

SUMMARY

- * Ceramic units are concentrated in particular locations like Thangadh, Morbi, Surendranagar, Wankaner, Kadi, etc. Ahmedabad accounts for 49% of the value of output and 57% of fixed capital investment in the industry.
- * Physico-chemical properties of ceramic minerals of Gujarat with proved reserves and grade are given for the utility purpose.
- * China clay 63.00 Million Tonnes (MT), Fire clay 155.22 MT, Bentonite 105.00 MT, Dolomite 720.00 MT, Bauxite 97.00 MT reserves have been estimated in the State by the State Directorate of Geology & Mining, Govt. of Gujarat.
- * State produced an average 6.80 lakh tonnes - Bauxite 1.50 lakh tonnes, Bentonite 0.2 lakh tonnes, China clay, 2.23 lakh tonnes, Fire clay 2.23 lakh tonnes, Plastic clay 0.11 lakh tonnes, Quartz 0.21 lakh tonnes, Silica sand 1.12 lakh tonnes during 1990-91.
- * X-ray diffraction, thermal behaviour - DTA, infrared spectroscopy, electron microscopy work carried out in the Petrography and Mineral Chemical Laboratory of DGM confirmed the presence of mineral constituents.
- * Projects on sanitarywares, glazed wall tiles, ceramic tower packing materials, ceramic unglazed vitreous tiles, stoneware crockery with oil fired ceramic fibre lined tunnel kiln prepared by SISI can be established in a functional estate in Surendranagar district.

QUALITY CONTROL & SPECIFICATIONS

BIS has formulated and published vide IS : 2556 (Part - I) 1974 the specifications of the sanitarywares. Following tests are carried out to control the quality standards of the sanitarywares:

1. Crazing
2. Water absorption
3. Chemical resistance
4. Modulus of Rapture
5. Resistance of staining and burning

COST OF PROJECT

1. Fixed Capital :

[Amount in Rs]

Land & Building	
Land - 4000 sq.m. @ Rs.150/sq.m.	6,00,000
Machinery & work shed - 5000 sq.m. @Rs.2600/sq.m	13,00,000
Kiln shed - 200 sq.m. @Rs.2600/sq.m.	6,50,000
Raw material/finished goods godown - 200 sq.m. @Rs.2600/sq.m.	5,20,000
Office/Laboratory etc. - 100 sq.m. @Rs.2600/sq.m.	2,60,000
Boundry walls - L.S.	<u>70,000</u>
Total Cost of Land & Building	<u>28,00,000</u>

2. Machinery & Equipment:

	Description	Qty.	Price (Rs.)
i.	Ball mills, size 1800 mmx1800mm with all accessories and 10 H.P.motor each	2	2,00,000
ii.	Screw blunger, dia of impeller 500 mm Dimension of RCC tank - 2000 mm dia x 1900 mm depth with all accessories and 5 HP motor.	2	1,00,000
iii.	Vibrating screen size 900 mm x 600 mm with all accessories and 2 H.P. Motor.	1	20,000
iv.	Ball Mill 900 mm x 900 mm with all accessories and 10 HP motor	1	70,000
v.	Agitator with all accessories and RCC tank and 5 HP motor each	2	80,000
vi.	Slurry pump - 1000 litre and 5 HP motor	1	30,000
vii.	Cemented store tank for glaze with stirrer and 5 HP motor	1	20,000
viii.	Magnetic separators permanent type	2	20,000
ix.	Spray booths complete with air compressor, spray gun & 2 HP motor each	4	40,000
x.	Water pump set with storage tank and 5 HP motor	1	<u>20,000</u>
	Total :		6,00,000

POTENTIALITIES OF CERAMIC PROJECTS

(Including Physico-Chemical Properties of Ceramic Minerals)

Compiled By

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Senior Development Officer (Minerals)

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**INDUSTRIAL EXTENSION BUREAU
(A Govt. of Gujarat Organization)
Nanlal Chambers
Ashram Road
Ahmedabad-380 009**

(ii) Raw materials per month:

Items	Qty	Rate	Price(Rs.)
Quartz	20MT	Rs. 400/MT	8,000
Felspar	20MT	Rs. 500/MT	10,000
China clay	5MT	Rs 1500/MT	15,000
Ball clay/Fire clay	35MT	Rs. 600/MT	21,000
Plaster of Paris	5MT	Rs.1500/MT	7,500
Kiln furniture	L.S.		5,000
Glazing materials & colours/chemicals	L.S.		8,00
Packaging materials	L.S.		6,000
LD Oil	21KL	Rs.4500/KL	<u>94,500</u>
Total cost of raw materials			<u>1,75,000</u>

(iii) Utilities per month:

(1)	Power charges for machinery 52 KWH x Rs.1.10 x 8 hours x 25 days	11,440
(2)	Power charges for kiln 12 KWH x Rs. 1.10 x 52 KWH x Rs.1.10 x 12 hours x 25 days	<u>3,960</u>
	Total	15,400
	Say	<u>15,000</u>

(iv) Other contingent expenses (per month):

Postage & Stationary.	200
Consumable stores.	1,000
Repairing & Maintenance	2,000
Advertaisement & Publicity	1,000
Misc. Expenditure	<u>800</u>
Total	<u>5,000</u>

(v) Working Capital Requirement:

Salary & wages	1 Month	74,000
Raw Materials & Fuel	3 Months	5,25,000
Utilities	2 Months	30,000
Other contingent expenses	1 Month	5,000
Bills receivables	1/2 Month	<u>1,34,500</u>
Total		7,68,500
Say		<u>7,68,000</u>

Total capital Investment :

(i)	Fixed Capital	57,00,000
(ii)	Working capital	<u>7,68,000</u>
	Total	<u>64,68,000</u>

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- | | | |
|-----|---|--------------------------|
| 6. | Jain Minerals
36, Kisagadh Koti
Jaipur Road
Ajmer (Rajasthan) | Quartz/Felspar/Ball clay |
| 7. | G.L.Mineral Supply Corporation
6/459 Serreffan Homalla
Beawar (Rajasthan) | -do- |
| 8. | Rajasthan Plaster & Industry
Outside Coga Gate
Bikaner (Rajasthan) | Plaster of Paris |
| 9. | Snow-white Industries
40 Mahendra Nagar
Rishikesh
Dehradun (U.P) | -do- |
| 10. | Ceramill Glaze & Zirconium Co
Daultabad Road
Gurgoan (Haryana) | Zir Enlum |
| 11. | Ferro Coatings & Colours Ltd
Post: Joka
24 Parganas
Calcutta (W.B) | Ceramic colours/glazes |

ADDRESS OF KILN CONSULTANTS

1. Sharma Kiln Technology
206, Hare Krishne Complex
Opp. Kothawala Flat
Ashram Road
Ahmedabad - 380 006.
2. N.M. Ceramic Kiln
P.B. No.30
B-8 Ram Balram Appartment
Kalol - 382 721, Dist. Mehsana.
3. Associated Industrial Furnace
2/5 Sarai Julena, 1st Floor
Okhla Road, New Delhi- 110 065.
4. Unifire
16-12 Shakespere Sarani
4th Floor, Culcutta - 700 071.
5. Taksago Bhagat Cere Kiln (P) Ltd.
D- 828, New Friented Colony
New Delhi -110 065.
6. Noble Enterprises
Umiya Shopping Centre
Nr. Bus Stand,
Limbdi - 363 421.

INTRODUCTION

The project profile envisages for the manufacture of sanitarywares i.e. wash basins, closets, urinals, sinks, etc. Sanitarywares belong to the body group of vitreous china. They have the property of resistance to weather action, crazing, chemical action, good strength and no water absorption. They are used in houses, educational and research institutions, hospitals, industries, hotels and restaurants, cinema halls and other public places.

MARKET POTENTIAL

Sanitarywares are used in houses, hospitals, industries, hotels, other public places etc. with the continued increase in population, the requirement of houses is increasing day by day, as shelter is the one of the basic needs of human beings next to food and clothes. Govt. of India has launched a plan to solve the problem of housing as a result of which number of houses are being constructed.

In the state of Gujarat, there are 4 units in large scale and about 110 units in SSI sector and the production capacity of these units is estimated 25,000 MT and 90,000 MT per annum respectively. In India, there are 15 units in large scale and 130 units in SSI sector and production capacity of these units is estimated 85,000 MT and 95,000 MT per annum respectively.

In addition to housing tenements, a large number of hotels, industries, market complex, other public buildings are being constructed and will be constructed in future to fulfil the needs of the increasing population, which increases the demand of sanitarywares.

Socio-economic change in society, increase in adult literacy, all round economic development in the country, for maintaining hygienic conditions have also increased the demand of the sanitarywares to a great extent. Further, the export potential to Arabian or African country has also increased the demand the sanitarywares.

Taking into consideration of the above factors, the demand is estimated at two lakhs tonnes of sanitarywares per annum in the coming next couple of years and is expected to increase at the rate of 20% every year. Hence there is a good scope for setting up some more new units for the manufacture of sanitarywares.

PRODUCTION TARGET PER ANNUM : Sanitarywares - 900 MT

BASIS AND PRESUMPTIONS

The project profile is based on the presumption of 8 hours working per day per shift for 25 days per month or 300 days per annum. However, the operation of kilns will be of continuous nature for each firing cycle. The cost of land, building, machinery, kiln, raw materials, labour etc. are estimated at the rate prevailing 1991-92, which obviously vary from time to time and place to place. Rejections in the end products is considered as 5%.

PROCESS OF MANUFACTURE

The raw materials like quartz, felspar and clays are ground with water in desired proportion in a ball mill and 0.3% soda ash and sodium silicate are mixed to form a good casting slip. The slip is sieved through 100-120 No mesh sieve. The articles are made by casting process by pouring the slip to the moulds of plaster of paris. The articles are finished dried and the glazed. The glazed articles are fired in kilns to the temperature of about 1200°C. The articles are taken out from the kiln when it is nearer to room temperature. The articles are sorted out and packed for selling.

INTRODUCTION

The project profile envisages the manufacture of glazed earthenware wall tiles used for the surface of walls where cleanliness is an important factor. Hospitals, Kitchens, Bathrooms, Chemical Laboratories are some of the important places where these glazed tiles are generally used. These tiles are made generally in sizes of 149 mm x 4.5 mm and 99 mm x 4 mm. These tiles may be manufactured in sizes other than above according to the agreement between the manufacturer and the purchaser. Commonly manufactured sizes are 108 mm x 108 mm x 5 mm; 152 mm x 152 mm x 5.5 mm; 200 mm x 200 mm x 6 mm; 200 mm x 150 mm x 6.5 mm and 200 mm x 200 mm x 7 mm. The top surface of the tiles is glazed either glossy or matt glazed in white and in various colours.

MARKET POTENTIAL

In the State of Gujarat, there are 6 units in large scale and 8 units in SSI sector engaged in the manufacture of glazed earthenware wall tiles. The production capacity of these units is estimated 16000 MT per annum. It is reported that these existing units do not have market problems at present and are sending their products to the other states also. Further, there is scope for exporting the product to Arabian and African countries.

As all round development activities are taking place in country, in result of which number of houses, offices, schools, colleges, hotels and other public buildings are being constructed in which ceramic tiles are used. The average standard of living has been improving steadily in India over past few years. Number of old houses are being modified by using these tiles. Further the population of India is increasing day by day and people are facing the problems of houses. The houses are the essential need of human being. To overcome the problem of houses the Govt. of India has made so many plans. Along with these developments came an increasing demand for these tiles. The demand is expected to grow substantially at the rate of 20% per annum during the coming years.

PRODUCTION TARGET PER ANNUM

Glazed Earthenware wall Tiles - 1200 MT

BASIS AND PRESUMPTIONS

The project profile is based on the presumption of 8 hours working per day for 300 days in a year. The firing operation of the kiln is however to be carried out continuously. It is presumed that total losses of raw material during the process would be 20% and rejections in finished product would be 5%. The cost of land, building, machineries, kilns, raw materials, wages etc. are estimated after having contacted with concerned agencies and may vary from time to time and place to place depending upon various factors.

