

**LOCATIONS**  
**FOR**  
**CEMENT PROJECTS**  
**IN**  
**KUTCH DISTRICT**  
**OF**  
**GUJARAT STATE**

By :

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**INDEX**<sup>ts</sup>****  
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## FOREWORD

Gujarat stands third in the mineral production in the country. Limestone, Lignite, Bauxite, Industrial Clays, Chalk, Agate and Fluorite are the important minerals in the State. Limestone tops the list with an estimated reserves of the order of 11,500 million tonnes having deposits in coastal belts of Saurashtra, Kutch, North Gujarat, Kheda and Panchmahals. There are good number of cement plants set up in the State using limestone availability. There is, however, great scope for setting up cement projects in Kutch district which is having limestone reserve of the order of 7700 million tonnes.

Kutch district of the State is the largest in area and is endowed with other important minerals like Lignite, Bauxite, bentonite, besides limestone. Lignite of Kutch can be used as a fuel for cement production. Kutch is now well connected with the hinterland in the country through broadguage railway network road network and airways. Kutch is having the largest coastline of 300 kms with 4 small and 4 medium ports besides Kandla. Kutch has started witnessing industrial development with lignite mining activities at Panandhro in the western Kutch, development of Kandla Free Trade Zone and setting up industrial units in Northern Kutch using salt resources of Greater Rann. Kutch is also attracting large cement projects exploiting both limestone and lignite minerals.

In view of limestone reserves and development of infrastructure network, there is good potential for exploiting the available mineral resources and setting up large cement plants both for meeting internal demands as well as export market.

The report on "LOCATIONS FOR CEMENT PROJECTS IN KUTCH DISTRICT OF GUJARAT STATE" is an attempt to identify specific locations in the vicinity of limestone reserves in Kutch district. The report provides useful information on limestone reserves, infrastructure in Kutch and preliminary information on identified locations. The report identifies 6 locations viz., Jakhau, Ghaduli, Khawada, Dayapar, Sanosara and Kaiyari where cement projects of the order of 1 million tonnes to 5 million tonnes capacity can be set up. It also gives other relevant information necessary for setting up cement project.

Shri JV Bhatt, Senior Development Officer (Minerals) with the overall guidance of Shri AK Ojha, General Manager (Technical) have put up commendable efforts in preparing this report and identifying potential sites to locate portland cement, pozzolona cement, high alumina cement, flyash cement, blended cement projects in the district.

I hope, this report will find very useful to prospective entrepreneurs who desires to set up cement projects as also Researchers, Academicians and Financial Institutions.

Suggestions in improving iNDEXTb publications in general and this specific report in particular are most welcome.

Ahmedabad  
June, 1995

**R.J. Shah**  
Chief Industrial Advisor &  
Executive Director, iNDEXTb

## I. INTRODUCTION

Kachchh is a paradise for the geologists and considered hunting ground for the minerals. It has derived its name from its crescent shaped geographical disposition resembling a tortise which is called "Katchba" in Gujarat language.

The District is endowed with solid fuel, industrial clays & non mettalic minerals in its geographical folds (Map No.1). Geological agencies like Geological Survey of India, Central Ground Water Board, Oil & Natural Commission, Atomic Mineral Division, Directorate of Geology & Mining, Gujarat Mineral Development Corporation have carried out exploration and prospecting work for lignite, bauxite, bentonite, Limestone and Oil & gas in the district. Prospecting results have highlighted sizeable reserves of Limestone 7700 Million tonnes, Bauxite 42 Million Tonnes, bentonite 70 Million Tonnes and Lignite 220 Million Tonnes in the district.

"Gujarat Mineral Development Corporation" runs its prestigious "Panandhro Lignite Project" in Lakhpat taluka of district. Corporation has recently established its 50,000 per annum calcined bauxite project at "Ghadhasisa" in Abdasa taluka. It is also planned to establish 60,000 per annum Alumina plant in joint ventures with GACL and "Rayothan Company" of USA. Gujarat Electricity Board has also established 220 MW thermal power station at "Panandhro". GMDC operates another "Akri Mota" "Lefri" Lignite mines in addition to Panandhro mine.

Findings of lignite & exploitation of Bauxite mines at Naredi has changed socio economic conditions of people of the district.

Directorate of Geology & Mining, Govt. of Gujarat & Geological Survey of India, Gujarat circle also launches one or other mineral prospecting or mapping schemes in the district since its inception.

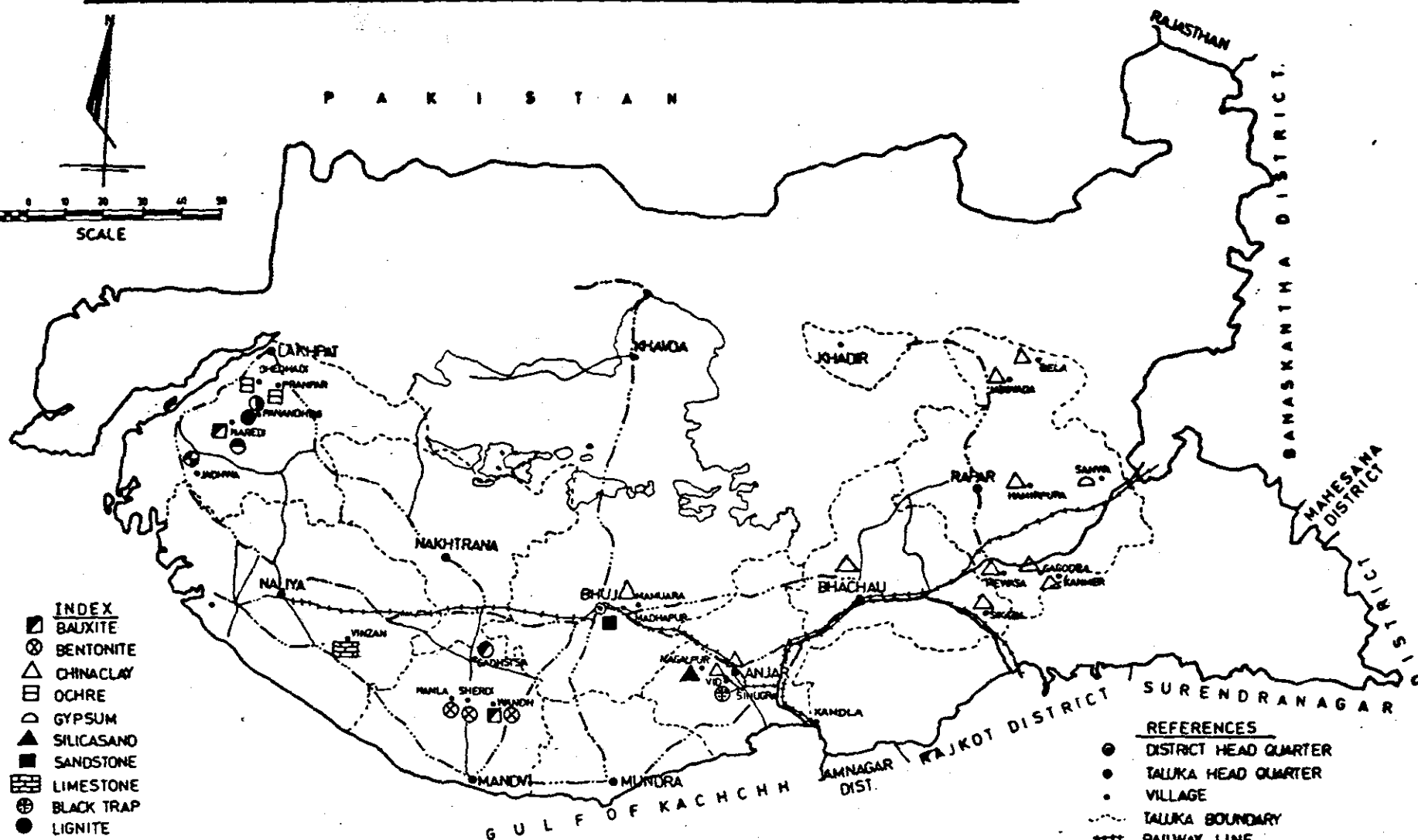
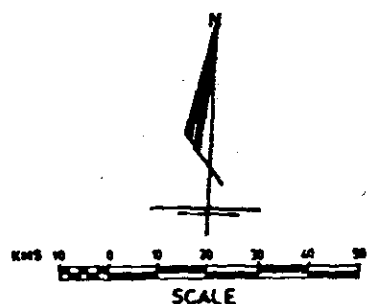
Detailed geological mapping & exploration have brought into light good cement grade limestone areas in the light. (Map No.2).

INDEXTb a nodal agency of Govt. of Gujarat released Prospects for Limestone based Industries in Gujarat study report in December, 1994. The report gave ideas of sizeable cement grade reserves lying untapped in the district. The cement grade, low mining cost limestone reserves, close to the existing shoreline & near to the lignite mines parameters attracted Big houses to think for large scale cement plants in the district utilising lignite as a fuel.

The Geological Survey of India, Gujarat circle in the year 1993- 94 after remapping estimated 300 million tonnes of Cement grade limestone in 20 sq.km. area of "Patcham island".

Government also instructed State Directorate of Geology & Mining to study its suitability for cement industries. It also desired to identify the infrastructured requirements for the optimum utilization of limestone deposits of Kachchh district. With the aims & objectives of above directives, the study was taken up on a priority basis with field trips, discussion with port authorities, geological officials at District and GEB officials, ground water Boards officials at district level as well as Road & Buildings, Executive Engineer, GMDC Project Manager & GSI Geologists, Jilla Panchayat, elected representative Collector and District Development Officer of Kachchh district.

# MINING CENTRES AND LINK ROADS IN KACHCHH DISTRICT.



- INDEX**
- BAUXITE
  - ⊗ BENTONITE
  - △ CHINACLAY
  - OCHRE
  - GYPSUM
  - ▲ SILICASAND
  - SANDSTONE
  - ▨ LIMESTONE
  - ⊙ BLACK TRAP
  - LIGNITE

## G.M.D.C. PROJECTS

- ① LIGNITE - PANADHRO
- ② BAUXITE - NAREDI
- ③ CALCINATION PLANTS - GADHSISA
- ④ CEMENT PLANT (PROPOSED) SANGHI INDUSTRIES

## REFERENCES

- DISTRICT HEAD QUARTER
- TALUKA HEAD QUARTER
- VILLAGE
- TALUKA BOUNDARY
- .... RAILWAY LINE
- NATIONAL HIGHWAY
- STATE HIGHWAY
- DISTRICT ROAD

## II. LIMESTONE RESOURCES

State has 11,104 million tonnes of limestone, out of which 7,700 million lies in Lakhpat, Abdasa & Naliya talukas. Recently, Geological Survey of India has done preliminary mapping in Khawada region of Bhuj taluka and 745 million tonnes reserves is estimated. Limestone is of cement grade, without any over burden.

Lakhpat, Abdasa & Naliya limestone deposits have been prospected by D.G.M in the year 1963-64-65 field season. Industrial houses interested to think for the cement project can purchase report on the limestone deposits in parts of Abdasa and Lakhpat talukas. Kachchh district on payment of Rs. 2500/- from Directorate of Geology & Mining, Block No. 1, New Mental Building, Meghaninagar, Ahmedabad 380 016. Details of nummulitic limestone and Patcham blocks are narrated.

### A. Western Kachchh "Nummulitic Limestone Deposits" in Lakhpat, Abdasa & Naliya

The nummulitic limestone belt runs between Ramania in the east and Lakhpat in the north forming a crescent shaped belt covering about 400 sq. kms. This belt is of marine sedimentary origin and occurs as a thick, bedded, massive deposit (Map No.3).

The limestone is creamy dirty white or brown in colour. The mean specific gravity is 2.3. The exposed surfaces are full of foraminifera. The gentle dip of 1 to 5 is marked towards the coast. A few horizontal beds are also noticed across the nala sections. Most of the area is barren of vegetation & the yellowish creamy colour of limestone is conspicuously noticed. No sizable overburden is noticed in the area capping this limestone deposit.

