70	1:20 33.00
	1:10-1:15 40.30	1:10-1:14 48.00			Upto 1:8 50		
	1:15-1:20 50.18						
	Above 1:20 50.90						
	Total 219.55						

Note: OBR --> Overburden Ratio

ACKNOWLEDGEMENT

The Industrial Policy 1995-2000 announced by Government of Gujarat has given special incentives for employment oriented projects and given stress for development of mineral based industries. The State is fortunate to possess 1072.32 million tonnes of lignite resources in its geographical fold - mainly confined to Kutch, Bhavnagar, Surat and Bharuch districts. The analysis of lignite from different parts of the country indicates that Gujarat lignite has 3500-4500 high calorific value.

This publication ***"Gujarat Lignite Resources and Scope for Joint Sector Thermal Power and SSI Project"*** includes data on lignite resources, demand and supply, proximate and ultimate analysis, pricing policy, different applications, etc.

It incorporates value added lignite based project profiles viz. Caustic Lignite Powder, Lignite based Met-Coke, Lignite Briquetting, Oil Well Drilling Mud Chemicals, Lignite Coke for Waste Water Treatment, Lignosulphonate, Carbonisation of Coal (Low Temperature) and State Power Policy. I hope, this report will be helpful to the industrial houses interested to set up lignite based power plants and entrepreneurs interested to go for lignite based SSI projects.

I appreciate the efforts of Shri JV Bhatt, GM (Tech)-II and his team members Shri MM Parmar, Dy. Manager and Smt. Mary Joseph for their commendable work in compiling the necessary information from various sources. I would also like to acknowledge the contribution made by Gujarat Mineral Development Corporation and Commissionerate of Geology & Mining, Govt. of Gujarat.

We solicit suggestions from the readers for improvement of the report.

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Gandhinagar

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