MANUFACTURING PROCESS

The raw materials required for the manufacture of glazed earthenware tiles are ball clay, dolomite, wallastonite, talc and slate pencil powder. The raw materials in desired proportion are charged in Ball Mill/Blunger for fine grinding (120 mesh) with about 40% water. After grinding in the ball mill this material is discharged and passed through vibrating screen of 120 mesh and magnet

	6,00,000
Electrification and installation charges @ 10% on the cost of machinery.	60,000
Drying racks, working tables, etc.	2,00,000
Laboratory equipments	25,000
Office equipments	<u>15,000</u>
Total cost of machinery & equipments	<u>9,00,000</u>

3. Kiln & Dryers		
i.. Shuttle kiln, fully fibre lined with two cars, with all accessories and automatic control system etc. including oil storage tank, etc.	1 No	11,00,000
Car Dimensions		
Setting length - 2850 mm, Setting width - 1500 mm		
Setting height - 2500 mm, Setting volume - 10.5 m ³		
ii. Chamber Dryer	1 No	<u>3,00,000</u>
Size 10 m x 8 m with all accessories		
Total :		<u>14,00,000</u>

Total Fixed Investment :

Land	6,00,000
Building	28,00,000
Machinery & Equipments	9,00,000
Kilns & Dryers	<u>14,00,000</u>
Total :	<u>57,00,000</u>

Salary and Wages Per Month :

1. Personal (Wages per month)

Designation	Nos.	Salary/ Month (Rs.)	Total salary (Rs.)
Ceramist	1	4000	4,000
Supervisors	4	2500	10,000
Accountant	1	1500	1,500
Clerk-cum-typist	2	1000	2,000
Skilled workers	15	1000	15,000
Semi-skilled workers	40	750	30,000
Watchman/Peon	2	750	<u>1,500</u>
Total :			64,000
Perquisites @ 15% of total salary			<u>9,600</u>
			73,600
Say			<u>74,000</u>

4.	Agitator with all accessories including cemented tank of size 6' dia x 6' deep	2	5	60,000
5.	Funnel magnets	3	-	15,000
6.	Diaphragm pump, strock 6" suction - 2 1/2", Delivery - 2" with all accessories	1	7.5	30,000
7.	Filter press No.of plates 60 chamber dia 600 mm with all accessories	1	-	2,00,000
Pressing section				
8.	1650 mm dia. dust pan mill with all accessories. Height of pan 200 mm Roller dia. 1000 mm x 250 mm face	1	7.5	1,80,000
9.	Vibrating screen with all accessories size 4' x 2' for clay dust	1	2	20,000
10.	Automatic tiles pressing capacity 40MT with all accessories. 18 stroke per minute	3	50 each	6,40,000
11.	Fetlingmachine with all accessories	1	15 each	40,000
12.	Dies - 149 mm x 149 mm x 4.5 mm 99 mm x 99 mm x 4 mm 200 mm x 150 mm x 6.3 mm	2 sets 2 sets 2 sets	- - -	1,50,000
13.	Trolley	6	-	30,000
14.	Conveyor system	1	3	50,000
Glazing section				
15.	Ball mill 1350 mm x 1200 mm with all accessories	1	10	70,000
16.	Vibrating screen size 4' x 2' with all accessories	1	2	40,000
17.	Permanent magnet		-	5,000
18.	Cemented store tanks for glaze with stirrer	1	2	20,000
19.	160' long glaze line with all accessories	1	6	1,80,000
20.	Selection line for finish tiles length 30' with all accessories	1	3	30,000
21.	Water pump set	1	5	25,000
22.	Misc. equipments	-	-	<u>35,000</u>
Total :				21,20,000

FINANCIAL ANALYSIS

1. Cost of production per annum:

Salary & Wages	8,88,000
Raw materials	21,00,000
Utilities	1,80,000
Other contingent expenses	60,000
Depreciation on building @ 5%	1,40,000
Depreciation on machinery @ 10%	1,90,000
Depreciation on Kilns & Dryers @ 15%	2,10,000
Interest on fixed capital @ 15%	8,55,000
Interest on working capital @ 20%	<u>1,53,600</u>
Total cost of production	<u>46,76,600</u>

2. Sales per annum:

Items	Qty.	Rate	Value(Rs)
Sanitarywares	855 MT	Rs.6500	55,57,500

3. Profitability Per annum:

Sales per annum	55,57,500
Cost of production per annum	<u>46,76,600</u>
Profit	<u>8,80,900</u>
Percentage profit on investment	: 13.6%
Percentage profit on sale	: 15.8%
B.E.P	: 64%

NAMES & ADDRESSES OF RAW MATERIALS SUPPLIERS

- | | | |
|----|--|-------------------|
| 1. | Eklara China Clay Works
Post Ekleri, Tal. Idar
Dist. Sabarkantha (Gujarat) | China clay |
| 2. | Swastik Industriies
Shiv Krup Nagpur College Road
Bhuj Kutch - 370 001 | China clay |
| 3. | Ashapura China Co
Near Rly. Station
Bhuj Kutch - 370 001 | China clay |
| 4. | Hemang Pottery Works
Thangadh
Dist. Surendranagar | Plaster fire clay |
| 5. | Muttani Minerals
Station Road, Thangadh
Dist. Surendranagar | - do - |

(ii) Raw materials per month:

Items	Qty	Rate (Rs.)	Price (Rs.)
Ball clay	60MT	700/MT	42,000
Dolomite	14MT	700/MT	9,000
Wallastonite	14MT	1500/MT	21,000
Talc	15MT	800/MT	12,000
Non-plastic burnt clay	17MT	300/MT	5,100
Frit	7MT	16000/MT	1,12,000
China Clay	1MT	2000/MT	2,000
Colours	L.S.		2,000
Kiln furniture	L.S.		25,000
crans and deck slabs			
Packaging materials	5000 Boxes	6/Box	30,000
LD Oil	30 KL	4500/KL	<u>1,35,000</u>
Total cost of raw materials			<u>3,95,000</u>

(iii) Utilities per month:

(1)	Power charges for machinery 100 KWH x Rs.1.10 x 8 hours x 25 days	22,000
(2)	Power charges for kiln 23 KWH x Rs. 1.10 x 24 hours x 25 days	<u>15,180</u>
	Total :	37,180
	Say	<u>37,000</u>

(iv) Other contingent expenses (per month):

Postage & Stationary.	200
TA/DA	3,000
Repairing & Maintenance	3,000
Advertaisement & Publicity	4,000
Misc. Expenditure	<u>2,800</u>
Total :	<u>13,000</u>

(v) Working Capital Requirement:

Salary & wages	1 Month	70,000
Raw Materials & Fuel	3 Months	7,80,000
Fuel	2 Months	2,70,000
Power charges	2 Months	74,000
Misc. expenses	1 Month	<u>13,000</u>
Total		<u>12,07,000</u>

TOTAL COST OF PROJECT

Land	9,00,000
Building	35,00,000
Machinery & Equipments	23,50,000
Kilns & dryers	23,00,000
Working capital	<u>12,07,000</u>
Total :	<u>1,02,57,000</u>

NAMES AND ADDRESSES OF MACHINERY SUPPLIERS

1. Amic Industries (P) Ltd.
86, D, Dr. Suresh Sirkar Road
Calcutta - 700 014.
2. D. K. Engg. Works
8, Panchanantala New Road
Balgaria
Calcutta - 700 056.
3. Lokmanya Engg. Works
26, Bharat Khand Cotton Mill Compound
Naroda Road
Ahmedabad - 380 016.
4. Jeevanlal Shivilal Panchal
Opp. Old Civil Hospital
Gheekanta Road
Ahmedabad.
5. Modern Engg. & Fabricating Works
Behind Kubeshwar Mahadev
Saijpur, Ambawadi
Ahmedabad.
6. Keshav Engg. Works
25 Swallow Lane
Calcutta - 700 001.
7. Sabarwal Metal Industries
9, Industrial Estate
Kalapi Road
Kanpur - 208 012.
8. Noble Enterprises
Umeya Shopping Centre
Nr. Bus Stand
Limbdī - 363421.

NAMES AND ADDRESSES OF SUPPLIERS OF MACHINERY

- | | | | |
|---|--|---|--|
| 1 | Amic Industries (P) Ltd.
86, D, Dr. Suresh Sirkar Road
Calcutta - 700 014. | 2 | D. K. Engg. Works
8, Panchanantala New Road
Balgaria
Calcutta - 700 056. |
| 3 | Lokmanya Engg. Works
26, Bharat Khand Cotton Mill Compound
Naroda Road
Ahmedabad - 380 016. | 4 | Jeevanlal Shivrul Panchal
Opp. Old Civil Hospital
Gheekanta Road
Ahmedabad. |
| 5 | Modern Engg. & Fabricating Works
Behind Kubeshwar Mahadev
Saijpur, Ambawadi
Ahmedabad. | 6 | Keshav Engg. Works
25 Swallow Lane
Calcutta - 700 001. |
| 7 | Sabarwal Metal Industries
9, Industrial Estate
Kalapi Road
Kanpur - 208 012. | 8 | Noble Enterprises
Umeya Shopping Centre
Nr. Bus Stand
Limbdī - 363421. |

NAMES AND ADDRESSSES OF THE RAW MATERIAL SUPPLIERS

- | | | | |
|---|--|---|---|
| 1 | Jain Minerals
36 Pashagalli Kothi
Jaipur Road
Ajmer (Rajasthan) | 2 | GC Minerals
6/459 Serreffan Mohalla
Beawar (Rajasthan) |
| 3 | Wolckel (P) Ltd
Nr Siroli Road 307 021
Rajasthan | 4 | Ferro Coatings & Colour Ltd
Post Joka
24 Parganas
Calcutta (W.B) |

to remove the iron particles and collected in an agitator from where it is pumped to filter press for de-watering and to get in the form of cakes. The cakes are allowed to dry. The dried cakes are charged into dust pan for making the powder mixed with necessary blinder which is further passed through a vibrating screen. The tiles are made by charging the press dust to the automatic tile press. The pressed tiles are taken out and felted by felting machine. The tiles are loaded in to kiln for biscuit firing. The tiles are unloaded from the kiln and defective tiles are removed. The biscuit tiles are glazed on the top surface on the glaze line machine. The glazed tiles are again loaded into kiln for glost firing upto the temperature of 1050°C, when kiln is cooled, the tiles are taken out from the kiln and sorted out and packed for selling.

QUALITY CONTROL

BIS has formulated and published IS: 777-1988 "specification for glazed earthenware wall tiles". This IS covers the requirements for glazed earthenware wall tiles used for finishing the surface of wall where cleanliness is an important factor. The tiles must be free from all defects. Following are the quality control tests that are carried out on the tiles:

1. Defects
2. Dimensions and tolerances
3. Trueness of shape
4. Water absorption
5. Crazeing
6. Impact resistance
7. Chemical resistance

Entrepreneurs are advised to refer IS - 777 : 1988 for more details.

COST OF PROJECT

Land - 6000 sq. m.	@ Rs. 150/sq.m.	9,00,000
Building:		
Manufacturing & Machinery shed	1000 sq.m. @ Rs.2600/sq.m	26,00,000
Godown for raw materials	200 sq.m. @Rs.2000/sq.m	4,00,000
Office	100 sq.m. @ Rs.2000/sq.m	2,00,000
Boundry walls	L.S.	<u>3,00,000</u>
Total :		<u>35,00,000</u>

2. Machinery & Equipment:

S.No	Description	Nos.	HP required	Price (Rs.)
Slip House				
1.	Ball mills, size 1800 mmx1800mm with all accessories and electric motor	2	10 each	2,00,000
2.	Screw blunger , Dia. of impeller -500 mm Dimension of RCC Tank - 2000 mm x 1900 mm depth RPM 250 - 300 capacity - 5000 litres.	1	5	60,000
3.	Vibrating screen size 600 mm x 900 mm with all accessories. Frequency of vibrating 3000 RPM Capacity 3000-4000 litre per hour.	1	2	40,000

IMPLEMENTATION SCHEDULE (PRESUMPTIONS)

1.	Preparation of project report	-	30 days
2.	Selection of site	-	30 days
3.	Registration of SSI	-	5 days
4.	Availability of finance	-	45 days
5.	Construction of building	-	90 days
6.	Machinery procurement & erection	-	90 days
7.	Raw material procurement	-	45 days
8.	Recruitment of labours	-	30 days
9.	Trial runs	-	15 days

If C.P.M. is drawn of above activities, the total period would be required about 180 days to implement the project, as many activities are to be completed simultaneously.

TECHNICAL ASPECTS

Process of Manufacture:

The raw materials like quartz, felspar, ball clay, fire clay etc. are charged in ball mill in desired proportion with 30-40% water and ground to the fineness of 100 -120 No. mesh. China clay and other soft clays are blunged in blunger with 30-40 water. The slurry from ball mill and blunger is mixed and passed through the sieve of 100 No mesh and then electromagnet in order to remove the iron particles from the slurry. Both slurries are kept and mixed properly in agitator tank. From agitator tank, it is passed through filter press for dewatering to make the form of cakes. These cakes are passed through de-airing pugmill to make the compact body. The round articles are made by this body on jigger and jolley. Other shapes are made by casting process. For casting first slip is made and poured into the moulds of plaster of paris. The articles are dried, finished, glazed, and fired at the temperature of 1250-1280°C. For firing tunnel kiln is proposed in this project profile. D.D. Kilns and shuttle kilns are also in practice. The articles taken out from the kiln are sorted and packed for selling.

Quality Specifications:

B.I.S. has formulated and published IS:11475-1985(Stonewares Dinnerwares) for carrying out the various tests for control the quality of the product.

Production Capacity per annum:

- (a) Quantity - 600 M.T.
- (b) Value - Rs. 54.15 lakhs.

Approximate power requirement: - 75 H.P.

Pollution Control:

This industry comes under "Red" Category. For the purposes of inspection for implementation of provisions of various statutes regarding control of pollution and protection of environment, it is proposed to visit a unit by the concerned authorities once in six month.

Energy Conservation needs:

This industry needs energy conservation in fuel as well as in electric. Ceramic fibred lined tunnel kiln proposed in the project profile conserves the fuel energy to 20-50%, when it is compared with conventional type D.D.Kiln.