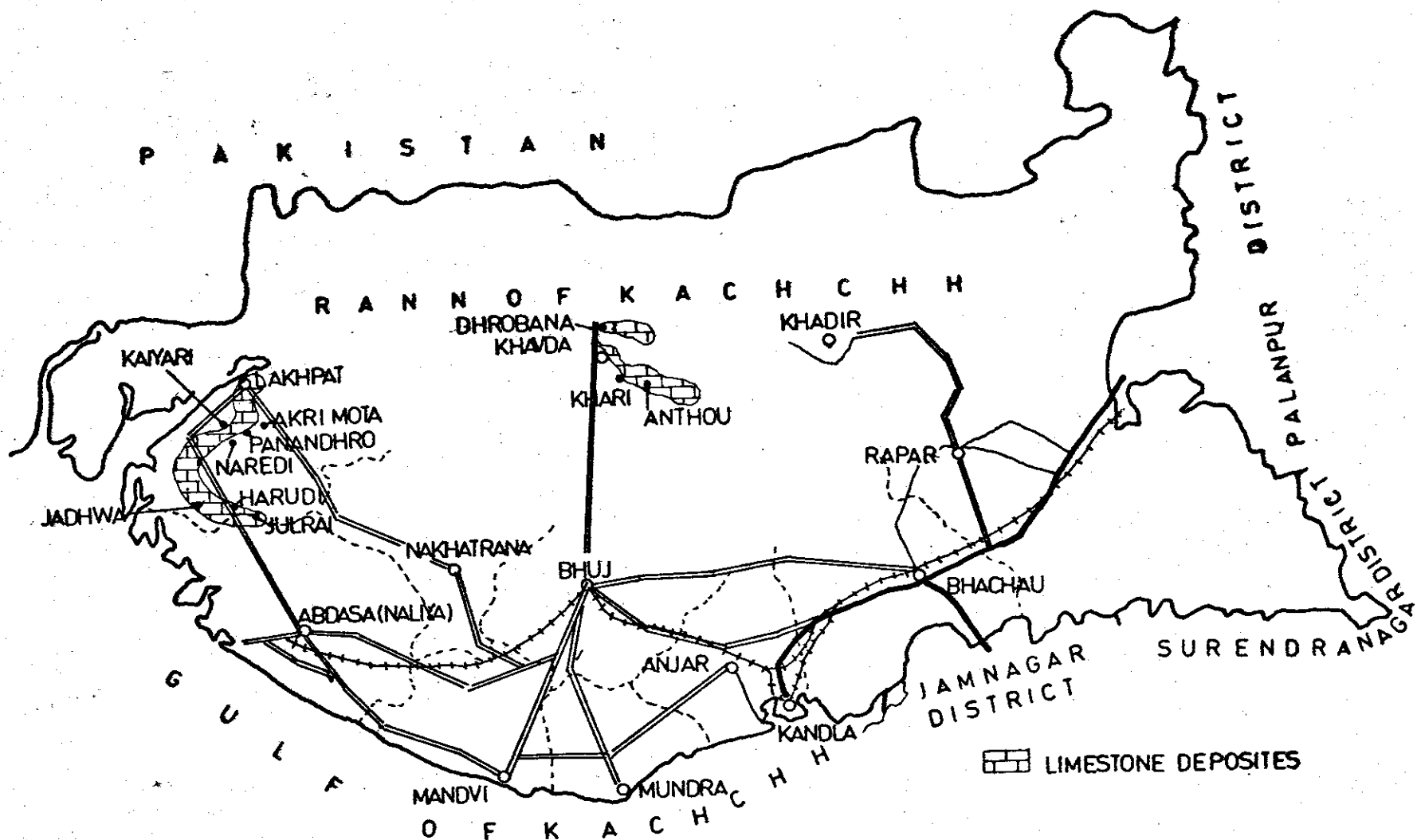
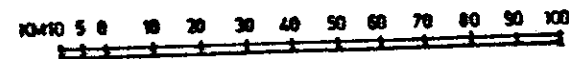
A maximum width of about 6-7 kms. is noticed west of Kharoda and Khari villages. The belt takes a turn towards the north around Ber (M) and extends further north. Along Godhated river a distinct vertical section of about 16-18 meters is observed for a length of about 1500 meters. Corals and gastropods are in abundance. The limestone belt later on further takes turn towards northeast covering Kuriyani, Fulra, Baiwa and Lakhpat in the north.

"Podar" has divided this nummulitic limestone belt into the following stages depending upon its foraminifera species (i) The basal sandy and clay beds contain the foraminifera nummulitic gypsious thick and other fossils. The horizon is persistent throughout the belt from Wagapadhar onwards. (ii) This horizon is made up of Discocyclina Sewerby and gradually followed zone of undulata and sisp same species alongwith other and foraminifera. (iii) The next horizon is full of Num. Cer with a number of other varieties such as Elliptica, D.Undulata Assillina etc. This covers three fourth of the outcrops. It is well exposed near Ber (M) and Ramania Villages. (iv) This horizon comprising of white to brownish, argillaceous limestones with alternate shale, clay and sandy beds overlies the massive limestone. It is partially represented near Lakhpat. (v) A brownish and chalk limestone passing to sandy clay and sandstone underlies the referred to above. Echinoids and pecten are commonly noticed nearby Ber (M). Sengupta (1959) has discussed the pliocene strata of Lakhpat north of the belt and has divided the zones on the basis of the belt and has divided the zones on the basis of the larger foraminifera.

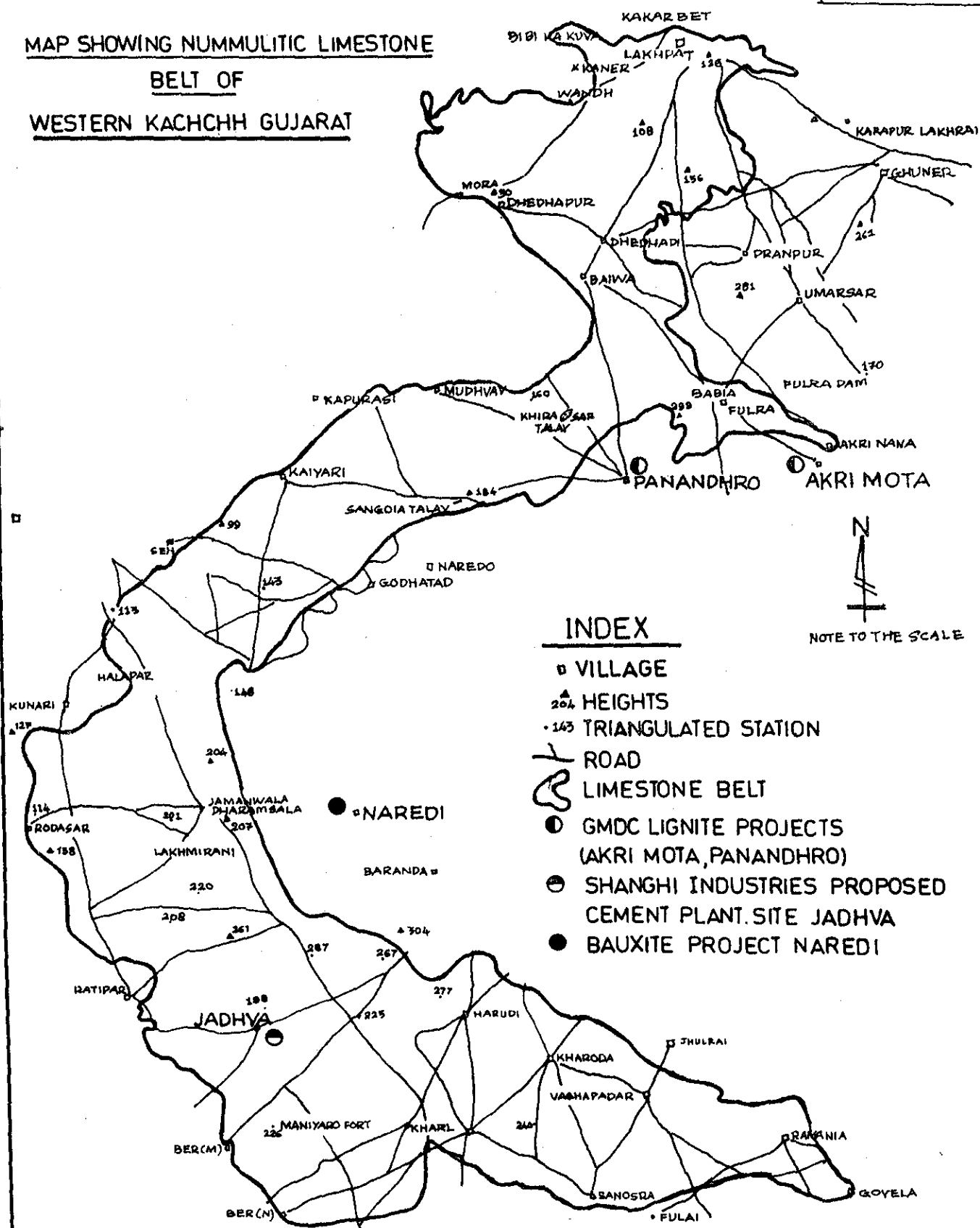
A mention of Babia Hill (29) is of special interest in view of the fact that it is entirely composed of two distinct limestone bands. Babia Hill is situated on the southern margin of the belt about three kms. northeast of village Panondhro (Map No.4).

The upper band of limestone is yellowish finegrained and the lower one is creamy in colour and highly fossiliferous. Estimated reserves and analytical data of representative samples are mentioned in Annexure (1) & (2).

# LOCATION MAP OF LIMESTONE DEPOSITS IN KACHCHH DISTRICT



MAP SHOWING NUMMULITIC LIMESTONE  
BELT OF  
WESTERN KACHCHH GUJARAT





The limestone deposit is fossiliferous and without overburden so mining cost will be low. It can be reaped easily without blasting, Surface Miner machine of Wirtgen Germany company (Wirtgen GmbH, Hohner StraBe 2, W-5469, Windhagen, Germany) will be ideal for limestone mining.

#### **B. Khavada Limestone Deposits: (Bhuj Taluka)**

The limestone exposed in the Patcham Pir Blocks belongs to the Patcham series. (Map No. 5 & 6) Patcham & Chari limestone deposits were estimated by Geological Survey of India four blocks.

Blocks	Area	Thickness	Reserves*
1. Panchmai Pir in Kala Dongar	20 Sq.Kms.	13 metres	330 MT
2. Paiya in Gora Dongar	04 Sq.Kms	12 metres	65 MT
3. Khari-Juna-Sadhara in Dongar	22 Sq.Kms	08 metres	330 MT
4. Dedhia in Gora Dongar	2.5 Sq.Kms	04 metres	20 MT

\* approximate reserves in million tonnes

Limestone is expected to continue further below in all the above blocks which may be tested by drilling. Directorate of Geology & Mining has also carried out preliminary geological mapping in October 1994 in Dhrobana, Kuran, Patcham Pir of "Patcham island".

#### **Analytical Results**

In these blocks CaO ranges from 41.08%, Acid insolubles from 1.5% to 10%, R2O3 1.08% to 3%, MgO 0.11% to 1.5% and LOI average 40%. Average grade in the area indicate that the limestone is of cement grade.

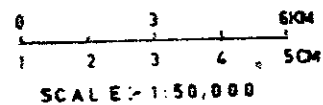
Beside these four blocks, in the eastern part of "Patcham Pir" the analytical results of few grade samples show that the limestones is suitable for cement grade. For this detailed mapping and sampling will be carried out in coming years.

The Limestone deposits prospected data and spot studies have revealed port oriented sites and inland locations for the establishment of cement projects in Bhuj, Lakhapat & Naliya talukas of the district.

A crescent shaped Nummulitic limestone belt of Kirthar series and limestone belonging to Chari formation showing grey and buff colour limestone occupying Kala & Gora Donger areas are cement grade limestone available for the cement project captive mines. These limestone deposits described earlier are vergin and without any overburden. The exploitation of these limestone will be cheaper as the deposits is a massive and with good thickness. Naliya limestone deposits can be mined by open case mechanised mining resorting the latest mining technique of Surface Miner developed by German company which will be pollution free limestone mining in Kachchh district.