	21,20,000
Electriciation and installation charges @ 10	2,12,00
Office equipments	<u>18,000</u>
Total :	<u>23,50,000</u>

3. Kilns & Dryers		
Shuttle Kilns		
1. Size 2850 mm x 1500 mm x 2500 mm	1 No.	8,00,000
Burners 3 Nos. Ceramic fibre lined capacity 4.5 MT tiles for biscuit firing with all accessories and with fully automisation control with 12 HP motors.		
2 Car 2850 mm x 1500 mm x 2500 mm	1 No.	12,00,000
size (2 cars). Burners 6 Nos. Ceramic fibre lined capacity 4.5 MT tiles for glost firing with all accessories and with fully automisation control and 18 HP motor.		
3. Chamber dryer size 40' x 40' x 10'	1 No.	<u>3,00,000</u>
Total :		23,00,000

Total Fixed Investment :

Land	9,00,000
Building	35,00,000
Machinery & Equipment	23,50,000
Kilns & dryers	<u>23,00,000</u>
Total :	<u>90,50,000</u>

Working Capital:

(1) Personal (Wages per month)

Designation	Nos.	Salary/Month	Total salary (Rs.)
Manager cum Ceramist.	1	6000	6,000
Supervisors	2	3000	6,000
Accountant	1	1500	1,500
Clerk-cum-typist	2	1000	2,000
Skilled workers	10	1000	10,000
Unskilled workers	50	700	35,000
Peon	1	700	700
Watchman	2	700	<u>1,400</u>
			62,600
Perquisites @ 15% of total salary			<u>7,340</u>
Total :			69,940
Say			<u>70,000</u>

3. Kilns:

Ceramic fibrelined push but tunnel kiln 18,00,000
 with control system, oil storage tank, combustion fan,
 hydraulic pusher etc.
 Dimension
 Length - 2400 mm
 Settling width - 900 mm
 Settling height - 820 mm
 No. of burners - 4
 Power required - 10 H.P.
 Capacity - 2 M.T. per day.

4. **Pre-operative expenses :** 60,000

Total fixed capital (1+2+3+4) 50,00,000

5. Working Capital:

(i) Personal (Wages per month)

Designation	Nos.	Salary/Month(Rs.)	Total salary(Rs)
Manager cum Ceramist.	1	3500	3,500
Supervisor	1	2500	2,500
Accountant	1	2000	2,000
Clerk-cum-typist	1	1500	1,500
Skilled workers	15	1000	15,000
Semi-skilled workers	20	750	15,000
Peon	1	750	750
Watchman	2	750	<u>1,500</u>
			41,750
Perquisites @ 15% of total salary			<u>6,262</u>
			47,912
		Say :	<u>48,000</u>

(ii) Raw materials & Fuel per month:

Items	Ind/Imp.	Qty.	Rate(Rs.)	Price(Rs.)
Quartz/Silica sand	Ind.	13MT	Rs.400/MT	5,200
Felspar	Ind.	16MT	Rs.500/MT	8,000
China clay	Ind.	10MT	Rs.1200/MT	12,000
Ball clay	Ind.	5MT	Rs.500/MT	2,500
Fire clay	Ind.	20MT	Rs.300/MT	6,000
Marble/Calcite	Ind.	750/KG	Rs.2000/MT	1,500
Zinc oxide	Ind.	100/KG	Rs.50/KG	5,000
Zirconium oxide	Ind.	700/KG	Rs.30/KG	21,000
Barium carbonate	Ind.	200/KG	Rs.20/KG	4,000
Colouring agents	Ind.	LS		2,800
Plaster of Paris	Ind.	2/MT	Rs.2000/MT	4,000
LDO (Fuel)	Ind.	18/KL	Rs.6500/KL	1,04,000
Kiln furniture	Ind.	LS		6,000
Packing material	Ind.	LS		<u>3,000</u>
Total cost of raw materials				<u>1,85,000</u>

FINANCIAL ANALYSIS

1. Cost of production per annum:

Salary & Wages	8,40,000
Raw materials	31,20,000
Fuel	16,20,000
Power charges	4,44,000
Other contingent expenses	1,56,000
Depreciation on building @ 5%	3,50,000
Depreciation on machinery @ 10%	2,35,000
Depreciation on Kilns & Dryers @ 15%	3,45,000
Interest on fixed capital @ 15%	13,72,500
Interest on working capital @ 18%	<u>2,17,260</u>
Total cost of production :	86,99,760
Say :	<u>87,00,000</u>

2. Sales per annum:

Items	Qty.	Rate	Value (Rs)
Glazed Earthenware tiles	1140 MT	Rs.8500 per MT	96,90,000

3. Profitability Per annum:

Sales per annum	96,90,000
Cost of production per annum	<u>87,00,000</u>
Profit	<u>9,90,000</u>
Percentage profit on investment	: 9.6%
Percentage profit on sale	: 10.2%
B.E.P	: 72%

ADDRESS OF KILN CONSULTANTS

- | | | | |
|---|---|---|---|
| 1 | Sharma Kiln Technology
206, Hare Krishna Complex
Opp. Kothawala Flat
Ashram Road
Ahmedabad - 380 006. | 2 | N.M. Ceramic Kiln
P.B. No.30
B-8 Ram Balram Appartment
Kalol - 382 721, Dist. Mehsana. |
| 3 | Associated Industrial Furnace
2/5 Sarai Julena, 1st Floor
Okhla Road, New Delhi- 110 065. | 4 | Unifire
16-12 Shakespere Sarani
4th Floor, Culcutta - 700 071. |
| 5 | Taksago Bhagat Cere Kiln (P) Ltd.
D- 828, New Friented Colony
New Delhi -110 065. | 6 | Noble Enterprises
Umiya Shopping Centr
Nr. Bus Stand,
Limdbdi - 363 421. |

1. The first part of the document is a list of the names of the members of the committee.

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INTRODUCTION

At present Crockery Wares are being manufactured in earthenware, stonewares, vitreous china and bone china. This project profile is prepared for the manufacture of Stoneware Crockery items. The main item under the group of Crockery are Cups, saucers, Plates, Bowls, tea sets, dinner sets etc. They are impermeable to most of the liquids and water absorption is less than 3%. They are bad conductor of heat. Ceramic Crockerywares have their own place in the field of kitchenware due to having some outstanding properties over to melamine and steel wares, such as more hygienic, easily cleanable, heat resistance etc. The main uses of these items are in houses, Railway/Defence canteens, tea stalls, hotels and restaurants etc.

MARKET

Stoneware Crockery items are used in the kitchen of every houses, hotels, restaurants, tea stalls, railway canteens, defence canteens etc. In the state of Gujarat, about 80 SSI units are engaged in the manufacture of Stoneware Crockeries. The installed capacity of these units is estimated around 30000 MT per annum. It is reported that these units are not facing the problems of marketing. In the region (Gujarat State), supply of the product is greater than demand. Therefore, units of Gujarat State are supplying their products to the outside of the state mainly, Maharashtra, Andhrapradesh, Tamilnadu, Kerala and Karnataka. On the national level, demand of the product is greater than supply. This product has good scope in international market, mainly in Gulf and South African Countries. It is presumed that demand of this item is increasing with a growth rate of 15% per annum due to the increasing of population and development activities in the country.

BASIS & PRESUMPTIONS

(1)	Efficiency and working hours considered for full capacity utilisation.	1.	80% (efficiency)
		2.	8 working hours per day or 300 days in a year.
		3.	Operation of kiln will be of continuous nature
(2)	Time required for achieving full/envisaged capacity utilisation.		6 months from the commencement of commercial production
(3)	Labour wages		Skilled workers - Rs.40/day
			Semi-skilled workers-Rs.30/day
(4)	Interest rate for fixed capital		18%
			working capital 20%
(5)	Margin money		30%
(6)	Pay back period of the project		9 years
(7)	Land rate		Rs.100/Sq.M.
(8)	Building construction rate		Rs.2500/Sq.M.

2. Turn over per year:

Items	Qty.	Rate	Value(Rs.)
Stoneware Crockery items	600 MT	Rs.9000/Mt	54,00,000
Less rejections etc. @ 5%			<u>2,70,000</u>
Net turn over			<u>51,30,000</u>

3. Net profit per year (before income tax)

Rs. 51,30,000 - Rs. 46,46,000 = Rs. 4,84,000

4. Net profit ratio = $\frac{484000 \times 100}{5130000}$ = 9.4%

5. Rate of return = $\frac{484000 \times 100}{5391000}$ = 9%

6. Breakeven point :

i)	Total Depreciation	4,64,000
ii)	Total Interest	10,50,000
iii)	40% of salary & wages.	2,30,000
iv)	40% of utilities	1,03,000
v)	40% of other contingent	<u>28,800</u>

Say 18,82,400

Net profit 4,84,000

B.E.P. = $\frac{1882400 \times 100}{1882400 + 484000}$ = 77%

NAMES & ADDRESSES OF MACHINERY SUPPLIERS

- | | |
|---|--|
| 1 Amic Industries Pvt. Ltd
80, D, Dr. Suresh Sircar Road
Calcutta- 700 014 | 2 Modern Engg. & Fabricating Works
Behind Kubeshwar Mahadev
Naroda Road, Ahmedabad |
| 3 Lokmanya Engg. work
20, Bharat Khand Cotton Mills Compound
Naroda Road
Ahmedabad-380 010 | 4 Jivanlal Shivilal Panchal
Opp: Old Civil Hospital
Gheekanta Road
Ahmedabad |
| 5 Gidwaney Brothers
73, Netaji Subhash Road
P.B.No. 2346
Calcutta-1 | 6 Saboo Engg. Works
Kuchaman Road 341 509
Rajasthan |
| 7 Hindustan Engg. Company
23/7 Gopallal Tagore Road
Bon Hooghly
Calcutta-700 035 | 8 D.K. Engg. Works
8, Panchanathala New Road
Balgaria
Calcutta- 700 056 |
| 9 Perfect Machine Tools Corporation
1 Smith Road
Madras-1 | 10 St. Vincant Industries
Convent Road
Calicut (Kerala) |

1. Fixed Capital :**Land & Building:**

Land	-	3000 sq.M. @ Rs. 100/sq.M.	3,00,000
Manufacturing & Machinery shed	-	300 sq.M. @Rs.2500/sq.M	7,50,000
Kiln shed	-	150 sq.M. @Rs.2500/sq.M.	3,75,000
Raw material shed	-	100 sq.M. @Rs.1500/sq.M.	1,50,000
Finished goods godown	-	100 sq.M. @Rs.2500/sq.M.	2,50,000
Office	-	50 sq.M. @Rs.2500/sq.M.	1,25,000
Boundry walls	-	L.S.	<u>1,50,000</u>
Total Cost of Land & Building			<u>21,00,000</u>

2. Machinery & Equipment:

S.No	Description	Ind/	Qty.	Price (Rs.)
(a)	Production unit			
1.	Ball mills, size 1800 mmx1800mm with all accessories and 10 H.P.motor each	Ind.	2	2,50,000
2.	Ball mill size 900 mm x 900 mm with all accessories with 7.5 H.P. motor	Ind.	1	40,000
3.	Screw blunger, capacity 5000 litre,vat (Hexagonal) 2.8 m x 1.8 m with 5 H.P. motor including cemented Tank.	Ind.	2	1,00,000
4.	Vibrating screen size 900 mm x 900 mm with all accessories and 1 H.P. Motor.	Ind	2	20,000
5.	Electromagnetic seperators with rectifier	Ind	1	10,000
6.	Agitator size 2.4 M x 1.8 M with 3 H.P. motor and cemented tank	Ind	1	40,000
7.	Diaphargm pump, stroke 225 mm suction 75 mm with 7.5 H.P. motor	Ind	1	30,000
8.	Filter press chamber dia 600 mm number of plates 50	Ind	1	1,00,000
9.	De-airing pugmill with vacuum pump etc. with 5 HP motor	Ind.	1	35,000
10.	Disintegrator size 550 cm with all accessories and 7.5 H.P. motor each	Ind	1	45,000
11.	Jigger & jolley with 5 HP electric motor	Ind	15	1,00,000
12.	Saggar press power Operated with 5 HP motor	Ind	1	50,000
13.	Water pump set with 2 H.P. motor	Ind	1	20,000
14.	Pot mill, Pot No.6, Pot size 9"x10" with electric motor of 2 HP	Ind	1	<u>10,000</u>
	Total			8,50,000
(b)	Electrification and installation charges @ 10% on the cost of machinery.			85,000
(c)	Testing equipments.			30,000
(d)	Misc. Tools, dies, Trolleys etc.			50,000
(e)	Cost of office equipments.			<u>25,000</u>
	Total cost of machinery & equipments			<u>10,10,000</u>

- | | |
|---|--|
| <p>11 Hindustan China Clay Works
Papinacheri
Kerala
[China Clay]</p> <p>13 Tahla Ram & Sons
Rathkhna
Bikaner (Rajasthan)
[Ball Clay]</p> <p>15 R.D. Manihar & Co
Prithviraj Marg
Bikaner (Rajasthan)
[Ballclay/Felspar]</p> <p>17 Multani Minerals
Station Road
Thangadh
Dist. Surendranagar (Gujarat)
[Fire Clay]</p> <p>19 Ceramills Glaze & Zirconium Co
Daulatabad Road
Gurgoan (Haryana)
[Zirconium]</p> <p>21 Ferro Coatings Coldurs Ltd
Post Joka
24 Paraganas, Calcutta - (WB)
[Frits/glazes, colours]</p> <p>23 Dudhan Industries
12, Cement Road
Dehradun (UP)
[Plaster of paris]</p> | <p>12 Ami Ceramics
Motipur, Himatnagar
Gujarat
[China Clay]</p> <p>14 Sita Ram Rajkumar
Inside Hemalton Ki Bari
Bikaner (Rajasthan)
[Ball Clay]</p> <p>16 Shri Draupadi Devi Ball
Clay Suppliers
Post-Sri Kolaytji
Bikaner - 334 001
[Ball Clay]</p> <p>18 Sompura Pran Shankar & Sons
Thangadh
Dist. Surendranagar (Gujarat)
[Fire Clay]</p> <p>20 Shahzips (P) Ltd
55, Industrial Estate
Nunhal, Agra
[Frits/glazes]</p> <p>22 Rajasthan Plasters & Inds.
Outside Coga Gate
Bikaner
[Plaster of paris]</p> <p>24 Snow-white Industries
40, Mahendra Nagar
Rishikesh
Dehradun (UP)
[Plaster of paris]</p> |
|---|--|