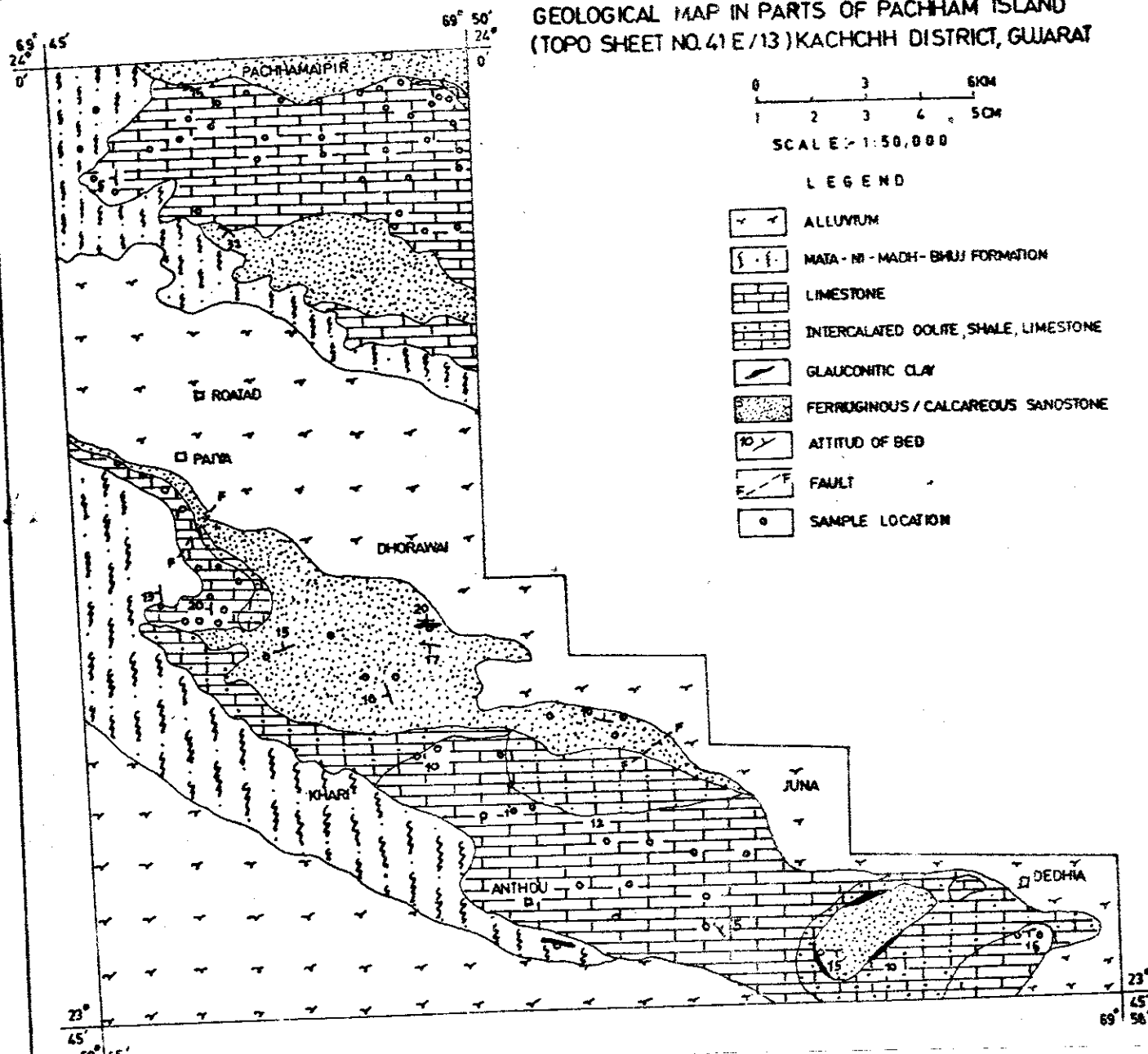
For the manufacture of different types of cements like Flyash, blended and High alumina, raw materials availability of flyash, bauxite, laterite, Shale are within the 50 Kms. radius of the proposed cement project site.

GEOLOGICAL MAP IN PARTS OF PACHHAM ISLAND  
(TOPO SHEET NO. 41 E/13) KACHCHH DISTRICT, GUJARAT



LEGEND

- ALLUVIUM
- MATA-NI-MADH-BHUJ FORMATION
- LIMESTONE
- INTERCALATED OOLITE, SHALE, LIMESTONE
- GLAUCONITIC CLAY
- FERRUGINOUS / CALCAREOUS SANDSTONE
- ATTITUD OF BED
- FAULT
- SAMPLE LOCATION



### **III. INFRASTRUCTURE**

Existing Industrial infrastructure facilities available in the district for setting up a large cement projects was studies (Map No. 586). By visiting limestone potential areas and field visit infrastructure requirements for six identified cement project sites are identified. Development and execution of suggested measures will give sound platform for cement houses to consider for cement unit in the district. Infrastructures bottle-necks of water, road, rail have played vital role for unutilization of vast limestone reserved.

Land, water, port, road & rail developments needed are indicated.

#### **Land:**

Factory site land can be applied to the concerned Collector Bhuj for the wasteland area. The area desired can be shown on the layout map showing material area, Guest House, colony, railway siding etc. The offer has to be channelised through Collector to Revenue Department of Sachivalaya with a recommendation from Industries Commissioner. After joint committee scrutiny, Government can offer factory site land on a reasonable charge basis.

If the area belongs to private, the applicant has to pursue with him directly. In all the sites, Government waste land is available. Collector Bhuj may be advised to delineate Government waste land area for the suggested site. A separate "Mamlatar" may be designed in the Bhuj Collector office for the expedition of cement project factory site proposal.

#### **Water:**

Kachchh has scanty rainfall of 10 cm. Most of the monsoon fails in the area. The ground water recharge is also very low. During monsoon, water passing in the sea are obstructed in following River basin (Dam). The details are given in Annexure-3. Suggested water of dams will not be sufficient for process water & drinking water for the projects. Considering technology developed by Central Salt & Marine Chemicals Research Institute, Bhavnagar by "Reverse OSMOSIS" and Interpolymer membranes for water desalination by electrodialysis, Desalination plants on "Reverse OSMOSIS" and membrane technology for desalination of brackish & saline waters can be erected. Project profile is enclosed in Annexure-4. The knowhow for the process is released through the Institute on suitable terms & conditions. It covers design and fabrication of reverse OSMOSIS plant with spiral configuration. It includes preparation of membranes on a large scale using memberane casting machine, material and components specification assembly of standard reverse OSMOSIS plants and training for operation and maintenance. The technology offered is suitable for desalination of saline water with TDS upto 10,000 PPM.

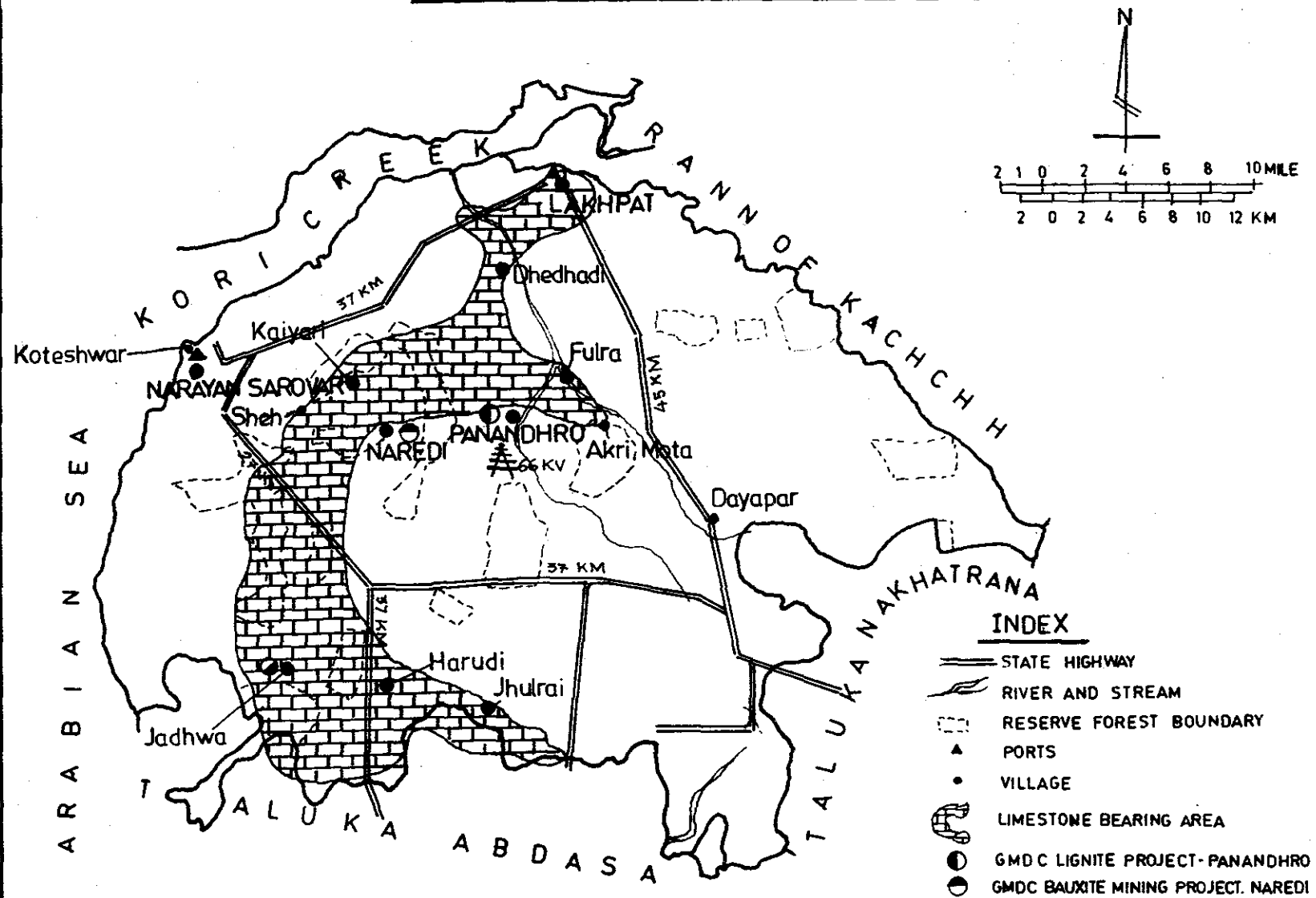
For the application on a large scale by the plant owners, it is advisable to sponsor one scheme to operate pilot plant near the Panandhro Lignite colony by GMDC. The pilot plant of "Reverse OSMOSIS" can be erected. GMDC may be advised to adopt the technology for the proposed desalination plant for "Panandhro Lignite Project".

#### **Power:**

Lignite deposits are explored by Directorate of Geology & Mining, Govt. of Gujarat in Kachchh district. Total 220 million tonnes reserves are proved in Panandhro, Akri Mota & Lefri basins. GMDC is engaged in lignite mining at Panandhro, Akri Mota & Lefri Villages. Corporation is producing 300 tonnes per day lignite, part of it is supplied to

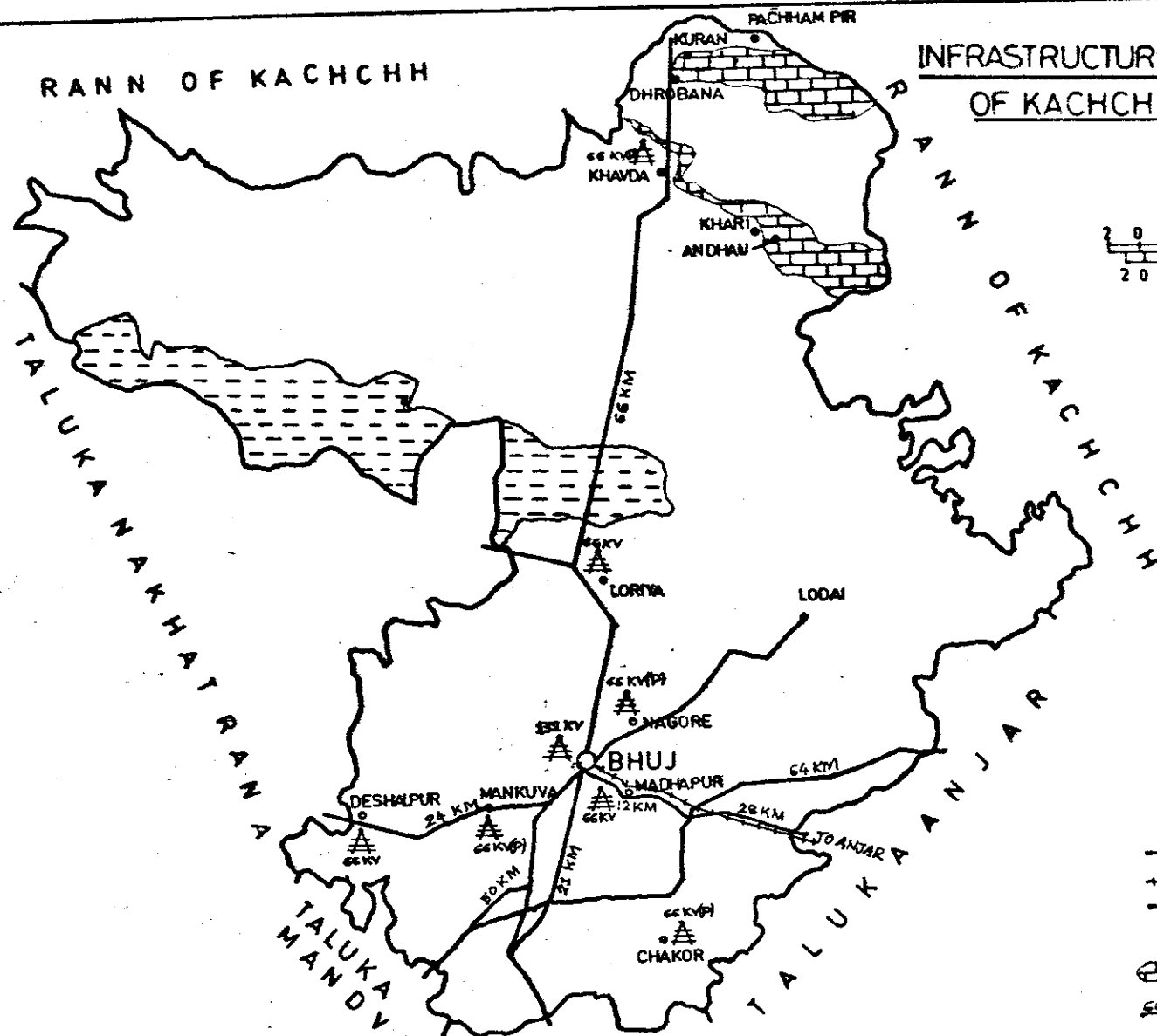
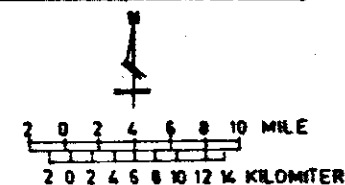
MAP NO.5