(iii)	Utilities per month :	
	(1) Power charges for machinery 80 KWH x Rs. 1.10 x 8 Hrs. x 25 days	13,200
	(2) Power charges for kiln 14 KWH x Rs. 1.10 x 24 Hrs. x 25 days	<u>8,240</u>
	Total	21,440
	Say	21,500
(iv)	Other contingent Expenses (per month):	
	Postage & Stationary	200
	Consumable stores	1,000
	Repairing & Maintenance	1,000
	Advertisement & Publicity	2,000
	Insurance etc.	1,000
	Misc. Expenditure	<u>800</u>
	Total	6,000
(v)	Total recurring expenditure per month:	
	Personnels.	48,000
	Raw Materials & Fuel.	1,85,000
	Utilities	21,500
	Other contingent expenses.	<u>6,000</u>
		<u>2,60,500</u>
(vi)	Total working capital for 3 months:	7,81,500
Total capital Investment :		
(i)	Fixed Capital	50,00,000
(ii)	Working capital for 3 months.	<u>7,81,500</u>
	Total	<u>57,81,500</u>

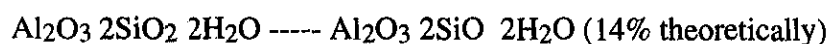
MACHINERY UTILISATION

Ball Mills	-	100%	(on the basis of 24 hours working)
Screw blunger	-	100%	- do -
Filter press	-	80%	- do -
Jigger Jolley	-	80%	(on the basis of 8 hours working on a day)
Tunnel kiln	-	80%	(on the basis on 24 hours working)

FINANCIAL ANALYSIS

1.	Cost of production per year:	
	Total recurring cost	31,20,000
	Depreciation on building @ 5%	90,000
	Depreciation on machinery & equipment @ 10%	1,04,000
	Depreciation on kiln @ 15%	2,70,000
	Interest on fixed capital @ 18%	9,00,000
	Interest on working capital @ 20%	<u>1,50,000</u>
	Total cost of production	<u>46,46,000</u>

The second stage, the hydroxylation change sees a structural change from kaolin to metakaolinite and the evolution of water. The reaction is endothermic, starting at 550°C - 650°C and is completed by 700° - 800°C. This metakaolinite formed at this stage is readily identifiable by X-ray analysis.



Kaolinite 500°C

Metakaolinite

The third stage which involves the formation of a direct spinel followed by onset of mullite formation which causes the peak on differential thermal analysis at 1000°C - 1100°C.



925°C

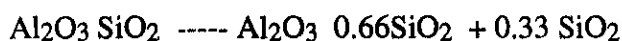
Silicon spinel



1100°C

1:1 mullite

The fourth and final stage above 1100°C sees the final transformation to mullite and the latter being either amorphous or crystalline silica (crystaobolite).



1400°C

3:2 mullite

PROJECT SIZE

The project envisages to manufacture 15,000 tonnes per annum calcined china clay.

(Rs. in lakhs)

Land	80.00
Building	75.00
Plant & Equipment	490.00
Working Capital	150.00
Total Cost :	795.00

RAW MATERIALS

Raw China-clay exploited in Mamuara, Manfera, Bhachau, Goniasar villages in Kachchh district. Dhokawada of Santalpura taluka of Banaskantha district, Arasodia, Eklara of Sabarkantha district are available from the China-clay levigation plant owners. At present, 500 tonnes washed clay per day is available from existing plant owners. Raw & refined china-clay @ Rs.400 to Rs.500 and @ Rs.1200 to Rs.1500 can be procured. Captive mines can be procured in Kachchh, Banaskantha and Sabarkantha districts by filing mining lease or prospecting licence applications as per Mineral Concession Rules, 1989.

QUALITY AND SPECIFICATIONS

Calcined China-clay are used in PVC cables, mechanical rubber goods, elastomers, PVC, polyamide, plastic & rubber applications for specific properties given below :

- 11 Keshab Engg. Works
25, Swallow Lane
Calcutta-700 001
- 13 Frigmeiras Engineers
Dalamal Towers, 9th Floor
No.903, Near New council Hall
Nariman Point, Bombay-1

- 12 Jacea Traders
12, Gitanjali, 1st Floor
P.B.No.378
Bombay 400 005
- 14 Sabarwal Metal Industries
9, Industrial Estate
Kalapi Road
Kanpur 208 021 (UP)

TUNNEL KILN/SHUTTLE, KILN

- 15 Bengal-Lion (Industrial Furnace) Ltd
27-B, Camac Street
Calcutta-700 010
- 17 Sharma Kiln Technol
206, Hare Krishna Complex
Opp. Kothawala Flat, Ashram Road
Ahmedabad- 380 006
- 19 N.M. Ceramic Kiln
P.B.No. 30, B-8, Ram Balram Apartment
Kalol (Gujarat) - 382 721

- 16 Teksago Bhagat Carakiln Pvt. Ltd
D-828, New Friends Colony
New Delhi - 110 005
- 18 Uni Fire
16-18, Shakespere Sarani, 4th Floor
Calcutta- 700 071

NAMES & ADDRESS OF RAW MATERIAL SUPPLIERS

- 1 Golachar Pallawad Co
Opp. Rly. Station
Gandhinagar, Ajmer Road
Beawar (Rajasthan)
[Quartz/Felspar]
- 3 Jotya Prakash Mining Works
4, Gupta Bali
Beawar- (Rajasthan)
[Felspar]
- 5 Satya Prakash Mining Works
2, Gupta Gali
Beawar - 305 901
[Felspar]
- 7 Ashwin & Co
Arsodia
Taluka - Idar
Sabarkantha - 383 430
[China clay]
- 9 Venkateswara Ceramics
Dhimadol
West Godavari District (A.P.)
[China Clay]

- 2 Jain Minerals
30 Kishangaahl Koti
Jaiour Road
Ajmer (Rajasthan)
[Felspar/Ball clay]
- 4 G.L. Minerals Supply Co
6/459, Srreffan Mohalla
Beawar- 305 901
[Felspar/Quartz]
- 6 Oriental Prospecting Co
1680/2, Opp. Desai pol, Khadia
Ahmedabad
[China Clay]
- 8 Swastik China Clay Works
1102/1103, GIDC, Bhuj
Bhuj-Kutch-370 001
[China Clay]
- 10 Bal Krishna Mineral Industries
Ramavaram
East Godavari District (A.P.)
[China Clay]

China-clay Specifications

Characteristic	Requirement in percent for			
	Textile & Paper coating	Rubber	Filler in paper	Insecticides
1. Residue on 53 micron IS Sieve	0.1 (max.)	1.9 (max.)	1.9 (max.)	2.0 (max.)
2. Particles larger than 10 microns in diameter	5.0 (max.)	7.0 (max.)	20.0 (max.)	20.0 (max.)
3. Particles smaller than 2 microns in diameter	62.0 (max.)	50.0 (max.)	35.9 (max.)	35.0 (max.)
4. Relative density at 27/27°C _a	2.5-2.9	-	-	-
5. Loss on drying	6.0 (max.)	2.9 (max.)	6.0 (max.)	6.0 (max.)
6. Loss on ignition	14.0 (max.)	14.0 (max.)	14.0 (max.)	14.0 (max.)
7. Matter soluble in water	-	0.5 (max.)	0.5 (max.)	-
8. Matter soluble in HCl	2.5 (max.)	2.5 (max.)	2.5 (max.)	2.5 (max.)
9. CaO	-	0.007 (max.)	-	-
10. Al ₂ O ₃	-	-	-	10 Ppm (max.)
11. Fe ₂ O ₃	0.7 (max.)	0.7 (max.)	0.7 (max.)	0.7 (max.)
12. MnO	-	0.013 (max.)	-	-
13. PH value of aqueous extract	-	-	4.5 to 7.5	-
14. Oil absorption	-	50 ml.per 100 gm(min)	-	-
15. Colour reflectance to blue light were length 3040A°	80.85	-	-	-

INTRODUCTION

Kaolin is one of the most versatile industrial minerals. It is chemically inert over a relatively wide pH range, is white in colour and has good covering power, when used as a pigment or extender. Kaolin is soft and non-abrasive and has a low conductivity of heat and electricity. Some uses of plastics require very rigid specifications including particle size, colour and brightness and viscosity whereas other uses require no specifications, for example in cement where the chemical composition is most important. The paper industry consumes the largest amount of kaolin where it is used both as a filler and as a coating material on the paper surface to improve the quality of printing.

MARKET POTENTIAL

China clay is mostly consumed in crockery, ceramic tiles, rubber, sanitaryware, insulators and paper industries. Some heat treated kaolin may be used for filling paper. Kaolin is used as coating clay. It imparts a smoother surface to the finished paper, improving its affinity for printing ink. Kaolin flows well under critical condition and manages to give a smooth and even film. Its platy structure lends itself particularly to the production of high class paper.

All coating grades of kaolin are water washed. Some heat treated kaolin may be used for filling paper where abrasion resistance is required. Paper coating requirement as per B.I.S.(505-1978) is as follows :

- i) Residue on 53-0.1 (Max. micron IS sieve)
 - ii) Particles Larger 5.0 (Max.) than 10 micro in diameter
 - iii) Particles smaller 62.0 than 2 microns in max. diameter
 - iv) Relative -2.5 -2.9 density at 27/27° Ca
 - v) Loss on drying 6.0 (Max.)
 - vi) Loss on ignition - 14.0 (Max.)
 - vii) Matter soluble in HCl-2.5 (Max.)
- CaO
- Al₂O₃-0.7 (Max.)
- Colour reflectance to 80.85
- Blue light wave length 3040 Å°

CALCINATION PROCESS

There are two basic methods of processing kaolin, a dry method or a wet process. The dry method is called air flotation which separates the clay from contaminants.

Calcination is a process to produce special grade products. Two different grades of calcined kaolins are produced depending on the treatment temperature calcination at temperature in range 650-700°C removes the structural hydroxyl groups and the escaping water vapour produces a bulky product with enhanced resiliency and opacity which are desirable attributes for paper coating applications.

Kaolin undergoes structural molecular changes when calcined. These changes occur in four distinct phases :

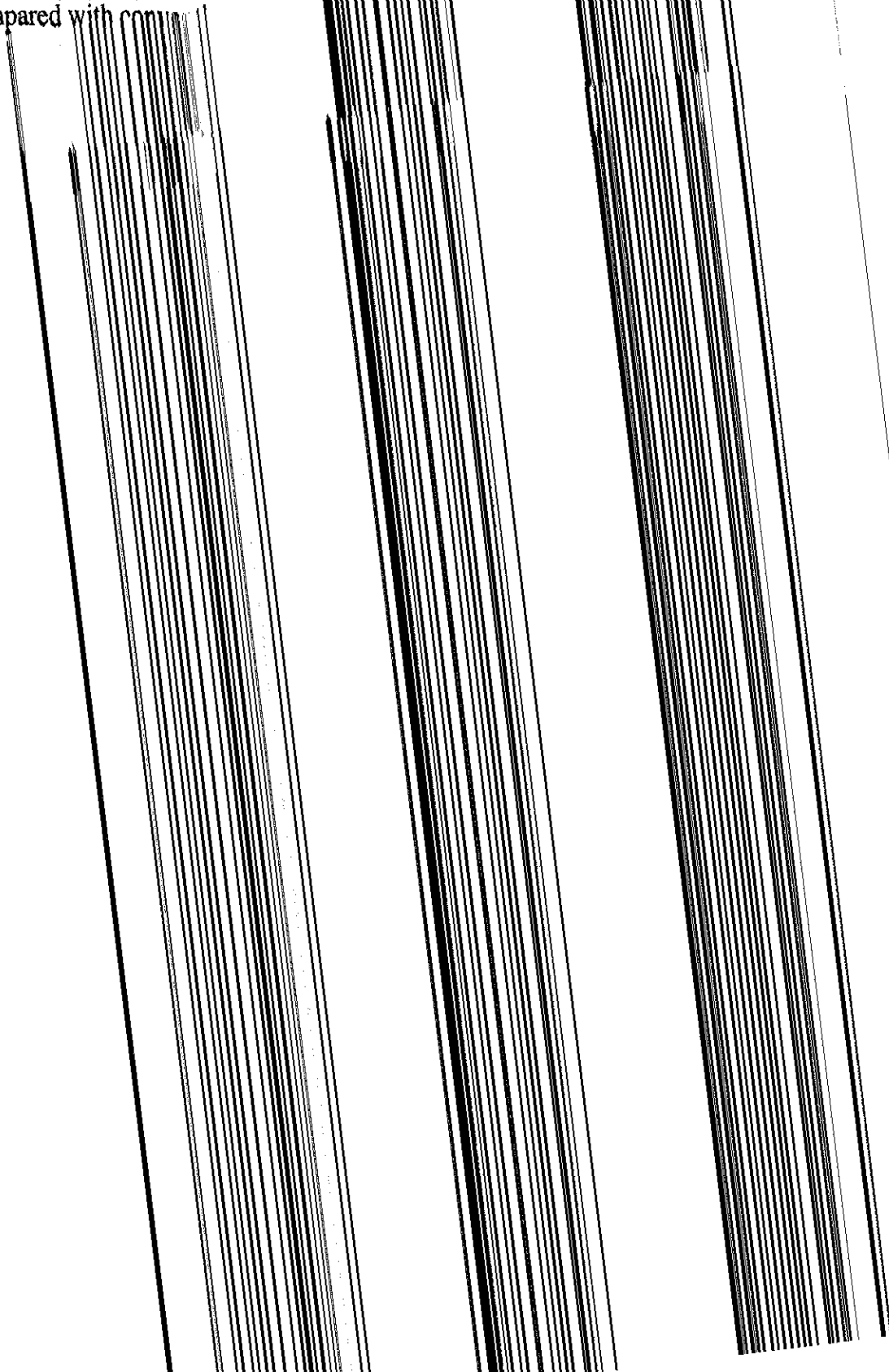
Absorbed water is removed in the first stage. This stage is complete at 150°C.