# INFRASTRUCTURE IN LAKHPAT TALUKA OF KACHCHH DISTRICT



MAP NO. 6

# INFRASTRUCTURE IN BHUJ TALUKA OF KACHCHH DISTRICT



## INDEX

- RAILWAY METRE GAJE
- STATE HIGHWAY
- VILLAGE
- LIMESTONE BEARING AREA
- ROAD DISTANCE

GEB thermal power station and rest is sold to consuming industries at per present Govt. guidelines at @ Rs. 416/- per tonnes at pit head. Lignite basins area, reserves & quality is mentioned in Annexure-7.

Requirements of coming group will be higher side. So it is essential to enhance GMDC production capacity. In the alternate companies will think and plan to import coal from South Africa, China, Australia through sea route. To facilitate coming projects, it is advisable to develop "Koricreek" with a construction of 12 Kms jetty & good warehouse facility. Technology developed to operate the kilns with lignite will be adopted by plant owners or they will be compelled to blend imported coal. To accommodate this strategy, GMDC may be advised to enhance the production capacity & Gujarat Maritime Board may be also persuaded to develop "Koricreek" on a war front basis to attract & convince the cement industrialists.

#### **Port:**

For the export oriented cement projects, Jakhau, (Annexure-5) a fair weather lighterage port situated in Godia Creek in the Gulf of Kachchh can be developed by extending present jetty upto deep sea area to avoid loading & unloading constraints (Map No.7).

In Godia Creek, another ideal site will be Pipar. Both the Pipar and Godia sites are close to the Naliya limestone belt. Development of link road to port and construction of jetty at the suggested sites will fulfill the requirement of bigger houses for the exports of cement clinker and import of coal from South Africa, China & Australia.

Natural deep sea coast exist near Godia site. Construction of 12 Kms. long jetty with the co-sponsorship of "Sanghi Industries" and DLF Industries Pvt. Ltd. at the Godia site will facilitate bigger capacity steamers to handle the clinker, cement, Bauxite, Lignite, cargo. Export of clinkers & cement special steamers with hydraulic system unloading vehicles can be operated by the Big cement project authorities for loose cement export to overseas market which will be more competitive in the international cement market. A separate port authority to plant & develop Godia port areas has to be created immediately. The land has to be acquired & lay out for the port development can be assigned to experienced consultant by the Maritime Board. Fixed Deposits from the suggested groups can be taken up for the immediate Budgetary provision.

#### **IV. ACQUISITION OF CAPTIVE MINES**

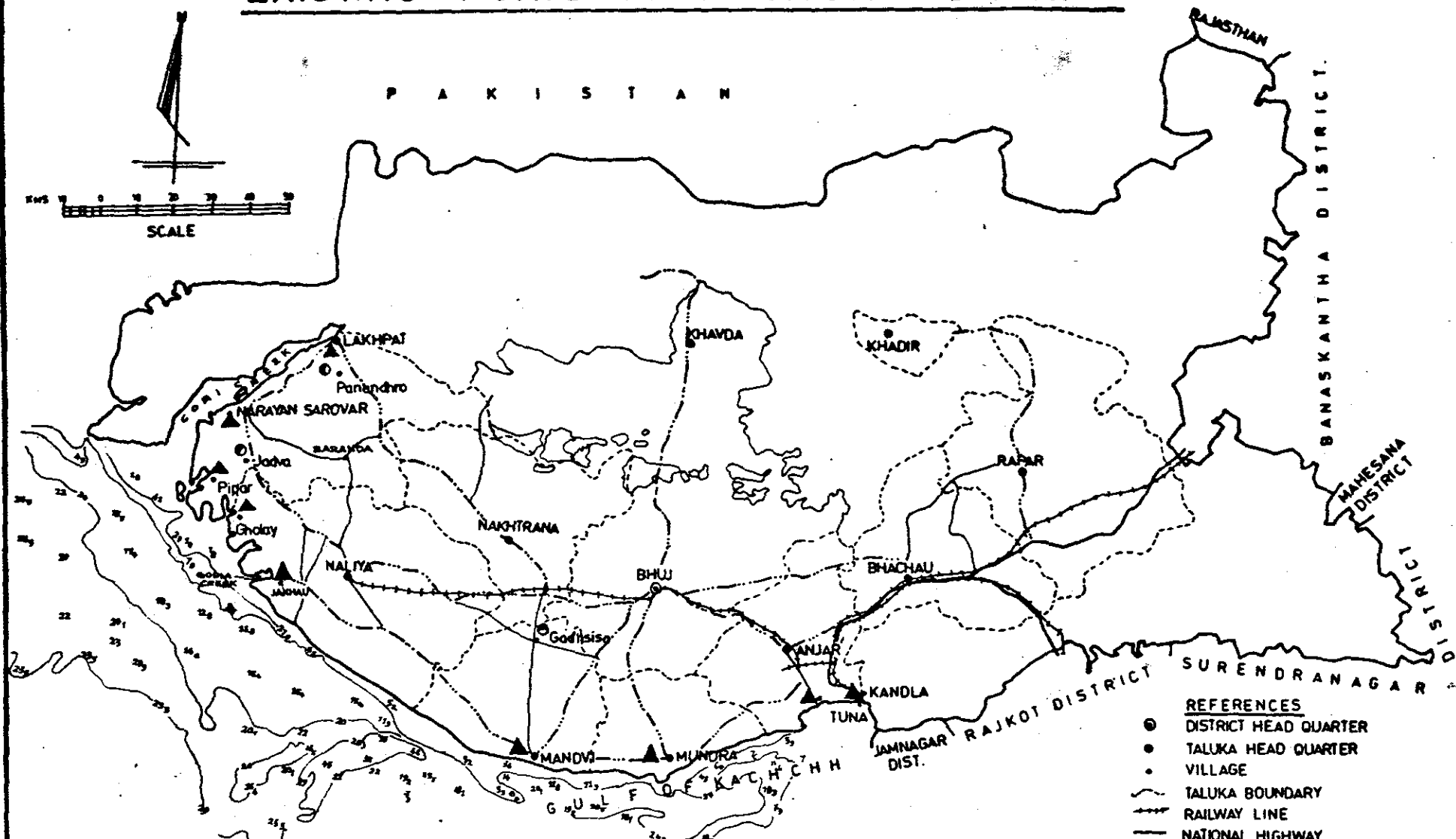
Cement project will require captive mines in nearby limestone areas. Directorate of Geology & Mining, Govt. of Gujarat during 1963-64-65 field seasons has done prospecting work. The report is available on a payment of Rs. 2500/- per copy from the Department.

Company can take detailed assessment work with a above base for quality & quantity assessment.

Following steps are to be followed with the Government.

1. Filing prospecting application in cadestral maps of villages to Government.
2. Prospecting to be carried out by private mining consultants.
3. Filing mining lease application in prospected areas.
4. Procurement of Environment clearance from Ministry of Environment and Forest. if area is more than 500 hectares.

# EXISTING PORTS IN KACHCHH DISTRICT.



5. Procurement of grant order from Industry & Mines Dept. of Govt. of Gujarat.
6. Demarcation of granted areas by D.I.L.R office of the District by paying necessary fees.
7. Payment of security deposits.
8. Mining lease deed agreement with payment of stamp duty.

All the above procedure and steps have to be followed with District Office, Bhuj Collector office and Sachivalaya at Gandhinagar.

Procurement of mining lease under MCDR 1983 can be done after filing prospecting lease application in the desired limestone are mentioned in Map. Prospecting licence and mining lease application forms are available at District Geology & Mining office, Datwadi Naka, Old Press Building, Bhuj (Phone) 02832- 23551).

For obtaining cadestral maps of villages, district land record office, Bhuj or Settlement Commissioner officer, Govt. of Gujarat Multistoryed Building, Lal Darwaja, Ahmedabad may be contacted. Desired village maps are available on a charge basis. For the filing mining lease or prospecting lease applications, other documents required alongwith prescribed forms are narrated with fees & other details in "Khani Niyamo" Publication of Directorate of Geology & Mining, Block No. 1, New Mental Building, Meghaninagar, Ahmedabad 380 016, Phone No. 377322-24, 377353. If certificate stating that the area applied is prospected by any Govt. agencies is attached. Direct mining lease application can be filed to the Secretary, Industries & Mines, Sachivalaya, Gandhinagar in triplicate through District Geology & Mining office.

Limestone is of Sedimentary nature. it is divided into different stages on the basis of fossil content. It is soft, friable, loosely packed fossiliferous. It can be easily mined by "Opencast" method. For the pollution free and large scale mechanised mining in these deposit, it is advisable to resort Surface Miner machine developed by Wirtgen GmbH, Germany. The application of Surface Miner in soft friable limestone mine can be resorted to minimise the mining cost. The details of the machine and its applicability in Limestone mines is enclosed in Annexure-6. The trial of the machine is in progress in the "Ambuja Cement" captive mines at Kodinar. "Tata Chemicals", Mithapur has also decided to mine its sedimentary limestone by suggested machine on trial basis. If results are satisfactory then above companies are planning to resort "Surface Miner" for its limestone exploitation.

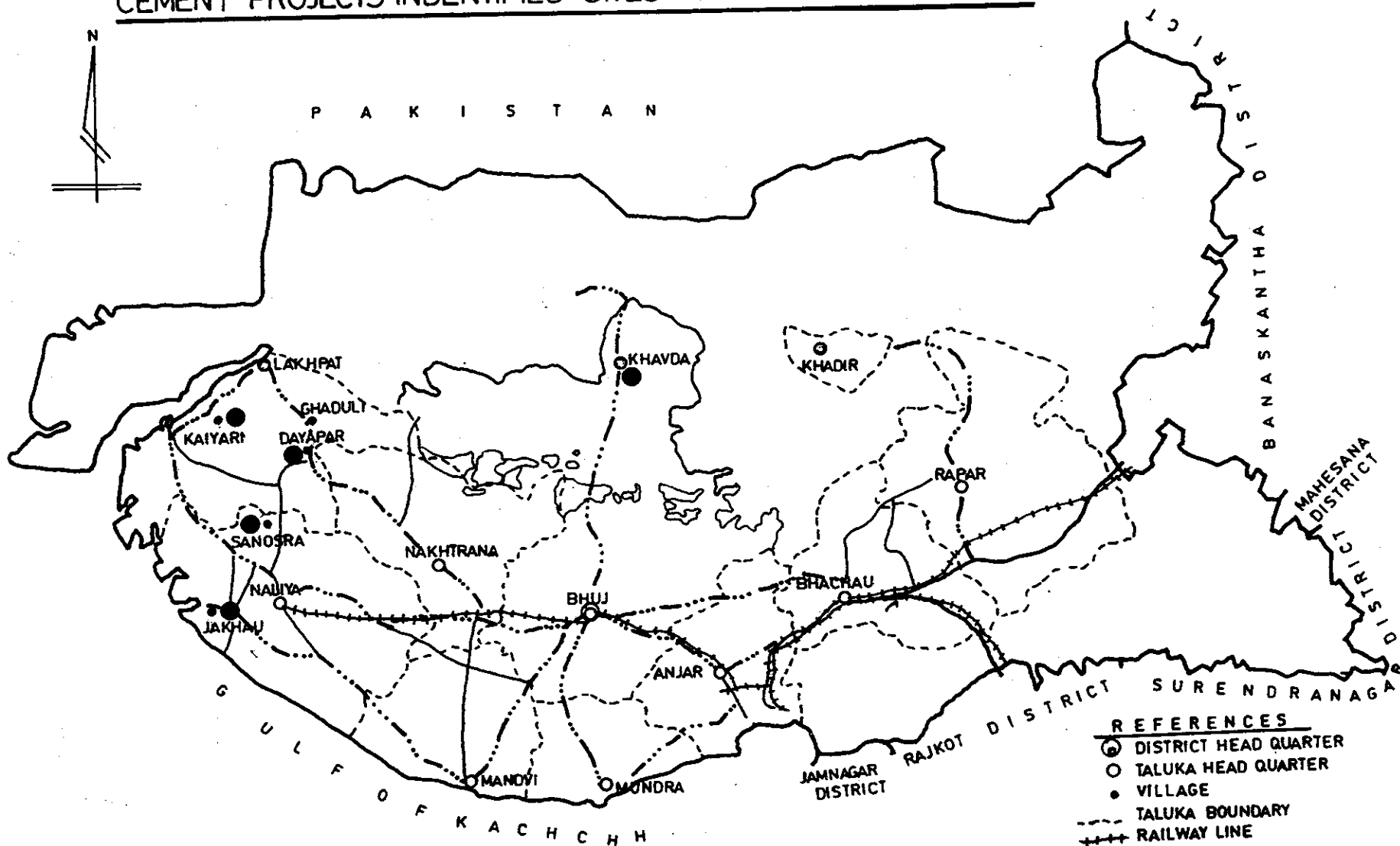
It is advisable that State Directorate of Geology & Mining, District Office Bhuj may be instructed to prepare villagewise limestone bearing areas maps. Maps can be provided to the desiring parties on a charge basis. To expedite the disposal of limestone applications of cement plants a Nodal Officer from Industries Commissionerate/INDEXTb/DGM may be nominated for the follow up with Ministry of Mines and other related agencies.

## **V. IDENTIFIED PROJECT SITES**

Kachchh district is known for its peculiar culture. It is one of the border districts of the State. District head quarter is located at Bhuj which 396 Kms from Ahmedabad and about 218 Kms. from Rajkot and 900 Kms. from Bombay and about 1200 Kms. from Delhi. The district has total 45652 Sq. kms. which accounts for 23.28% of the total area of the State. The district is having highest area of the State. A national Highway starts



# CEMENT PROJECTS IDENTIFIED SITES IN KACHCHH DISTRICTS.



from Anjar which connects the district with Ahmedabad, Bombay and Delhi. A broad gauge railway line of 53 Kms. is present which connects the district with Ahmedabad and Bombay. There is also meter gauge railway line of 217 Kms. which connects Naliya town to Gandhidham and Palanpur town of Banaskantha district which in turn connects it with Delhi. Kandla and Bhuj are two airports which connect the district with Ahmedabad, Bombay and other major towns of the country.

Lignite based power station with 140 MW capacity is in operation at Panandhro. Sub-station with capacity of 120 KV and 132 KV and above are existing at Anjar and Bhuj. At Nani Khakhar and Mandvi taluka and at Nakhatrana with capacity of 220 KW each are also in operation.

Kandla Free Trade Zone (KFTZ) established in 1965 is attraction for the export oriented units. Industrial houses interested for cement projects can think to select identified sites for the project. Identified six project sites can be approached from Bhuj or Gandhidham by road within four hours drive.

At Bhuj, Mandvi and Gandhidham, good hotel accommodation are available. District Industry Centre, Bhuj (Telephone No. 02832- 23501) and District Geology & Mining Office (Telephone No. 02832- 23551) can be contacted for filing MOU and captive mine applications. At six identified sites, factory site land is available in the wasteland. Captive mines areas are also within 25 Kms. radius of the factory sites. Tar mine line roads are existing for hauling raw materials like lignite and limestone.

Factory sites land in Lakhpata, Abdasa and Naliya talukas are identified with a view of availability of wasteland, raw material availability, water and power. The factory sites of 100 hectares plain wasteland are located. For water availability, sea water proximity for desalination project is also considered.

Locations identified for domestic and export oriented cement projects are below:

- A. Jkhau (Export Oriented)
- B. Ghaduli
- C. Khawada
- D. Dayapar
- E. Sanosara
- F. Kaiyari (Export Oriented)

Except Khawada site all the sites fall in the "Narayan Sarovar Chinkara Sanctuary". Present Government is considering to reduce the area under sanctuary to around 96 Sq. km. The reduction in the area by the Govt. will clear the above five sites and captive mines are for the industrial purpose.

With the easy availability of additives and bauxite, laterite and flyash within 25 Kms. radius of the suggested sites. Flyash, High alumina, Blended, Acid proof cements variety can be planned in addition to Portland 43 and 53 and pazzolonic products.

Industrial houses can think for different category cement looking to the domestic and overseas marketability.

Details of above sites covering introduction, type of cement to be manufactured; infrastructures, raw materials, technology availability and suggested project size are indicated in the following sections.

## **A. Jakhau Site (Export Oriented Cement Plant):**

### **(1) Introduction**

Jakhau village situated on Naliya-Jakhau State road 98 Kms. away from Bhuj District head Quarter and 13 Kms away from Naliya town. The village is a Jain Pilgrimage centre. "Krishna Salt Works" operates its salt factory near the port. On the both side of the road, Govt. waste land is available for the factory site. Site is 440 Kms from Ahmedabad. It can be approached from Gandhidham or Bhuj by taxi or private car within three hour's road journey. Daily Air service from Bombay is available.

### **(2) Raw Materials**

The nummulitic limestone in this Naliya belt has especially good reserves and more than 6 meters thickness. Limestone is fossiliferous and soft which can be mined by opencast working.

Cement grade limestone occurs in Akri (N), Ber (M), Ber (N), Baiwa, Dhedhdi, Dhedhpar, Furla, Hanmankudi, Jamanwara Mota, Jadhva, Kuneri, Kaiyari, Kuriyani, Kalhpat, Mori, Mudhvay, Pakho, Ratipar, Rodhasar, Seh villages out of which part of the Jadawa village area has been applied by "Sanghi Industries" for their captive purpose. All the villages falls in wild life sanctuary area, Govt. is thinking to shift wild life sanctuary out of limestone bearing area. The exercise is under active consideration of the State.

### **(3) Additives**

#### **Gypseous Shales & Clays:**

The laterite and clays of various shales are overlain by the gypseous shales. Gypsum of selenite crystal variety is also found in Lakki formation which can work as a additive.

### **(4) Infrastructures**

#### **Land:**

Govt. waste land upto 100 hectares will be available for the factory site. Land is flat and without any rugged topography. Village covers an area of 13,014.48 hectares land. Three hundred fiftysix hectares wasteland is available for factory site.

#### **Water:**

Nira river will be nearest non parenial source of water. Desalination of brackish sea water will be the future source for the project. Drinking water supply is from the well.

#### **Power:**

Domestic power generation can be considered with the use of Panandhro lignite of GMDC. Nearest 66 KV sub station exists at GMDC Panandhro colony.

#### **Road & Rail:**

Tar road exist from Jhakhau to Naliya. Naliya town to Bhuj, State transport bus services available. Naliya is a last railway terminal for Bhuj-Naliya meter gauge line. Military air-strip exists at Naliya town.

**Port:**

Site is near to the fair weather lighterage port situated in Godia creek in the Gulf of Kachchh. Details are given in annexure-5.

**Education and Medical Facility:**

Village has 3086 population with 658 houses. Primary education, primary health centres dispensary, telephone, post office services exists.

**(5) Project Size:**

Blended cement project with 6 million tonnes capacity can be planned involving Rs. 3000 crores investment with desalination plant and captive power generation.

**(6) Types of Products:**

Blended O.P.C. & P.P.C cements can be manufactured. Raw materials for P.P.C and blended cements are easily available around 20 Kms. radius of site.

**B Ghadhuli Site****(1) Introduction**

Village covers an area of 2881.33 hectares. It is 16 Kms. away from Panandhro Colony of GMDC. It has 2172 population with 387 houses. Factory site location 315.3 hectares Govt. wasteland is available. Present Government has decided to allot wasteland for factory site. GEB thermal power station is 5 Kms away from the site. It is 500 Km from Ahmedabad. It can be approached by car or taxi within four hours journey from Bhuj or Gandhidham. Bombay to Bhuj and Gandhidham, Ahmedabad to Bhuj twice in a week air services are available.

**(2) Raw Materials**

The nummulitic limestone of Lakhpatt, Baiwa, Dhedhdi, Dhedhpar, Furla can be acquired for captive limestone mines for the proposed project.

**(3) Additive Components**

The laterite and clays of various shales are overlain by the gypseous shales can be worked for silica, clay and ferrous additives.

**(4) Infrastructures****Land:**

Village has 1566 hectares unirrigated land. Cultivation land available is 712 hectares. Land is plain and without any disturbed topography. Top soil is mostly laterite.

**Water:**

Well water is source of drinking water. Village has tap water arrangement. For plant process water, Desalination project can be another source of water. "Furla Dam" water can be one of the source of utility of drinking water. "Reverse OSMOSIS" plant of 30 m<sup>3</sup>/day with Rs. 1.80 crores investment can be erected with the CSMCRI technology.

**Power:**

Panandhro GEB sub-station 66 KV line can be utilised for the power.

**Road & Rail:**

It is connected by Pakka tar road with Bhuj district. In the VIII plan, Naliya-Lakhpat extension is under consideration of Railway board.

**Educational & Medical Facility:**

Primary education school and private registered practitioner dispensary exist in the village. Post office also exists in this village.

**(5) Project Size**

Two cement plants of 2.5 million tonnes flyash cement and P.P.C cement with an investment of Rs. 800 crores can be erected in the suggested site.

**(6) Types of the Products**

Flyash cement can be manufactured utilising Panandhro thermal power station flyash and suggested villages limestone and shale components.

**C. Dayapar Site:****(1) Introduction**

Village is situated on the nakhatrana-Lakhpat State road. It has 4755.12 hectares area with 398 hectares of unirrigated land and 3322.27 hectares area are available for cultivation. It has 2414 population with 432 houses. Site can be approached from Bhuj, Naliya, Narayan Sarovar by ST service. Ahmedabad to Bhuj twice a week air service is available. Bombay to Bhuj four days in a week and Bombay to Kandla twice in week air flights are available. It is four hundred and eighty Km. from Ahmedabad.

**(2) Raw Materials**

Cement grade limestone of nummutic character has been prospected by the Directorate of Geology and Mining in Lakhapat taluka of district. Limestone can be mined at a cheaper rate as it occurs without overburden in Lakhapat, Ratipar, Sanosara villages. Limestone has an average more than 45% CaO and below 10% silica. Captive mines can be acquired in the Fulra, Babia, Baiwa villages.

- (i) Flyash: GEB thermal power flyash analysis and lime reactivity ratio can be tested in GERI, Baroda or NCB, Delhi.
- (ii) Limestone: Creamy, Dirtywhite, foraminifera limestone prospected by DGM.
- (iii) Shale: Chari series Shale is available for Al<sub>2</sub>O<sub>3</sub> modules.

**(3) Additive Components**

Laki series carbonaceous shale will be components for additives. They occur in Lefri village area.

**(4) Infrastructure****Land:**

Village has 1000 hectares wasteland area. Factory site can be located on this area. Present Govt. policy decision to allot wasteland for industrial purpose will serve the purpose.

**Water:**

River Khari is non perennial river. Tank water is another source. Project water can be made available from Desalination plant.