Pollution control:

This industry comes under "Red" category. For the purpose of inspection for implementation of the provisions of various statutes regarding control of pollution and protection of environment, it is proposed to visit a unit by the concerned authorities once in six month.

Energy Conservation:

This industry needs energy conservation in fuel as well as in electric. Ceramic fil
kiln proposed in the project profile is latest modern kiln
When it is compared with con



Principal Used**Specific Properties**

- | | | |
|----|--|--|
| 1. | PVC cables
High voltage compounds | - Improve electrical properties |
| 2. | Low and medium voltage
power cable insulation | - Low moisture content
- Low water absorption |
| 3. | Mechanical Rubber Goods | - Good processability
- Low mill sticking
- Neutral PH
- Uniform cure rates |
| 4. | Elastomers | - Good resilience
- Low permanent set
- Good electrical properties |
| 5. | PVC | - Improve extrusion and calendering |
| 6. | Polyamide | - Improve heat distortion and
reinforcing properties |
| 7. | Other Plastic/Rubber Applications | - Finest partical size
- Significant increase in impact strength
- Improvement in tensile & flexural modules |

Gradewise Physico-chemical Characteristics

Grade		China clay 20	China clay 10	Chinaclay CL100	Chinaclay CL500	Chinaclay CLT100	Chinaclay CLT500
Type		Lavigated Air- floated Mirco- nised	Lavigated Air- floated Mirco- nised	Calcined Mirco- nised	Calcined Mirco- nised	Calcined Mirco- nised coated	Calcined Mirco- nised coated
Particle Size Distri- bution	Average M	3	1.5	2	1	2	1
	Topcut M	20	10	10	6	10	6
	Surface area M ² /Gm	7.8	15.5	11.4	22.8	11.4	22.4
Physical Analysis	Sp. Gravity	2.58	2.58	2.63	2.63	2.63	2.63
	Bulk Density (Gm/Litre)	680	550	600	520	610	530
	Dry Brightness	86	86	88-90	88-90	88-90	88-90
	Oil Absorption	42	55	65	72	46	52
	PH(Sat.Soln.)	8.0	8.0	7.5	7.5	N.A	N.A
	Moisture	0.5	0.5	0.2	0.2	0.05	0.05
		(Max.)	(Max.)	(Max.)	(Max.)	(Max.)	(Max.)
Chemical Analysis	SiO ₂	44.5	44.5	51.3	51.3	51.3	51.3
	Al ₂ O ₃	36.1	36.1	44.2	44.2	44.2	44.2
	Mix Oxide	4.5	4.5	2.7	2.7	2.7	2.7
	Loss on Ignition	14.6	14.6	1.3	1.3	1.3	1.3

Items	Ind/Imp.	Qty.	Rate (Rs.)	Price (Rs.)
Colouring agent	Ind.	L.S		20,000
Fuel(L.D.O)	Ind.	18K.L	Rs.8500/KL	1,04,000
Kiln furnuture	Ind.	L.S.		15,300
Packaging material	Ind.	L.S.		<u>10,000</u>
Total cost of raw materials				<u>1,56,000</u>
(iii) Utilities per month :				
(1) Power charges for machinery 80 KWH x Rs.1.10 x 8 Hrs.x 25 days				13,200
(2) Power charges for kiln 14 KWH x Rs. 1.10 x 24 Hrs.x 25 days				<u>8,240</u>
Total				21,440
		Say :		<u>21,500</u>
(iv) Other contingent expensed (per month):				
Postage & Stationar				200
Consumable stores				1,000
Repairing & Maintenance				1,000
Advertaisement & Publicity				2,000
Insurance etc.				1,000
Misc. Expenditure				<u>1,300</u>
Total				<u>6,500</u>
(v) Total recurring expenditure per month:				
Personnels				48,000
Raw Materials & Fuel				1,56,000
Utilities				21,500
Other contingent expenses.				<u>6,500</u>
				<u>2,32,000</u>
(vi) Total working capital for 3 months:				<u>6,96,000</u>
6. Total capital Investment :				
(i) Fixed Capital				47,50,000
(ii) Working capital for 3 months.				<u>6,96,000</u>
Total				<u>54,46,000</u>

MACHINERY UTILISATION

Ball Mills	- 100%	(on the basis of 24 hours working)
Screw blunger	- 100%	- do -
Filter press	- 80%	- do -
Presses	- 80%	(on the basis of 8 hours working on a day)
Pushbat tunnel kiln	- 80%	(on the basis on 24 hours working)

NAMES AND ADDRESSES OF KILN MANUFACTURERS

- | | | | |
|----|--|----|---|
| 1. | Andrew Hule & Co. Ltd
(A Govt. of India Enterprises)
Yule House, 8 Clive Row
Calcutta-700 001 | 4. | Testeels Limited
Navdeep Building
Ashram Road, PB No.5, Navjivan
Ahmedabad-380 014 |
| 2. | Bird & Co (Pvt) Ltd
Chartered Bank Building
Calcutta-700 001 | 5. | Vulcan Engineers Pvt Ltd
Mahalaxmi Chambers
Bhulabhai Desai Road
Bombay-400 026 |
| 3. | Larsen & Toubro Ltd
L&T House
Ballard Estate, PO Box.278
Bombay-400 038 | | |

NAMES & ADDRESSES OF RAW MATERIAL SUPPLIERS

1. Eklera Chinaclay Works
8 Janpath Commercial Centre
4th Floor, Opp Capital Comm. Centre
Ashram Road
Ahmedabad-380 009
Phone: 443343
2. Amrapali & Co.
289 New Cloth Market
O/s Raipur Gate
Ahmedabad-380 002
Phone: 361253/365851
Fax: 313175
3. Shri HD Patel
HD Enterprises Pvt Ltd
HD House, Silver Point
New Station Road
PO Bhuj-370 001
Dist. Kachchh
Phone: (02832) 21972
Fax: (02832) 21937

- | | | | |
|----|---|----|---|
| 5 | Gidwaney Brothers
73, Netaji Subhash Road
P.B.No. 2346
Calcutta-1 | 6 | Saboo Engg. Works
Kuchaman Road 341 509
Rajasthan |
| 7 | Hindustan Engg. Company
23/7 Gopallal Tagore Road
Bon Hooghly
Calcutta-700 035 | 8 | D.K. Engg. Works
8, Panchanathala New Road
Balgharia
Calcutta- 700 056 |
| 9 | Perfect Machine Tools Corporation
1 Smith Road
Madras-1 | 10 | St. Vincant Industries
Convent Road
Calicut (Kerala) |
| 11 | Keshab Engg. Works
25, Swallow Lane
Calcutta-700 001 | 12 | Jacea Traders
12, Gitanjali, 1st Floor
P.B.No.378
Bombay 400 005 |
| 13 | Frigmeiras Engineers
Dalamat Towers, 9th Floor
No.903, Near New council Hall
Nariman Point, Bombay-1 | 14 | Sabarwal Metal Industries
9, Industrial Estate
Kalapi Road
Kanpur 208 021 (UP) |

TUNNEL KILN/SHUTTLE, KILN

- | | | | |
|----|--|----|--|
| 15 | Bengal-Lion (Industrial Furnace) Ltd
27-B, Camac Street
Calcutta-700 010 | 16 | Teksago Bhagat Carakiln Pvt. Ltd
D-828, New Friends Colony
New Delhi - 110 005 |
| 17 | Sharma Kiln Technol
206, Hare Krishna Complex
Opp. Kothawala Flat, Ashram Road
Ahmedabad- 380 006 | 18 | Uni Fire
16-18, Shakespere Sarani, 4th Floor
Calcutta- 700 071 |
| 19 | N.M. Ceramic Kiln
P.B.No. 30, B-8, Ram Balram Apartment
Kalol (Gujarat) - 382 721 | | |

NAMES & ADDRESS OF RAW MATERIAL SUPPLIERS

- | | | | |
|---|--|---|---|
| 1 | Golachar Pallawad Co
Opp. Rly. Station
Gandhinagar, Ajmer Road
Beawar (Rajasthan)
[Quartz/Felspar] | 2 | Jain Minerals
30 Kishangaahl Koti
Jaiour Road
Ajmer (Rajasthan)
[Felspar/Ball clay] |
| 3 | Jotyia Prakash Mining Works
4, Gupta Bali
Beawar- (Rajasthan)
[Felspar] | 4 | G.L. Minerals Supply Co
6/459, Srreffan Mohalla
Beawar- 305 901
[Felspar/Quartz] |

13.	Saggar press Hand Operated	Ind	1	30,000
14.	Water pump set with 2 H.P. motor	Ind	1	<u>20,000</u>
	Total			<u>10,00,000</u>
b)	Electrification and installation charges @ 10% on the cost of machinery			1,00,000
c)	Testing equipments			30,000
d)	Misc. Tools, dies, Trolleys etc			50,000
e)	Cost of office equipments			<u>20,000</u>
	Total cost of machinery & equipments			<u>12,00,000</u>
3.	Kilns: Ceramic fibre lined push but tunnel kiln with cintrol system, oil storage tank, hydraulic pusher etc. Dimension Length - 2400 mm Setling width - 900 mm Settling height - 820 mm No. of burners - 4 Power required - 10 H.P. Capacity - 2 M.T. per day			14,00,000
4.	Pre-operative expenses: Total fixed capital (1+2+3+4)			50,000 <u>47,50,000</u>

5. **Working Capital:**

(i) Personal (Wages per month)

Designation	Nos.	Salary/Month(Rs.)	Total salary (Rs.)
Manager cum Ceramist	1	3500	3,500
Supervisor	1	2500	2,500
Accountant	1	2000	2,000
Clerk-cum-typist	1	1500	1,500
Skilled workers	15	1000	15,000
Semi-skilled workers	20	750	15,000
Peon	1	750	750
Watchman	2	750	<u>1,500</u>
Total			41,750
Perquisites @ 15% of total salary			<u>6,262</u>
			47,912
		Say :	<u>48,000</u>

(ii) Raw materials & Fuel per month

Items	Ind/Imp.	Qty.	Rate (Rs.)	Price (Rs.)
Quartz	Ind.	10MT	Rs.400/MT	4,000
Felspar	Ind.	10MT	Rs.500/MT	8,000
China clay	Ind.	5MT	Rs.1200/MT	6,000
Ball clay	Ind.	5MT	Rs.500/MT	2,500
Fire clay	Ind.	10MT	Rs.300/MT	3,000
Vitrefied clay	Ind.	5MT	Rs.200/MT	1,000
Lime Stone	Ind.	1MT	Rs.200/MT	200

Ceramic tower packing materials come under the group of chemical stonewares and chemical porcelain. The main items are partition rings, intolos saddles, Berl saddles, Rachining rings, honeycombs etc. They are made in various sizes and shapes according to the requirement of customers. They are impermeable ot most of the liquids and water absorption is less than 1%. They are resistant to acids, alkalies and other chemicals and gases. They are used in various types of chemical and petrochemical industries.

Ceramic tower packing materials are used in chemical industries. They are used mainly in those industries which are engaged in the manufacture of organic chemicals, petrochemical, alkalies, acids etc. As Govt. of India has made the policy to promote the industry, in result of which number of industries are being set up in the state of Gujarat as well as in the country in which ceramic tower packing materials are used.

Secondly they are replaced by new one between the period from one month to one year depending upon the various factors. Hence, there is a good scope for the setting up of few more units in the state of Gujarat.

1.	Efficiency and working hours considered for full capacity utilisation	(a) 75% (Efficiency) (b) 8 hrs working per day or 300 days in a year (c) Operation of Kiln willbe of continuous nature for each firing cycle.
2.	Time required for achieving full/envisaged capacity utilisation	6 months from the commencement of commercial production.
3.	Labour wages	Skilled workers-Rs.40/day Semi skilled workers - Rs.30/day
4.	Interest rate - for Fixed Capital - for Working Capital	- 18% - 20%
5.	Margin Money	- 30%
6.	Pay back period of the project	- 9 years
7.	Land rate	- Rs. 100/sq.M.
8.	Building construction rate	- Rs. 2500/sq.M.