**Power:**

66 KV power station exists at Panandhro village. GMDC with GEB intends to erect new power station.

**Road & Rail:**

Site is connected tar road with State highway with district town Bhuj-Extension of Bhuj-Lakhapat Railway line and conversion into broad gauge is under consideration of Railway Board.

**Educational and Medical Facility:**

Primary and secondary education facilities exist in the village. Maternity hospital, primary health centre, post office services are also available in the village.

(5) **Project Size**

Cement plant of two million capacity with Rs. 800 crores investment can be planned.

(6) **Type of Products**

GEB thermal power station flyash availability per day will be around 500 tonnes. Flyash cement plant with dry process and captive power integrated project can be considered.

(7) **Technology Supplier**

National Cement and Building Research Institute, New Delhi can be approached for technology and techno feasibility report work.

D. **Khavada:**

(1) **Introduction**

Village is on the Bhuj-Khawada State road last terminal. It covers an area of 1061.37 hectares, out of which 65.37 hectares is wasteland. Factory site can be located in the wasteland. It is a military centre and BSF staff resides in the village. Bhuj to Khawada is 80 Km. away. Bhuj is connected by air services daily. Ahmedabad to Bhuj twice a week air service is available.

(2) **Raw Materials**

The Patcham & Chari limestone deposits were estimated roughly in a block of 8 Kms. length. Total 360 M. Tonnes of limestone is estimated by Directorate of Geology & Mining, Govt. of Gujarat.

**Limestone:**

Dhrobona limestone deposits have mapped by GSI & DGM office. Chemical analysis shows CaO: 41.08% to 53.08%

Acid insolubles : 1.5 to 10%, R<sub>2</sub>O<sub>3</sub> - 1.08 to 3%, MgO - 0.11% to 1.5% LOI average 40%.

**Gypsum:**

- a) Unwashed Marine Gypsum at @ Rs. 110/- per tonne can be available from the existing Krishna Salt Works and by products.

- b) Adesar sheet natural gypsum can be also available for the final grinding. There exist gypsum lease holders in the Adisar centre in the district.

**Shale:**

Lefri carbonaceous shale is available for Al<sub>2</sub>O<sub>3</sub> component for P.P.C and blended cement.

**(3) Infrastructures**

**Land:**

Government waste land is available in the proposed site village at a nominal price of Rs. 5/- per sq. mtr. or at a cheaper rate Rs. 0.80 per sq. ft. from private owners.

**Water:**

Utilisable ground water resource is 207 MCM/Year. Sakra, Kalia and Khari rivers are flowing through the taluka.

**Power:**

1. 66 KV sub-station is proposed by GEB in Khavada.
2. 132 KV sub-station exist at Bhuj which is 70 Kms. away.
3. 220 KV at Anjar 110 Kms. on Bhuj-Gandhidham State highway.

**(4) Educational & Medical Facility**

Primary and secondary schools exists in the village. Maternity hospital, child welfare centre and dispensary services are provided by Government in the village. Post office & twentytwo working connection telephone exchange exist in the village.

**(5) Project Size**

Blended cement project of one million capacity with Rs. 800 crore investment can be planned.

**(6) Types of Products**

Looking to the availability of cement grade limestone O.P.C 53, P.P.C products can be manufactured.

**(7) Technology Supplier & Collaborator**

National Cement Building Material Institute, Delhi can give technology and prepare techno feasibility report or foreign collaborator from Japan, USA, UK can come for equity participation.

**E. Sanosara**

**(1) Introduction**

Village covers an area of 1061.02 hectares land, out of which 111.02 is a wasteland and 377 hectares can be cultivated. Factory can be located at wasteland. As per new guideline of Govt. for industrial project, Govt. wasteland will be made available to industrial houses on a nominal charge. It falls in Abdasa taluka of Kachchh district. Population of village is 654 with one hundred thirtytwo houses. Ahmedabad to Bhuj air service is available twice in a week. Bombay to Bhuj daily service is available. Site approached by private car or taxi within four hour by road journey.

(2) **Raw Materials**

Nummullitic limestone deposits of Waghapadar, Kharoda, Ramania, Harudi KHARL BER(N) & BER(M) can be procured for captive mines. Limestone reserves is estimated by DGM. Detailed prospecting of limestone is essential for the plant feed requirement for 40 years life.

(3) **Additive Compounds**

Gypseous shales & marls are available in the area.

(4) **Infrastructures**

**Water:**

Barkhan non parenial river and Nira river with all the streams are source of water during monsoon. Desalination plant can be considered utilising sea water.

**Power:**

Panandhro is the nearest 66 KV power sub-station. Captive power generation can be planned with lignite availability.

**Road & Rail:**

State transport bus service from Bhuj & Nakhatrana is available.

**Educational & Medical Facilities:**

Primary education school exists in the village. Post Office facility is also available.

(5) **Project Size**

6 million tonnes of integrated cement plant can be considered with Rs. 6000 crores investment.

(6) **Types of Product**

Blended cement or ordinary portland cement can be considered as raw materials and additive components are available within 15 Kms. radius.

(7) **Technology Supplier**

UBC Industries Ltd., Japan, Acalor Ltd., London, UK, F.L Smidth (FLS), Denmark, Nirhom Cement Co. Ltd., Japan are the leading technology supplier.

F. **Kaiyari (Export Oriented)**

(1) **Introduction**

It is small village with 113 population (1981). Naliya town is 62 Kms. which is taluka Head Quarter. Panandhro lignite mine is 20 Kms. away from the village. it covers 2739.70 hectares land out of which 2530 hectares is wasteland. It is 500 Km. away from Ahmedabad. It can be approached from Bhuj or Ghandhidham by road Bhuj & Ghandhidham are connected by air services from bombay and Ahmedabad.

(2) **Raw Materials**

Proposed project site SEIL, Kapurasi, San Goia talav limestone pockets can be acquired or the captive mines.

(3) **Additive Compounds**

Laterite & clays of various shades are available in the area.



(4) **Infrastructures**

**Land:**

Factory land & housing colony and is available. Captive mines land falls in Narayan Sarovar Sanctuary. Govt. is active to release captive limestone mining areas from the sanctuary.

**Water:**

No perennial streams. In rainy seasons talas are filled up with water. Matiwariwali river and San Goia talav are source of water during rainy season.

**Road & Rail:**

Bhuj-Naliya meter gauge railway line exist. In the VIII Plan proposal to extend upto Lakhapat is under scrutiny. State transport bus operates its route from Bhuj to Narayan Sarovar.

**Port:**

Narayan Sarovar/Koteswar is the nearest small port. It has to be developed with the help of Gujarat Maritime Board.

(5) **Educational and Medical Facilities**

Primary education facilities is available. Registered private practitioner runs his dispensary.

(6) **Project Size**

6 million tonnes capacity with Rs. 6000 crores investment can be planned.

(7) **Types of Product**

Blended cement variety can be manufactured.

(8) **Technology Supplier**

Dry process technology from Nippon of Japan or Fuller International Inc. USA.



## **ANNEXURES**

**WESTERN KUTCH LIMESTONE RESERVES**

Field Season	Area Covered in Sq. Kms.	Estimated Reserves in Millions Tonnes	Less Allowance	Estimated Reserves in Million Tonnes
1963-64	13.00	131.22	5%	124.60
1964-65	70.65	1041.15	10%	937.02
1965-66	323.84	7448.32	10%	6703.49
Total	407.49	8620.69	-	

Source: Report on the Limestone Deposits in parts of Abdasa and Lakhapat talukas, Kachchh district, Gujarat State (Field Season 1963-64-65-66) Directorate of Geology & Mining, Govt. of Gujarat.

## Annexure-2

## ANALYTICAL RESULTS OF LIMESTONE

Sr. No.	Sample No.	Acid Insoluble Matters SiO <sub>2</sub> (%)	Total Oxide RzO <sub>3</sub> (%)	Ferric Oxide FeO <sub>3</sub> (%)	Alumina Al <sub>2</sub> O <sub>3</sub> (%)	Lime CaO(%)	Magnesia MgO(%)	Loss on Ignition %	Total %	CaCO <sub>3</sub> %
1.	KL 10	3.33	2.63	0.86	1.77	48.19	1.25	43.80	99.20	86.03
2.	KL 20	4.20	2.25	1.40	0.85	43.81	5.02	44.60	99.87	79.25
3.	KL 30	4.00	1.85	1.22	0.63	50.82	-	41.50	98.17	90.76
4.	KL 40	3.35	3.00	1.04	1.96	47.25	4.39	40.30	98.29	84.37
5.	KL 50	4.13	2.50	1.86	0.64	41.18	11.30	40.00	98.91	73.51
6.	KL 60	4.55	2.73	0.94	1.79	50.82	1.25	40.50	99.85	90.76
7.	KL 70	4.48	3.00	1.70	1.30	46.44	3.75	41.50	99.17	81.15
8.	KL 80	6.28	3.63	1.30	2.33	43.81	5.00	40.30	99.2	78.21
9.	KL 90	5.80	3.13	2.00	1.13	42.94	5.00	42.20	99.07	76.69
10.	KL 100	2.62	6.25	2.50	3.37	33.29	12.50	45.20	99.87	59.41
11.	KL 110	4.25	3.25	1.90	1.35	49.94	0.63	40.50	98.47	89.18
12.	KL 120	6.77	4.00	1.10	2.90	48.19	1.25	38.20	98.51	86.03
13.	KL 130	3.33	3.50	2.74	0.76	50.82	0.63	40.20	98.48	90.76
14.	KL 140	3.20	3.38	1.00	2.38	50.82	-	40.70	98.10	90.76

Source: Petrological & Chemical Laboratory of Directorate of Geology & Mining, Govt. of Gujarat (Field Seasons: 1963-64-65-66)  
 Report on the limestone deposits in parts of Abdasa & Lakhpat taluka, Kachchh district

Annexure-3

**WATER AVAILABLE FOR UTILISATION FROM VARIOUS  
EXISTING DAMS OF LAKHPAT TALUKA**

Sr. No.	River Basin or Name of Dam	Location	Water Utilisation in M.C Ft.
01.	Kanoj Dam	Kanoj village	45.67
02.	Matiwariwali, Baranda Dam	Branda village Lakhpat taluka	57.79
03.	Sanandhro Dam	Sanandhro village Lakhpat taluka	415.10
04.	Fulra Dam	Fulra village Lakhpat taluka	96.20
05.	*Kali basin Godhated Dam	Dodnated village Lakhpat taluka	247.00

\* Proposed Dam

Source: Irrigation Investigation Circle PWD, Govt. of Gujarat.

## REVERSE OSMOSIS DESALINATION PROJECT (Technical Information:1991)

### Introduction

What is Reverse Osmosis: When salt and pure water are separated by a semi-permeable membrane, nature allows pure water to pass through the membrane to bring down the concentration of salt water. This process is known as OSMOSIS. This flow can be made to cease by applying a higher balancing pressure on the salt water side this is known as OSMOTIC PRESSURE. By application of much higher pressure on the salt side, natural osmotic flow is reversed and water is forced out of salt solution to produce fresh water. This process is called Reverse Osmosis.

The semipermeable membrane is made of cellulose acetate. These membrane permit to pass only a small percentage of salt into product water. In addition, they hold back other impurities including bacteria and viruses, if properly collected. At present, cellulose acetate is the most promising material for membrane preparation and the membranes prepared by Institute give water flux as high as 500 litres/m<sup>2</sup> x day (10 GFD) with 90% salt rejection.

In the actual reverse osmosis plant saline feedwater is passed through a Pressure Sand Filter which removes most of the suspended particles. It is then treated with chemicals to provide proper pH. The feedwater is then forced by the High Pressure Pump into Pressure Vessels, containing spiral wound Cellulose Acetate Membranes. These membranes purify the feedwater to the required level. Pure water is then passed into a decarbonating tower to remove the dissolved carbon dioxide and may further be treated with alkali to the required pH level. The diagram shows a typical system.

The reverse osmosis plants are supplied in different forms, depending on the membrane configurations, namely, flat, tubular, spiral wounds, hollow fibre etc. New polymers and their different formulations are used in the preparation of membranes suitable for various applications like desalination (including that of seawater in single pass), concentration and separation.

This Institute has developed totally indigenous technology of reverse osmosis for desalination of saline water and has worked on flat, tubular and spiral configurations. Over the years of developmental work the Institute has successfully demonstrated the technology by installing a number of demonstration plants to supply drinking water to villages having saline water in the states of Tamilnadu, Andhra Pradesh, Rajasthan and Gujarat with plant capacities ranging between 30 to 100 m<sup>3</sup>/day. The performance of these plants has been quite satisfactory. It has not only developed designs for mobile plants but also demonstrated their utility by fabricating assembling and operating such plants in various states of our country using Swaraj Mazda vans. Under the bilateral exchange programme, Reverse Osmosis technology as developed in this Institute has been exported to Thailand for fabrication, installation and operation of both land based and mobile plants by Government of India.

The technology has been so far released to M/s Bharat Heavy Electricals Ltd., Hyderabad and M/s Arrotechnologies Pvt. Ltd., Ahmedabad.

### Scope

The Government of India's National Mission on Water Supply to Rural people included a sub-mission on brackishness. It is stated that there are more than 17,000 villages in the country which have saline water. Government is planning to solve drinking water problem in these villages by installing desalination plants in a phased manner. During

the last couple of years more than 100 desalination plants have been installed and one can expect that in the years to come a good number of plants will be installed.

Although Reverse Osmosis technique has been developed for desalination, it has a wide potential utility for the separation of a solution into a dilute and concentrated stream. Applications in which dilute stream is more important includes desalination, water softening, production of high purity water, water pollution control and waste water recovery. Thus reverse osmosis has a good potential both in domestic and industrial sectors.

### Process Knowhow

The knowhow package offered by this Institute covers the design and fabrication of reverse osmosis plant with spiral configuration. It includes preparation of membranes on large scale using membrane casting machine, material and component specifications, assembly of standard reverse osmosis plants and training for operation and maintenance. The technology offered is suitable for desalination of saline water with TDS upto 10,000 ppm.

The knowhow for the process is released through the Institute on suitable terms and conditions.

(Economic Information: 1991)

Fabrication and assembly of desalination plants of 30 m<sup>3</sup>/day capacity each

Capacity : 96 plants per annum.

The plant consists of a number of components some of which are readily available off the shelf (See Encl.2) and remaining have to be fabricated in the works itself like membranes. The overall economics has been worked out on this basis.

### Project Cost

	Rupees
a) Land 200 m <sup>2</sup> @ Rs. 70/m <sup>2</sup>	1,40,000
b) Building - office, laboratory 1000 sq. mt. @ Rs. 1,400/sq.m)	14,00,000
c) Plant & Machinery	29,35,000
d) Furniture & Fixtures	75,000
e) Pre-operative Expenses	2,00,000
f) Contingencies	1,45,000
g) Knowhow fees	1,00,000
Project Cost	49,95,000
h) Working Capital	1,27,84,000*
Total Project Cost	1,77,79,000

\*(Margin Money Rs. 38,57,000/-)



## Means Of Finance

a)	Loan from Financial Institutions (Loan Term Loan) 70% of Project cost.	34,96,500
b)	Bank Loan for Working Capital required	89,27,000
c)	Promotor's Contribution	
	i) 40% of Project Cost	Rs. 14,98,500
	ii) Remaining Working Capital	Rs. 38,57,000
		<u>Rs. 53,55,500</u>
	Total	<u>1,77,79,000</u>

## PROFITABILITY

a)	Sales Receipt @ Rs. 5,00,000	4,80,00,000
b)	Expenditure	4,47,36,000
c)	Net Profit Before Taxation	36,64,000
d)	Break Even Point	51.28%
e)	Return on Investment	
	i) On project cost	18.35%
	ii) On project cost with Margin Money	37.08%
	iii) On Promotor's Contribution	60.95%

## Cost Of Production

	Cost/Annum(Rs.)
1. Raw Materials (details in Encl.II) 3,82,000 x 96	3,66,72,000
2. Utilities	
i) Electricity 1/KW 100 KWH	100
ii) Water 2/KL 2 KL	<u>4</u> 104
	31,200
3. Labour & Supervision (Salary)	10,80,000
4. Depreciation	
i) On Plant & Equipment (General) @ 10%	2,93,500
ii) On Buildings @ 5%	70,000
5. Rent, Taxes, Insurance etc. @ 2% on PE and Bldings	86,700
6. Recurring Royalty @ 2.1/2% on sales value	12,00,000
7. Maintenance & Repairs	
i) On Plant & Equipment @ 5%	1,46,750
ii) On Building @ 2.1/2%	35,000
8. Interest on Term Loan @ 15%	5,24,475
9. Interest on Bank Loan @ 16%	14,28,300
10. Packing Charges @ Rs. 8000/plant	7,68,000
11. Distribution & Selling Expenses @ 5%	24,00,000
12. Total Cost of Production	4,47,35,925
13. Cost of Production per plant	4,65,999
	<b>Say</b> 4,66,000

Source: Central Salt & Marine Chemicals Research Institute, Bhavnagar.

**LIST OF PLANT & MACHINERY FOR  
PRODUCTION & FABRICATION**

**1. Infrastructure Facility**

- a) Boiler
- b) Chilling Plant
- c) Filter Tank-Sand Filter

**2. Membrane Preparation Facility**

- a) Casting Room with air conditioner & humidity controller.
- b) Membrane Casting Machine
- c) Membrane Annealing Machine
- d) Spiral Element Preparation Room

**3. Test Facilities**

- a) Membrane Test Kit
- b) Spiral Test Rig

**4. Hardware Preparation Facility**

For assembling most of machine work will be given outside only. Machineries included for minor adjustment etc. include:

- a) Lathe Machine, Drill Machine, Shaping Machine etc.
- b) Material Test Laboratory & Instrument for Inspection.

**5. Chemical Analytical Laboratory**

- a) Casting Solution Preparation Equipment
- b) Water Analysis Laboratory

Source: Central Salt & Marine Chemicals Research Institute, Bhavnagar.

**LIST OF EQUIPMENTS/COMPONENTS REQUIRED  
FOR A DESALINATION PLANT  
AND READILY AVAILABLE IN MARKET**

1. **Pro-treatment Equipment**
  - a) Pressure Sand Filter
  - b) Centrifugal Pump
2. **Chemical Dosing System**
  - a) Dosing Pumps
  - b) Solution Tank with Stirrer
3. **High Pressure Pump**

High pressure, pump liquid end made of SS, pump RPM maximum 250 with electric motor and base.
4. **Revers Osmosis Plant**
  - a) Pressure vessel, rubberlined with SS end plates, couplings.
  - b) High Pressure Hoses
  - c) Support Frame
  - d) Back Pressure Regulator
  - e) Control Panel
  - f) Spiral Elements
5. **Post-treatment Equipment**

Decarbonator with air blower.
6. **Monitoring Equipments**
  - a) pH Meter
  - b) Conductivity Meter

Source: Central Salt & Marine Chemicals Research Institute, Bhavnagar.

## INTER POLYMER MEMBRANES FOR WATER DESALINATION BY ELECTRODIALYSIS

Membrane technology is comparatively a recent technique for application in desalination of brackish and saline waters. "CSMCRI has carried out considerable work on desalination of brackish and electrodialysis should be flexible, with good mechanical strength for handling and packing and require low cost supporting material with similar properties. R & D efforts have been successful to prepare interpolymer membranes from polyethylene and styrene-divinyl benzene co-polymer. Imbibing desired inorganic groups to obtain suitable ion-exchange membranes. The raw materials required are now available indigenously and all the equipments can be fabricated within the country.

### Scope

The membranes prepared from interpolymer film have excellent electro-chemical and physico-chemical properties and are ideal for use in electrodialysis. It has been found that power consumption for such membranes is 1 KWH/Kg of salt removed. The technology will not only help in manufacture of membranes required for electrodialysis plants in country but can also be exported.

### PREDESIGN COST ESTIMATES ON INTER POLYMER MEMBRANES FOR WATER DESALINATION BY ELECTRODIALYSIS

Basis: 30,000 Sq.m. of cation and anion exchange membranes. 300 working days per annum.

<b>Capital Investment:</b>		<u>Rupees</u>	<u>Rupees</u>
<b>A.</b>	<b>Fixed Capital on Land &amp; Buildings</b>		
	1. Land area 2500 sq. m @ 10/- per sq.m	25,000	
	2. Built up area 3200 sq. m @ Rs.40/sq.m.	1,28,000	
		<u>1,53,000</u>	1,53,000
<b>B.</b>	<b>Fixed Capital on Plant &amp; Equipments</b>		
	1. Plant & Equipments	3,09,500	
	2. Equipment erection @ 10% of PE	30,950	
	3. Freight & handling charges @ 4% on PE	12,370	
	4. Process pumping @ 2% on PE	6,200	
	5. Electrical installation @ 5% on PE	15,500	
	6. Engineering & Supervision @ 5% on PE	15,500	
	7. Contingencies @ 10% on PE	30,950	
	8. Premium for know-how	5,000	
		<u>4,25,910</u>	4,25,910
		Say..	<u>4,26,000</u>
<b>C.</b>	<b>Total Fixed capital</b>		<u>5,79,000</u>
<b>D.</b>	<b>Working Capital</b>		<u>2,82,400</u>
	<b>Total capital outlay</b>		<u>8,61,400</u>

## **COST OF PRODUCTION**

Production: 30,000 sq.m. of cationsand anion exchange membranes per day.

Basis: 300 working days

		<u>Rupees</u>
1.	Chemicals	10,63,000
2.	Utilities	14,850
3.	Labour & Supervisions	62,600
4.	Maintenance & repairs:	
	1. On Plant & Equipments @ 5%	21,300
	2. On Buildings @ 2 1/2%	3,800
		<u>25,100</u>
		25,100
5.	Depreciation	
	1. On Plant & Equipments @ 15%	63,900
	2. On Buildings @ 5%	7,650
		<u>71,500</u>
		71,559
6.	Operating supplies @ 15% of Maintenance & repairs	3,800
7.	Taxes and insurance @ 2% on Land & Buildings and Plant & Equipments	11,600
8.	Plant overheads @ 50% of labour & supervision	31,300
	Manufacturing cost	12,83,800
9.	Administrative expenses @ 3% of mfg.cost	38,500
10.	Distribution and selling exp. @ 7% on mfg.cost	90,000
11.	Interest on total capital @ 14%	1,20,600
12.	Assuming 15% return on total capital outlay	1,29,200
13.	Royalty @ 2 1.2% on sales	42,600
14.	Total sales value	17,04,700
15.	Selling price per sq. mt. of membrane pair	56.82

N.R.D.C Terms for release:

Lumpsum premium : Rs. 5,000/-

Recurring royalty : 2 1/2%

Source: Central Salt & Marine Chemicals Research Institute, Bhavnagar.

## JAKHAU PORT

### Introduction:

A fair weather lighterage port is situated in Godia Creek in the Gulf of Kutch, on the west coast of India.

### Geographical Location:

Latitude: 23° 51' N., Longitude : 68° 56' E.

### Communication with Steamers:

At High Sea:	Via Kandla Wireless Station
Call Sign :	VVK. Range: 800 Kms.
Operates:	Round the clock
At Anchorage :	Through messenger

### Free Pratique:

Free pratique is issued in normal cases by Government Medical Officer, Naliya, but in case of the vessel is coming from yellow Fever Area and Jigger Infections Port within 30 days, then by the Health Officer, Kandla.

### Bill of Health:

Bill of health is issued by the Medical Officer, Primary Health Centre, Naliya.

### Accommodation:

#### Anchorage:

Good anchorage can be obtained in about 9.5 metres on mud, about 8 Kms. south-westward of the entrance to Godia Creek. Distance of anchorage from shore is about 12 Kms. One steamer can work at a time.

Jetties for Lighters: Landing State: Length - 72.24 metres.

Jetty for fishing vessels: Length - 60 metres.

Note: Salt works have their own jetty for loading salt.

### Floating Crafts:

Barges, tugs and launches are provided from Mandvi Port as and when required on request.

### Port Working Hours:

One shift of 8 hours. Additional shifts and work in recess is permitted with overtime fees.

### Cargo Handling Practice:

The shippers manage the handling of cargo on the steamers and sailing vessels themselves.

**Monsoon Period:** 15th June to 16th September.

### Provisions:

Provisions and stores can be supplied on prior notice in a limited quantity.

### Inland Communication:

Road:	By road to Gandhidham and then by National Highway.
Rail:	Nearest Railway Station - Naliya.
Air:	Nearest Air Port - Bhuj.

### Traffic:

Export: Salt

## SURFACE MINER AN ALTERNATIVE FOR LIMESTONE MINING - CASE STUDY

### Introduction

The steadily increasing cost for transporting the limestone from Beli Kamen open pit to the 18 Km. distant cement factory in Beocin now necessitate an alternative solution.

Belt conveyers would actually be a true alternative, but if such a system was installed, the existing crushing plant would have to be relocated, and it would no longer be the first but the last component of the downstream equipment.