FINANCIAL ANALYSIS

1.	Cost of production per year:		
	Total recurring cost		27,84,000
	Depreciation on building @ 5%		90,000
	Depreciation on machinery & equipment @ 10%		1,20,000
	Depreciation on kiln @ 20%		2,80,000
	Interest on fixed capital @ 18%		8,55,000
	Interest on working capital @ 20%		<u>1,39,000</u>
	Total cost of production		<u>42,68,000</u>
2.	Turn over per year:		
	<u>Items</u>	<u>Qty.</u>	<u>Rate</u>
	Ceramic unglazed vitreous Tiles	600 MT	Rs.8500/Mt
			51,000.00
	Less: Rejections etc. 5%		<u>2,55,000</u>
	Net turn over		<u>48,45,000</u>
3.	Net profit per year (before income tax)		
	Rs. 48,45,000 - Rs. 42,68,000	= Rs. 5,77,000	
4.	Net profit ratio	= $\frac{577000 \times 100}{4845000}$	= 12%
5.	Rate of return	= $\frac{577000 \times 100}{5446000}$	= 10.6%
6.	Breakeven point		
	i) Total Depreciation		4,90,000
	ii) Total Interest		9,94,000
	iii) 40% of salary & wages.		2,30,000
	iv) 40% of utilities		1,03,000
	v) 40% of other contingent		<u>31,000</u>
			18,48,800
		Say :	<u>18,49,000</u>
	B.E.P.	= $\frac{1849000 \times 100}{1849000 + 577000}$	= 76%

NAMES & ADDRESSES OF MACHINERY SUPPLIERS

1	Amic Industries Pvt. Ltd 80, D, Dr. Suresh Sircar Road Calcutta- 700 014	2	Modern Engg. & Fabricating Works Behind Kubeshwar Mahadev Naroda Road, Ahmedabad
3	Lokmanya Engg. work 20, Bharat Khand Cotton Mills Compound Naroda Road Ahmedabad-380 010	4	Jivanlal Shivilal Panchal Opp: Old Civil Hospital Gheekanta Road Ahmedabad

Energy conservation needs:

This industry needs energy conservation in fuel as well as in electric Ceramic fibre lined shuttle kiln proposed in the project profile, conserves the fuel energy to 20-40% when it is compared with conventional type D.D.Kiln.

FINANCIAL ASPECTS**Fixed capital :****1. Land & Building:**

Land	3000 sq.m.	@ Rs. 100/sq.m.	3,00,000
Machinery shed	300 sq.m.	@ Rs.2500/sq.m.	7,50,000
Kiln shed	150 sq.m.	@ Rs.2500/sq.m.	3,75,000
Raw materials shed	100 sq.m.	@ Rs.1500/sq.m.	1,50,000
Finished goods godown	100 sq.m.	@ Rs.2500/sq.m.	2,50,000
Office	100 sq.m.	@ Rs.2500/sq.m.	2,50,000
Boundry wall etc.			<u>1,25,000</u>
Total Cost of land & Building			22,00,000

2. Machinery & Equipment:

S.No	Description	Ind/Imp.	Qty.	Price (Rs)
a)	Production unit			
1.	Ball mills, size 1800 mmx1800mm with all accessories and 10 H.P.motor each	Ind.	2	2,50,000
2.	Ball mill size 900 mm x 900 mm with all accessories with 7.5 H.P. motor	Ind.	1	40,000
3.	Screw blunger, capacity 5000 litre, vat (Hexagonal) 2.8 m x 1.8 m with 5 H.P. motor including cemented Tank.	Ind.	1	60,000
4.	Vibrating screen size 900 mm x 600 mm with all 1 H.P. Motor.	Ind	2	20,000
5.	Electromagnetic seperators with rectifier 200 volts A.C.	Ind	1	10,000
6.	Agitator size 2.4 M x 1.8 M with 3 H.P. motor	Ind	1	40,000
7.	Diaphargm pump, stroke 225 mm suction 75 mm with 7.5 H.P. motor	Ind	1	30,000
8.	Filter press chamber dia 600 mm number of plates 50	Ind	1	1,00,000
9.	Disintegrator size 550 cm with all accessories and 7.5 H.P. motor each	Ind	1	80,000
10.	Granules making machine with 2 H.P.motor	Ind	1	20,000
11.	Toggle press, hand operated	Ind		
12.	Saggar press Hand Operated	Ind	1	30,000
13.	Water pump set with 2 H.P. motor	Ind	1	<u>20,000</u>
	Total			<u>10,00,000</u>

- 5 Satya Prakash Mining Works
2, Gupta Gali
Beawar - 305 901
[Felspar]
- 7 Ashwin & Co
Arsodia
Taluka - Idar
Sabarkantha - 383 430
[China clay]
- 9 Venkateswara Ceramics
Dhimadol
West Godavari District (A.P.)
[China Clay]
- 11 Hindustan China Clay Works
Papinacheri
Kerala
[China Clay]
- 13 Tahla Ram & Sons
Rathkhna
Bikaner (Rajasthan)
[Ball Clay]
- 15 R.D. Manihar & Co
Prithviraj Marg
Bikaner (Rajasthan)
[Ballclay/Felspar]
- 17 Multani Minerals
Station Road
Thangadh
Dist. Surendranagar (Gujarat)
[Fire Clay]
- 19 Ceramills Glaze & Zirconium Co
Daulatabad Road
Gurgoan (Haryana)
[Zirconium]
- 21 Ferro Coatings Coldurs Ltd
Post Joka
24 Paraganas, Calcutta - (WB)
[Frits/glazes, colours]
- 23 Dudhan Industries
12, Cement Road
Dehradun (UP)
[Plaster of paris]
- 6 Oriental Prospecting Co
1680/2, Opp. Desai pol, Khadia
Ahmedabad
[China Clay]
- 8 Swastik China Clay Works
1102/1103, GIDC, Bhuj
Bhuj-Kutch-370 001
[China Clay]
- 10 Bal Krishna Mineral Industries
Ramavaram
East Godavari District (A.P.)
[China Clay]
- 12 Ami Ceramics
Motipur, Himatnagar
Gujarat
[China Clay]
- 14 Sita Ram Rajkumar
Inside Hemalton Ki Bari
Bikaner (Rajasthan)
[Ball Clay]
- 16 Shri Draupadi Devi Ball
Clay Suppliers
Post-Sri Kolaytji
Bikaner - 334 001
[Ball Clay]
- 18 Sompura Pran Shankar & Sons
Thangadh
Dist. Surendranagar (Gujarat)
[Fire Clay]
- 20 Shahzips (P) Ltd
55, Industrial Estate
Nunhal, Agra
[Frits/glazes]
- 22 Rajasthan Plasters & Inds.
Outside Coga Gate
Bikaner
[Plaster of paris]
- 24 Snow-white Industries
40, Mahendra Nagar
Rishikesh
Dehradun (UP)
[Plaster of paris]

(iii)	Utilities per month:	
	Power charges for machinery	
	60 KWH x Rs.1.10 x 8 hours x 25 days	13,200
	Power charges for kiln	
	14 KWH x Rs.1.10 x 12 hours x 25 days	<u>4,120</u>
	Total	17,320
	Say	<u>17,500</u>
(iv)	Other Contingent expenses (per month):	
	Postage and stationery	300
	Consumable stores	2,000
	Repairing and maintenance	4,000
	Advertisement publicity	1,000
	Insurance etc.	2,000
	Misc. expenditure	1,200
	Total	<u>10,500</u>
(v)	Total recurring expenditure per month	
	Personnel	53,000
	Raw material	2,34,000
	Utilities	17,500
	Other contingent expenses	<u>10,500</u>
		<u>3,15,000</u>
(vi)	Total working capital for 3 months	<u>9,45,000</u>
6.	Total Capital Investment :	
(i)	Fixed capital	47,00,000
(ii)	Working capital for 3 months	<u>9,45,000</u>
	Total	<u>56,45,000</u>

MACHINERY UTILISATION

Ball Mills	- 100% (on the basis of 24 hours working in a day)
Screw blunges	- 100% -do-
Filter press	- 100% -do-
Toggle press	- 80% (on the basis of 8 working hours in a day)
Shuttle kiln	- 100% (on the basis of 24 working hours till particular firing cycle is completed)

Note: Capacity utilisation of the unit depends on the capacity of shuttle kiln.

IMPLEMENTATION SCHEDULE (Presumptions)

1.	Time required for preparation of project report	- 30 days
2.	Selection of site.	- 30 days
3.	Registration of SSI(trmporary	- 5 days
4.	Availability of finance	- 45 days
5.	Construction of building	- 90 days
6.	Machinery Procurement & Erection	- 90 days
7.	Raw Materials procurement	- 30 days
8.	Recritment of Labour	- 30 days
9.	Trial runs	- 15 days

If C.P.M Chart is drawn of above activities, the total time would be taken about 180 days to implement the project as many activities may be completed simultaneously.

TECHNICAL ASPECTS

Process of Manufacture:

The raw materials like quartz, felspar, ball clay, plastic fire clay with 30 - 40% water are ground in ball mill to finess of 100 - 120 No, mesh in desired proportion. China clay amd other soft clays with 30 - 40% water are blunged in blunger. The slurry from ball mill and blunger is passed through the seive 120 No. mesh and then electromagnet in order to remove the iron particles. Both slurries are mixed properly in agitator tank. The slurry from agitator tank is passed through filter press for dewatering tomake the form of cakes. The cakes are dried and powdered in a disintegrator. Dry broken articles are also used up with this body. The powder is mixed with water (about 6%) and oil about 3% in powder and made into such consistency that when a handful of them is pressed, the powder forms a lump but does not wet the hand. The oil is made up from:Thin oil, or crude petrol - 4 parts, and thick oil linseed or castor oil 1/2 to 1 part. The prepared mass is again passed through a centrifugal disintegrator where any lump formed during mixing is broken and make the form of granules. The mass is them pressed into shapes in a piller press/toggle press fitted with dies of required shapes. The articles are dried and finished. The articles are glazed if required and then fired at the temperature of 1280°C in shuttle kiln. D.D. Kiln and Tunnel kiln are also in practice. The articles taken out from the kiln are sorted and packed for selling.

Quality specification:

IS: 7087-1979 B.I.S. has formulated and published IS-7087- 1979 for carrying out the various tests for control of the quality of the product.

Production capacity per annum:

a)	Quantity	-	900 MT
b)	Value	-	Rs. 6075000

Approximate power requirement : 75 H.P.

Pollution Control :

This industry come under "Red" Catagory. For the purposes of inspection for implementation of the provisions of various statutes regarding control of pollution and protection of environment, it is proposed to visit a unit by the concerned authorjorities once in six month.

- | | | | |
|----|---|----|---|
| 5 | Gidwaney Brothers
73, Netaji Subhash Road
P.B.No. 2346
Calcutta-1 | 6 | Saboo Engg. Works
Kuchaman Road 341 509
Rajasthan |
| 7 | Hindustan Engg. Company
23/7 Gopallal Tagore Road
Bon Hooghly
Calcutta-700 035 | 8 | D.K. Engg. Works
8, Panchanathala New Road
Balgharia
Calcutta- 700 056 |
| 9 | Perfect Machine Tools Corporation
1 Smith Road
Madras-1 | 10 | St. Vincant Industries
Convent Road
Calicut (Kerala) |
| 11 | Keshab Engg. Works
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P.B.No.378
Bombay 400 005 |
| 13 | Frigmeiras Engineers
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9, Industrial Estate
Kalapi Road
Kanpur 208 021 (UP) |

TUNNEL KILN/SHUTTLE, KILN

- | | | | |
|----|--|----|--|
| 15 | Bengal-Lion (Industrial Furnace) Ltd
27-B, Camac Street
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D-828, New Friends Colony
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Opp. Kothawala Flat, Ashram Road
Ahmedabad- 380 006 | 18 | Uni Fire
16-18, Shakespere Sarani, 4th Floor
Calcutta- 700 071 |
| 19 | N.M. Ceramic Kiln
P.B.No. 30, B-8, Ram Balram Apartment
Kalol (Gujarat) - 382 721 | | |

NAMES & ADDRESS OF RAW MATERIAL SUPPLIERS

- | | | | |
|---|--|---|---|
| 1 | Golachar Pallawad Co
Opp. Rly. Station
Gandhinagar, Ajmer Road
Beawar (Rajasthan)
[Quartz/Felspar] | 2 | Jain Minerals
30 Kishangaahl Koti
Jaiour Road
Ajmer (Rajasthan)
[Felspar/Ball clay] |
| 3 | Jotyia Prakash Mining Works
4, Gupta Bali
Beawar- (Rajasthan)
[Felspar] | 4 | G.L. Minerals Supply Co
6/459, Srreffan Mohalla
Beawar- 305 901
[Felspar/Quartz] |

b)	Electrification and installation charges @ 10% on the cost of machinery	1,00,000
c)	Testing equipments.	30,000
d)	Misc. Tools, dies, Trolleys etc.	50,000
e)	Cost of office equipments	<u>20,000</u>
	Total cost of machinery & equipments	<u>12,00,000</u>

3. **Kilns:**

Ceramic Fibre lined shuttle kiln with two cars, control system oil storage Tank, and two extra cars.	<u>12,50,000</u>
Car dimension	
Setting length - 2850 mm	
Setting width - 1500 mm	
Setting height - 2500 mm	
No. of Burners - 6 Nos.	
H.P. required - 16	
Capacity - 4 to 5 MT per cycle	

4. **Pre-operative expenses :** 50,000

Total Fixed Capital (1+2+3+4) 47,00,000

5. **Working Capital:**

(i) Personal (Wages per month)

Designation	Nos.	Salary/Month(Rs.)	Total salary (Rs.)
Manager cum Ceramist	1	3500	3,500
Supervisor	1	2500	2,500
Accountant	1	2000	2,000
Clerk-cum-typist	1	1500	1,500
Skilled workers	15	1000	15,000
Semi-skilled workers	20	750	19,500
Peon	1	750	750
Watchman	2	750	<u>1,500</u>
			46,250
		Perquisites @ 15% of total salary	<u>6,937</u>
		Total	53,187
		Say	<u>53,000</u>

(ii) Raw materials & Fuel per month

Items	Ind/Imp.	Qty.	Rate (Rs.)	Price (Rs.)
Quartz/silica sand	Ind.	20MT	400/MT	8,000
Felspar	Ind.	25MT	500/MT	12,500
China clay	Ind.	20MT	1200/MT	24,000
Ball clay/Fire clay	Ind.	30MT	500/MT	15,000
Glazing materials	Ind.	2MT	6000/MT	12,000
LDO (fuel)	Ind.	23ML	6500/ML	1,49,000
Kiln furniture	Ind.	LS		4,000
Packing materials	Ind.	LS		<u>9,000</u>
Total cost of raw materials				<u>2,34,000</u>

INTRODUCTION

Crockeryware is most prominent household products which are marketed as per technical specification like Earthenware, Stoneware porcelain.

Bone China is a most sophisticated fine product which requires proper technology in the manufacturing process. Hard porcelain and soft poreclain were earlier produced successfully even on commercial basis. A special variety of poreclain was first introduced in England in 1794 by using tricalcium phosphate as the most fundamental raw material. Great interests was expressed in USA early this century. The important of the use of bone ash as a major constituent in the ceramic body produced a sophisticated ware known as 'Bone China'. Like poreclain, Bone China is a vitrified body having short firing range of biscuit firing. A proper control is the main parameter in Bone Chianware preparation.

Stoneware crockery is the general crockery in India for most of the manufacturers to fulfill the demand of the people. Earthenware crockery which was known as common man's crockery has now disappeared. Poreclain is somehow technically specified wares.

MARKET POTENTIAL

In India crockery units having significant growth in organised as well as SSI sector. In SSI sector, maximum growth has been observed which can fulfill common man's demand. At Khunja (UP), lot of small scale units are producing crockeryware. There are about 600-630 small scale units in UP. Next to UP higher concentration has been observed in Gujarat.

For Gujarat, at Ahmedabad, Thangadh and Himatnagar various crockery units producing stoneware crockerries. There are about 190 small scale units manufacturing crockeryware in Gujarat. After Gujarat, some small scale units are found in Haryana (about 30 units).

As regards to manufacturing capacity, "Hitkari Pottery" of UP producing 60-70 MT monthly production of Bone China. Previously Bansal Pottery was only unit manufacturing Bone Chine in large scale. But, due to various problems the unit is not in a stage now to manufacture this. M/s Crown Ceramics Ltd, Alware in Rajasthan is the only unit mainly manufacturing Bone China. In India, there are about 7-8 units manufacturing Bone Chinaware. The lack in the production of Bone China is due to skilled labour, proper supervision, sophisticated machineries and availability of raw materials, etc. Cost effectiveness is also one of the factor. Maintenance of quality is the prime factor for Bone China crockery. It is luxury household item particularly for rich people and some upper class people. But due to increasing trend and popularity of the items it has become useful in common man's devise also. So there is much demand of the item roughly estimated 10,000 MTs valued about Rs.55-60 crores per annu by the next five years. Besides, it has good export potential.

MANUFACTURING PROCESS

Bone China is a vitufied body best known for translucency. The body composition of Bone China is as follows :

Bone ash	:	45-50%
China clay	:	25-30%
Felspar	:	25-30%
Ball clay	:	5-5%

FINANCIAL ANALYSIS

1. Cost of production (per year)

Total recurring cost	37,80,000
Depreciation on building @ 5%	95,000
Depreciation on machinery & equipment @ 10%	1,20,000
Depreciation on kiln @ 20%	2,50,000
Interest on fixed capital @ 18%	8,40,000
Interest on working capital @ 20%	<u>1,90,000</u>
Total cost of production	<u>52,81,000</u>
2. Turn over (per year)

Items	Qty.	Rate	Value (Rs.)
Ceramic tower packing materials	900 MT	Rs.7500/MT	67,50,000
Less: Rejection 10%			<u>6,75,000</u>
Net turn over			<u>60,75,000</u>
3. Net profit per year (before income tax)

Rs. 60,75,000 - Rs. 52,81,000 = Rs. 7,94,000
4. Net profit ratio - $\frac{7,94,000 \times 100}{60,75,000} = 13\%$
5. Rate of return - $\frac{7,94,000 \times 100}{56,45,000} = 14\%$
6. Break-even Point
 - (i) Fixed cost

a) Total depreciation	4,67,000
b) Total interest	10,36,000
c) 10% of salary	2,54,400
d) 40% of other contingent expenses	45,600
e) 40% of utilities	<u>1,08,000</u>
Total	<u>19,11,000</u>
 - (ii) Net profit per year

7,94,000
 - B.E.P = $\frac{19,11,000 \times 100}{27,05,000} = 70.6\%$

NAMES & ADDRESSES OF MACHINERY SUPPLIERS

- | | |
|--|--|
| <ol style="list-style-type: none"> 1 Amic Industries Pvt. Ltd
80, D, Dr. Suresh Sircar Road
Calcutta- 700 014 3 Lokmanya Engg. work
20, Bharat Khand Cotton Mills Compound
Naroda Road
Ahmedabad-380 010 | <ol style="list-style-type: none"> 2 Modern Engg. & Fabricating Works
Behind Kubeshwar Mahadev
Naroda Road, Ahmedabad 4 Jivanlal Shivilal Panchal
Opp: Old Civil Hospital
Gheekanta Road
Ahmedabad |
|--|--|

When reviewed over electromicroscope anorthite layer is visible. In Bone China body 45% B-tricalcium phosphate, 25% anorthite and 30% glass gives a very good homegenous structure producing sufficient strength and translucency. The translucency is the prime objective of the Bone Chinawares. Mixture of bone ash, felspar and China clay increases translucency due to higher glossyphase. Addition of ball clay should be very limited as it decreases translucency. Translucency is increased by glazzy phase. Fluxing materials is to be added considering on the maturing temperature. Drying and firing shinnase are high for which there is high rejecting manufacturing stage. So all the possible efforts to be needed for man's less rejecting by adopting suitable composition and mode of manufacturing techniques.

RAW MATERIALS

Bone Ash:

It is fundamental constituent in manufacturing Bone Chinaware. Bone ash is prepared from calcined bone. Cattle bones are specially preferred as it is free from iron. The processing of bone is very important. First the bones are crushed, washed and subjected to heat treatment which residual organic matters are removed. With increasing temperature crystal growth occur. Over the temperature range 900°C to 1000°C the crystal side is changed. It is noticed that too rapid a calcination may cause residual carbonaceous matter, which is difficult to remove. High oxidising atmosphere during calcination is preferred.

The calcined bones are finally ground with water in ball mill. Bone ash constituents some plasticity due to finer grain size and organic matter. If the bones are not properly calcined defects like scratches, shrinkage, etc. devbelops. The such ground material is passed over sieves and magnets. To increase the workability of the body the material is aged for about some days where chemical reaction occurs.

After ageing the bone is dried to a moisture contents of 10-15%. The drying of the bone in kiln preferred to remove air from the ground ash.

China Clay:

China clay used in the manufacture of Bone China requires proper washing before use. White burning China clay is preferred. After purification, silica content and Al_2O_3 content ratio should be 45-47% and 35-38% and Fe_2O_3 contents. As less as possible, sometimes 3-5% ball clay is incorporated in the body composition.

Felspar:

It is a flux. It is an isneous mineral containing alumino silicate of Na K or Ca. Felspar is used for introducing nearly insoluble alkalies. Felspar is used in the body and glazes.

LOCATION

The plant can be located in Mehsana, Ahmedabad or in Kachchh districts. Ideal location will be in Bachau taluka of Kachchh district.

COST OF PROJECT

The project envisage to manufacture 150 MT Bone Chinaware crokery with an investment of Rs.1.10 crores.

- | | |
|---|---|
| <p>5 Satya Prakash Mining Works
2, Gupta Gali
Beawar - 305 901
[Felspar]</p> <p>7 Ashwin & Co
Arsodia
Taluka - Idar
Sabarkantha - 383 430
[China clay]</p> <p>9 Venkateswara Ceramics
Dhimadol
West Godavari District (A.P.)
[China Clay]</p> <p>11 Hindustan China Clay Works
Papinacheri
Kerala
[China Clay]</p> <p>13 Tahla Ram & Sons
Rathkhna
Bikaner (Rajasthan)
[Ball Clay]</p> <p>15 R.D. Manihar & Co
Prithviraj Marg
Bikaner (Rajasthan)
[Ballclay/Felspar]</p> <p>17 Multani Minerals
Station Road
Thangadh
Dist. Surendranagar (Gujarat)
[Fire Clay]</p> <p>19 Ceramills Glaze & Zirconium Co
Daulatabad Road
Gurgoan (Haryana)
[Zirconium]</p> <p>21 Ferro Coatings Coldurs Ltd
Post Joka
24 Paraganas, Calcutta - (WB)
[Frits/glazes, colours]</p> <p>23 Dudhan Industries
12, Cement Road
Dehradun (UP)
[Plaster of paris]</p> | <p>6 Oriental Prospecting Co
1680/2, Opp. Desai pol, Khadia
Ahmedabad
[China Clay]</p> <p>8 Swastik China Clay Works
1102/1103, GIDC, Bhuj
Bhuj-Kutch-370 001
[China Clay]</p> <p>10 Bal Krishna Mineral Industries
Ramavaram
East Godavari District (A.P.)
[China Clay]</p> <p>12 Ami Ceramics
Motipur, Himatnagar
Gujarat
[China Clay]</p> <p>14 Sita Ram Rajkumar
Inside Hemalton Ki Bari
Bikaner (Rajasthan)
[Ball Clay]</p> <p>16 Shri Draupadi Devi Ball
Clay Suppliers
Post-Sri Kolaytji
Bikaner - 334 001
[Ball Clay]</p> <p>18 Sompura Pran Shankar & Sons
Thangadh
Dist. Surendranagar (Gujarat)
[Fire Clay]</p> <p>20 Shahzips (P) Ltd
55, Industrial Estate
Nunhal, Agra
[Frits/glazes]</p> <p>22 Rajasthan Plasters & Inds.
Outside Coga Gate
Bikaner
[Plaster of paris]</p> <p>24 Snow-white Industries
40, Mahendra Nagar
Rishikesh
Dehradun (UP)
[Plaster of paris]</p> |
|---|---|

The raw materials bone ash, China clay, ball clay and felspar are proportionately weighed and ground in ball mill in wet condition. Afterwards the slurry is passed through a screen and magnets to a blunger. Then it is passed to filter press for dewatering and passed through a deairing pug mill. The material thus obtained is used for shaping.

Shaping:

The method of shaping consists of plastic making slip casting dry pressing. Flatwares are generally made by disgering cups and simple hollow ware shaping is done by sollying. Roller making has improved the quality of surface. Now-a-days automatic disger solley is used for maximum output and uniform thickness. The hollowwares like tea pots, milk pots, sugar pots and oval shaped dinner sets are made by slip casting process in plaster mould. The latest method of shaping bone china flatwares are by isostatic pressing.

Finishing and Drying:

The finishing operation is same as normal procedure in general crockeryware. Seams are removed by knife carefully sponging for finishing is necessary.

For drying mangle drier is preferred. As far as drying is concerned, the importance of slow and especially even drying cannot be over stressed. Dobbins is another type of dryer incorporated hot airjets are most widely used for bone china.

Biscuit Firing:

The biscuit temperature of bone china lies between 1250°C-1300°C. The firing temperature is very critical. Underfiring leaves open pores and cannot bring translucency. Overfiring cause blistering bloating and distortion.

Biscuits firing done in intermittent shuttle kiln or continuous tunnel kiln. The setting of wares in the kiln each piece must be individually supported and even plate must be placed in a tray with alumina powder and impressed in the correct shape. After biscuiting the ware are stored for glazing.

Glazing & Glost Firing:

Bone Chinaware is glazed with lead borosilicate frit with small percentage of white burning China clay which will act as a suspending agent for the glaze. Colourless transparent glaze is used. Glaze is to be applied on the biscuitwares by dipping or spraying. The maximum firing temperature of glaze for Bone China will be around 1050-1100°C. Bone China glaze will be much more fluid at the maximum temperature than hard porcelain. Glaze firing is done at the temperature much lower than biscuiting. Glost firing is done either in shuttle kiln tunnel kiln, thickness of glass maintains the fundamental factor to avoid defects like blibs or rolling.

Decoration:

On glaze decoration creates good attraction on Bone Chinawares specially at 700-750°C. Decoration is carried out by transfer hand painting and liquid gold decoration.

Constitution, Microstructure & Conditions:

Bone acts as flux but when added excess acts as a refractory. The fluxing action will continue only at 1 to 10. It has been observed that first sometime from bone reacts with China clay to form anorthite, remaining line of bone product β -tricalcium phosphate, lastly P_2O_5 reacts with other materials form glass.