In consideration of the above, the question now is: Should the existing crushing plant be modified to an in-pit mobile or semi- mobile one, or should a Surface Miner be used for limestone mining?

To establish the productivity of this technology in Beli kamen open pit, a Wirtgen 1900 SM was tested.

The test results and the subsequent techno-economical analysis confirmed the benefits of the Surface Miner Operation for limestone mining, compared with conventional methods.

### 1. Major Application Criteria

The limestone mined in Beli Kamen is processed in a cement factory and is, with minor exceptions, specified as medium-hard to hard rock.

The table below shows the physical and mechanical properties of the rock to be mined in Beli Kamen open pit.

	Medium - hard	Hard
1. Compressive strength	227-256 daN/cm <sup>2</sup>	274 - 739 daN/cm <sup>2</sup>
2. Tensile strength	33 - 45 daNcm <sup>2</sup>	81 - 94 daN/cm <sup>2</sup>
3. Cohesion	40 - 60 daN/cm <sup>2</sup>	53 - 158 daN/cm <sup>2</sup>
4. Angle of internal friction	39 - 49°	41 - 50°
5. Bank density	2,14 - 2,12 t/m <sup>3</sup>	2,22-2,58 t/m <sup>3</sup>
6. Moisture content	10 -12 %	6 - 8 %
7. Seismic wave velocity	1000 m/sec	1750 m/sec.

From these properties, and as proven in practice, the limestone material is rippable; it can be easily drilled and blasted. However, hydraulic excavator operation without prior blasting is only possible to a small extent. Approx. 3% of the deposit are soft materials while 5 - 10% are very tough, requiring blasting.

The open pit was designed for a two-shift operation, with a daily limestone production of 4300T. Loosening is accomplished by bulldozer and blasting, and wheel loaders load 26 T dump trucks which transport the limestone to the 18 km distant cement factory.

In the cement factory, the limestone is crushed from 600 mm to 100 mm by a twin roll crusher.

## 2. The Problem

The current mining cost structure is as follows:

- Loosening 11%
- Loading 8%
- Heavy haulage 74%
- Primary crushing 7%

Preliminary analyses indicate that conveyor transport would be more economical than heavy haulage. Said conveyor system would have an overall length of 11 Km with 800 mm belt width and a capacity of 360 t/h. If this alternative was selected, primary crushing of the limestone down to particle size of less than 200 mm would be required.

To this end, the following mining methods were investigated.

### I. IN-PIT MOBILE CRUSHER

Limestone loosening by 338 kw bulldozer, equipped with a single snank ripper and loading by 5.4 m<sup>3</sup> wheel loader.

Crushing to 100 mm by mobile crusher with a capacity of 360 t/h (new crusher or modification of the existing one).

The crusher would feed a mobile bench conveyor (Qh = 360 t/h; belt width = 800 mm). loading the transport conveyor.

### II. IN-PIT SEMI-MOBILE CRUSHER

Blasting operation with loading of the limestone by wheel loader (5.4 m<sup>3</sup>) and transport to the semi mobile crusher with a capacity of 360 t/h (modification of the existing stationary crusher) by 22.5 t dump trucks.

III. Limestone loosening by blasting (as outlined in II above), with hydraulic excavator (3 m<sup>3</sup> bucket capacity), loading 22.5 t dump trucks.

### IV. SURFACE MINER

Loosening and crushing by a 2600 SM Surface Miner, and transport by 22.5 t dump trucks to the receiving hopper feeding the conveyor.

Any of the above alternative mining systems would, however, necessitate primary crushing by a new coarse crusher which, in turn, would naturally entail a reduced and therefore uneconomical utilization of the existing crushing plant.

Therefore, a techno-economical analysis was made to establish the most viable mining technique.

## 3. Comparative Analysis Of Mining Techniques Under Investigation

### 3.1 The parameters

The following calculations are based on the machine performances recorded in Boecin.

#### 3.1.1 Loosening the limestone for subsequent loading

- Bulldozer operation:	338 KW engine output	
	Average working length 45 m:	
Ripping	860 t/h	
Dozing	414 t/h	
Average performance	866	= 280 t/h
	1+866	
	414	



The ripped material contains approx. 5% oversize lumps which cannot be loaded.

- Drilling and blasting : 105 mm dia. crown rotary drill  
23 t/m of drill hole  
(burden x spacing = 12.25 m<sup>2</sup>)

Performance: 345 t/h

The blast rock contains approx. 5% oversize material which cannot be loaded.

Explosives ANFO: 0.2 kg/t

Fuel Consumption: 24.1 l/h

- Crushing of oversize material by tractor mounted hydraulic hammer.

### 3.1.2 Loading

The wheel loader performance averages 34 bank m<sup>3</sup>/h or 75 t per bucket m<sup>3</sup>/h, and that of a hydraulic excavator is 61 bank m<sup>3</sup> or 134.2 t per bucket m<sup>3</sup>/h. The average fuel consumption is 0.12 l/t and 0.10 l/t respectively.

Wheel loader operation for blast rock removal also necessitates a bulldozer with an average performance of 1 h per 2,000 t of material loaded.

### 3.1.3 Crushing

Energy consumption : 0.45 KW/t

Special wear items : 2 gr/t

### 3.1.4 Surface Miner

For evaluating the surface mining technology, a 1900 SM machine manufactured by M/s Wirtgen was tested in beli Kamen open pit.

The machine-technical data is

- Working width 1900 mm  
- Cutting depth 150 mm  
- Engine output 298 kw  
- operating weight 27400 Kg.

With an engine load of 45 - 60% during the trial operation, the machine production ranged between 180 and 200 t/h, and the fuel consumption was 29.1 l/h i.e. 51% of the theoretical fuel consumption.

Sieve analysis of material cut by Surface Miner.

Particle size	Material			
	1 (%)	2 (%)	3 (%)	4 (%)
8.6 mm	31.7	31.9	18.2	15.0
16 mm + 2 mm	57.3	62.9	73.5	69.0
63 mm + 16 mm	6.8	2.3	6.4	16.0
63 mm + 31.5 mm	3.2	2.1	1.9	-
63 mm	1.0	0.8	-	-

Materials 1 and 2 classified as hard limestone;

Material 3 = tough limestone and material 4 = concrete.

To meet the requirements in Beli Kamen open pit, the surface Miner 2600 SM would be ideally suited. The specification of this model is as follows :

- Working width                      2600 mm
- Cutting depth                      250 mm
- Working speed                      0 - 26 m/min
- Engine output                      559 KW
- Operating weight                      59000 kt.

Based on the test results achieved by the 1900 SM in the specified material, M/s Wirtgen, the manufacturer of the 2600 SM, will guarantee the following machine performance :

- Surface Miner operation with material windrowed(not loaded)                      312 m<sup>3</sup>/h or 686 t/h
- Surface Miner operation with material loaded on trucks                      187 m<sup>3</sup>/h or 411 t/h

To calculate the 2600 SM hourly performance with direct loading on dump trucks, the author would recommend to use the formula given below :

$$Q_n = \frac{60 \times Q_k \times K_e}{\frac{Q_k \times 1}{s \times h} + t_i + t_o} \quad (\text{m}^3 [\text{bank}]/\text{h})$$

Where :

- $Q_k$  = Truck payload (m<sup>3</sup> [bank]/h)                       $n$  = No. of trucks loaded per m/c pass
- $s$  = Cutting width (m)                       $t_o$  = Manoeuvring surface miner = 1.2 min(min)
- $h$  = Cutting depth (m)                       $n$
- $v$  = Working speed (m/min)                       $K_e$  = Availability of system, acc. to PCSA
- $t_i$  = Waiting for/positioning of trucks 0.50 min

Based on the above formula, the 2600 SM performance with direct loading of the cut limestone on 22.6 dump trucks is as follows :

$$Q_n = \frac{60 \times 10.22 \times 0.75}{\frac{10.22 \times 1}{2.6 \times 0.25} + 0.5} = 163.9 \text{ m}^3 [\text{bank}]/\text{h}$$

or 360 t/h

When the cut limestone is windrowed, the 2600 SM will produce 272 m<sup>3</sup> [bank]/h or 600.6 t/h

Estimates when operating a 2600 SM machine are :

- Particle size produced :                      100% 100 mm
- Fuel consumption :                      72 l/h
- Cutting tool wear :                      0.0014/t

### 3.2 Calculating the operating costs

#### Notes :

- The operating cost calculation is based on standard industrial guidelines, including the specific operating costs.
- Depreciation : Simple straight-line write-off, until book value is 0.
- Capital cost : 14% of the average investment.
- Useful machine life acc. to experience from mining applications.
- Equipment cost as quoted in January 1988.

#### Additional costs

- **Blasting**

Explosives	0.089 \$/t
Devices	0.011 \$/t
Labour	0.002 \$/t
<b>Total</b>	<b>0.126 \$/t</b>
- Oversize material crushing: 0.018 \$/t, assuming a capital expenditure of \$ 56,000.
- Relocating the semi-mobile crusher: \$ 66,000 - every 4 years, i.e. average cost 4.34 \$ per working hour (+/- 10%).

### 4. CONCLUSIONS

- 4.1 The benefits to be expected from Surface Miner operation with conveyor transport of the mined material are quite obvious, compared with conventional mining methods.

- 4.2 Irrespective of the installation of a conveyor system, the surface Miner lends itself to the following applications :

- (a) Loosening, crushing and loading of limestone.
- (b) Loading of limestone without prior blasting.

Application (a) above based on the assumption that the primary crushing requirement (currently 0.07 \$/t) is eliminated, and loading costs are lower compared with (current) wheel loaded operation i.e.

0.472 \$/t compared with 0.626 \$/t = 24.6 %

compared with hydraulic excavator operation i.e.

0.472 \$/t compared with 0.552 \$/t = 14.5 %

Application (b) above, without consideration of the crushing costs, and based on the assumption that loading by Surface Miner is by 16.1% cheaper than by wheel loader, namely 0.472 \$/t compared with 0.556 \$/t, and by 2% cheaper than by hydraulic excavator, namely 0.472 \$/t compared with 0.482 \$/t.

- 4.3 There is a clear advantage when blasting the limestone rather than ripping and dozing, i.e. 0.281 \$/t compared with 0.379 \$/t = minus 25.9 % and hydraulic excavator operation will be more economical than wheel loader operation i.e. 0.482 \$/t compared with 0.556 \$/t = less 13.3%.

Source: Wirtgen GmbH, Hohner, Stra BC2, D-53b78, Windhagen, Germany.

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**KUTCH LIGNITE BASINS SHOWING AREA,  
RESERVES & QUALITY**

Details	Panandhro Lignite Deposits	Akrimota Lignite Deposits	Umarsar Lignite Deposits	Matanomadh- lefri Deposits
District	Kachchh	Kachchh	Kachchh	Kachchh
Taluka	Lakhpat	Lakhpat	Lakhapat	Lakhapat
	Panandhro (130 kms. North West of Bhuj)	Akrimota 120 kms. North West of Bhuj)	Umarsar	Matanomadh & around (100 kms. North West of Bhuj)
Area in sq.kms.	8.2	3.14	15.00	20.00
Over burden ratio	1:4	Upto 1:5 Upto 1:8	1:10	1:20
Reserves in MT	94	35 50	13.70	33.00
Proximate analysis in %				
A. Moisture	35.40%	10 to 15%	27.89%	11.71%
B. Ash	8.10%	10 to 25%	12.72%	20.05%
C. Vocatile matter	30.43%	30 to 50%	37.98%	41.70%
D. Fixed carbon	22.25%	15 to 25%	21.90%	26.20%
E. Calaarific value (K.Cal.Kg.)	4187	3440 to 5080	4182	4187
F. Sulphur	2.5 to 5.4	2.5 to 5.4	2.5 to 5.4	2.5 to 5.4
Ultimate analysis				
Carbon	61.28%	-	-	45.88%
Hydrogen	4.87%	-	-	3.78%
Sulphur	2.05%	-	-	5.40%
Nitrogen	0.91%	-	-	0.50%
Ash analysis				
SiO <sub>2</sub>	16.26%	20.6%	-	-
Fe <sub>2</sub> O <sub>3</sub>	37.9%	21.3%	-	-
Al <sub>2</sub> O <sub>3</sub>	12.2%	11.6%	-	-
CaO	11.0%	13.05%	-	-
TiO <sub>2</sub>	-	-	-	-
SO <sub>3</sub>	11.4%	18.5%	-	-