	81,000
Add: perquisites @ 30% of pay	<u>24,300</u>
Total	1,05,000
Say	<u>1,06,000</u>

Raw Materials & Consumables per month:

Item	Qty.	Rate (Rs.)	Amount (Rs.)
1. Bone ash	9 T	25000/T	2,25,000
2. Felspar powder	7 T	700/T	4,900
3. China clay	10 T	1500/T	15,000
4. Plastic clay	0.5 T	800/T	400
5. Calcite powder	200 Kg	2/Kg	400
6. Borax	1 T	50/Kg	50,000
7. Quartz powder	1 T	700/T	700
8. White lead	0.5 T	50/UG	400
9. Plastic pans	3 T	1500/T	4,500
10. Kiln furniture	LS	-	20,000
11. Chemicals	LS	-	20,000
12. Transfer/Decoration	LS	-	10,000
13. Packing materials	LS	-	20,000
14. Light diesel oil	30 KL	6000/KL	<u>1,80,000</u>
	Total		5,75,900
	Say		<u>5,76,000</u>

Other expenditure:

1.	Power charges for machineries: 65KWH	20,000
2.	Power charges for both kilns : 100 M	30,000
3.	Power charges for decoration kiln: 80 M	<u>25,000</u>
	Total	<u>75,000</u>

Contingent expenditure per month:

1.	Postage & stationery	2,000
2.	Consumable stores	4,000
3.	Water	4,000
4.	Repairs and maintenance	6,000
5.	Travelling expenses	4,000
6.	Advertisement/publicity	6,000
7.	Insurance	1,000
8.	Other Misc.	<u>5,000</u>
	Total	<u>32,000</u>

Land and Building:

Land	- 7000 sq.m. @ Rs.60/sq.m.	4,20,000
Built up area	- 2000 sq.m. @ Rs.1500/sq.m.	<u>30,00,000</u>
Total		<u>34,20,000</u>

Machineries & Equipment:

Sr.No.	Description	Nos.	Cost (Rs.)
1.	Ball mill size 6'x4 1/2' with 10 HP motor & accessories	2	2,00,000
2.	Ball mill size 3'x3' with 7.5 HP motor and accessories	2	80,000
3.	Agitator double fan with 5 HP motor and accessories	1	35,000
4.	Screw blunger with 5 HP motor and accessories	2	36,000
5.	Vibroshifter - 1 HP	2	25,000
6.	Magnets	3	9,000
7.	Diaphragm pump stone 6" section	1	32,000
8.	2.5 delivery 2" with 7.5 HP motor and accessories	1	56,000
9.	Filter press. 24 plates. Chamber dia 600 mm with all accessories	1	45,000
10.	Deairing pug mill with vacuum pump motor - 5 HP and accessories	1	40,000
11.	Jigser tolley including 4 HP motor	8	8,000
	Potmill or racer mill including spot size each 4-5 us capacity with 1 HP motor and accessories.	1	55,000
	Electric and installation charges		25,500
	Office equipments		<u>1,25,000</u>
	Benches, trolleys, reclis, spray gum compressor with motor		7,71,500
Total			<u>7,72,000</u>
Say			

Kiln & Dryers :

1.	Push bat tunner, length 85' width 8', height 10' Capacity 1 ton fine crockery item per day including bunner, cooling fan, hydraulic pusher, power 20KW.	2	30,00,000
2.	Frit making furnace	1	1,00,000
3.	Electrical kiln for decoration	1	1,00,000
4.	Mangle drier	2	<u>2,25,000</u>
Total			39,25,000
Say			<u>40,00,000</u>

Salaries & Wages per month:

Designation	Nos.	Pay(Rs.)	Amount (Rs.)
Manager(Technical)	1	6,000	6,000
Administrative Officer	1	3,000	3,000
Supervisors	7	2,000	14,000
Moulder	1	2,500	2,500
Accountant	1	1,000	1,000
Clerk-cum-typist	2	1,000	2,000
Skilled workers	25	1,000	25,000
Unskilled workers	30	750	22,500
Watchmen	3	1,500	4,500
Peon	1	500	<u>500</u>
			81,000

Working Capital Requirement:

Description	Months	Amount (Rs.)
1. Salaries & wages	1	81,000
2. Raw materials	3	17,28,000
3. Utilities	1	75,000
4. Contingencies	1	32,000
5. Work in progress	1/2	1,50,000
6. Finished goods in stock and received	1	<u>6,00,000</u>
	Total	26,66,000
	Say	<u>27,00,000</u>

Total investments :

1. Land and building	34,00,000
2. Machineries & equipment	7,72,000
3. Kilns and driers	40,00,000
4. Working capital	<u>27,00,000</u>
	Total
	1,08,72,000
	Say
	<u>1,10,00,000</u>

Cost of Production per annum:

1. Salaries & wages	9,72,000
2. Raw materials	69,12,000
3. Utilities	9,00,000
4. Other contingencies	3,84,000
5. Depreciation on building @ 20% p.a.	1,50,000
6. Depreciation on machinery	77,000
7. Depreciation on kilns @ 10% p.a.	4,00,000
8. Interest on total investment @ 15% p.a.	<u>7,33,333</u>
	Total
	1,05,28,533
	Say
	<u>1,06,00,000</u>

Total Sales per annum & Profitability:

Bone Chinaware: 150 T @ Rs.1 lakh/T	1,50,00,000
Cost of production per annum	<u>1,06,00,000</u>
	Profit
	<u>44,00,000</u>

Percentage profit on sales : 34%

Percentage profit on investments : 25%

INTRODUCTION

Gujarat has potential of 65.3 million tonnes of China Clay contributing share of about 9.2% and ranking fifth in the field of production. Districts of Sabarkantha, Mehsana and Kachchh are richly endowed with good quality of China Clay. The total reserves in Sabarkantha, Mehsana districts are 62 million tonnes and 2 million tonnes respectively. The production of processed clay is 6700 metric tonnes in the State. Potential locations for beneficiation with modern techniques should be in Sabarkantha district. The adopted methods of mining and beneficiation of China clay are primitive, as compared to the techniques adopted in England, Czechoslovakia and USA. The methods that may render our clays a considerable improvement in quality and bring down the cost of production are available from M/s Mozley Ltd., England.

In paper, kaolin is used as a filler and for coating. As a filler, it is used to fill the interstices of the paper fibres. Kaolin is less expensive than paper pulp and, therefore, effectively lower paper production costs. Kaolin has advantages as high glass, brighteners and low viscosity at high solids contents. Existing units may improve the quality of processed kaolin.

MARKET POTENTIAL

Kaolin is used as coating clay. It imports a smoother surface to the finished paper, improving its affinity for printing ink. Kaolin flows well under critical condition and manages to give a smooth and even film. Its platy structure lends itself particularly to the production of high glass paper.

All coating grades of Kaolin are water washed. Some heat treated kaolin may be used for filling paper where abrasion resistance is required. Paper coating requirement as per BIS (505-1978) is as follows :

- | | | | |
|-------|--|------|--|
| (i) | Residue on 53 Micron
IS sieve - 0.1 (Max.) | (ii) | Particles larger than 10 Microns
in diameter - 5.0 (Max.) |
| (iii) | Particles smaller than 2 Microns
in Max. diameter - 62.0 | (iv) | Relative density at
27/27°C - 2.5 - 2.9 |
| (v) | Loss on drying - 6.0 (Max.) | (vi) | Loss on ignition - 14.0 (Max.) |
| (vii) | Matter soluble in HCl - 2.5 (Max.) | | |
| | CaO - | | |
| | Al ₂ O ₃ - | | |
| | Fe ₂ O ₃ - 0.7 (Max.) | | |
| | Colour reflectance to blue light
wave length 3040 Å - 80.85 | | |

MANUFACTURING PROCESS

Kaolin refining process rely on pasticlesize separation. Mined raw china clay is crushed by stationery raw crusher. Crushed kaolin may be dispersed in soft water to turn into slurry. With the application of hydrocyclone separation, it is possible to produce paper coating grade clay. In this process, traditional methods of processing such as centrifuging, air floating have proved no longer good. The mozley 10 mm hydrocyclone is a high performed small diameter unit offering 50 cut points in the 2 to 5 micron size range. The hydrocyclone, which is injection moulded in polyurethane for good abrasion resistance or PVDF for corrosive applications is fitted in multiples of 60 numbers.

Break even point:**Fixed Cost:**

1.	40% of salary & wages	3,88,000
2.	40% of utilities	3,60,000
3.	40% of other expenses	1,53,000
4.	Depreciation on building	1,50,000
5.	Depreciation on machinery	77,200
6.	Depreciation on kiln	4,00,000
7.	Interest	<u>7,33,333</u>
	Total	23,62,933
	Say	<u>23,63,000</u>

B.E.P

$$\frac{\text{Fixed cost per annum}}{\text{fixed cost per annum} + \text{profit per annum}} \times 100 = 35\%$$

GOVERNMENT POLICIES & PROCEDURES

1. Certificate from Gujarat Pollution Control Board.
2. Industrial Entrepreneurs Memorandum to be filled to Industry Department, Govt. of India, New Delhi.
3. For the production of bone ash, air pollution control equipments are essential.

MACHINERY SUPPLIERS**Kiln Erectors:**

1. M/s Sharma Kiln Tech Ltd
Sharda Complex
Opp. Kothawala Flat, Ashram Road
Ahmedabad-380 006

Ceramic Machinery Suppliers:

1. M/s NM Ceramic Kiln Ltd
P.B. No.30
B-6 Ram Balram Apartments
Kalol - 382 721
2. M/s Dayal Machinery Works
Dariyapur Gate
Ahmedabad - 380 001
3. M/s Lokmanya Engg. Works
26 Bharat Khand Cotton Mill Compound
Naroda Road
Ahmedabad

PLANT & MACHINERY

Sl.No.	Description	Qty.(Nos)	Price (Rs.)
1.	Blunger (3.04 mtrs. dia)	1	25,000
2.	Agitator (5.22/3.48 mtrs)	3	60,000
3.	One Mozley, Hydrocyclone system consisting of two Nos.of Mozley C1030C Assemblies.	60 Nos. hydrocyclones assemblies 2 Nos.	
4.	Two-way inline feed distributor with Trash screen.		
5.	One Feed pressure gauge.		
6.	1 Mtr. long overflow & underflow pipes at the system discharge point.		
7.	Slurry pumps		2,00,000
8.	Miscellaneous		1,00,000
9.	Buell drier		20,00,000

Captive Mines:

The project involves captive mines of china clay of 10 hectares area with 50 tonnes per day output from the mines.

GOVERNMENT POLICY

1. China clay captive mines can be procured from the State Government as per Mineral Concession Amended Rules, 1988 by filing lease applications to the State Government in prescribed forms.
2. Erection of Hydrocyclone assemblies can be done by the firm as per proposal.
3. Before installation of above assemblies, it is advisable to test slurry. In the laboratory, model of the company or pilot model can be erected first.

TECHNOLOGY SUPPLIER & ERECTOR

1. Richart Mozley Ltd
Cardrew, Redruth
Cornwall - TR 15, ISS England
Tel: (0209) 211081
Tlx: 45735 Mozely G
Fax: (0209) 211081

Firm can erect hydrocyclone assemblies after testing slurry in their laboratory.

RISK FACTOR

1. Procurement of captive mines from the State Government will depend upon passing of Mine Plan by IBM, Government of India.
2. Prospected china clay pockets are mostly in the private land, so potential land have to be purchased from the owners.

Mozley high performance 10 mm hydrocyclones each fitted with ceramic lined Vortex finers (3.2 mm) & SPiGOTS (1.5 mm) system will have two-way in-line feed distributor with trash screen. One feed pressure gauge. One meter long overflow and underflow pipes at system discharge points. The individual hydrocyclones screw together in two sections allowing easy replacement of one without disturbing the remainder 10 mm hydrocyclones are a low cost alternative to centrifuges. They offer lower power consumption, more consistent product quality and considerably easier maintenance.

All operated from single feed pump. Desired 30,000 litre slurry with 100 PSI pressure is feed to the assemblies. Hydrocyclone system underflow will separate coating clay slurry which will be dried in a buell drier. Dried clay can be packed in 50 kg. paper bag in packing section.

RAW MATERIAL

Gujarat produces 6% of total china clay of the country. An average 5 lakh tonnes of raw china clay is exploited. Plant can procure its plant feed of 30,00,000 litres slurry from the captive mines. Captive mines can be procured in the Sabarkantha, Mehsana districts. Visnagar, Vijapur area is a clay zone in Mehsana district. Kot, Ransipur, Arsodia, Eklera, Kadoli Davad are potential villages for captive mines. In case of Banaskantha, Aluvas, Dhokanwada of Santalpur taluka is good area for captive purposes.

SUGGESTED LOCATION

Plant can be erected in subsidy area of Mehsana and Sabarkantha district. Ideal location will be Himatnagar in Sabarkantha district, Bhachau in Kachh district.

COST OF PROJECT

The project envisage to operate at an inlet pressure of 100 PSI. The required throughput will be of the order of 30 M³/hr. Plant will treat 3,00,000 litres per day on 10 hrs. operating day basis, involving Rs. 5.0 crores with 20 tonnes per day refined capacity.

		[Rs. in crores]
1)	Land	: 0.02
2)	Plant & Machinery	: 2.00
3)	Capital Money	: 0.80
4)	Captive Mechanised Mines (with mining machinery)	: <u>2.00</u>
Total		: 4.82
Say		: <u>5.00</u>

RESERVES OF VARIOUS MINERALS OF GUJARAT

[In Million Tonnes]

Sl.No.	Name of Mineral	Reserves
1	Attapulgit	N.E
2	Base Metal (Pb, Cu, Zn)	8.50
3	Bauxite	97.00
4	Bentonite	105.00
5	Chalk	57.90
6	China clay	63.00
7	Coal	3.00
8	Dolomite	720.00
9	Fire clay	155.22
10	Fluorite	11.00
11	Graphite	2.06
12	Gypsum	5.85
13	Lignite	700.00
14	Limestone	11,500.00
15	Marble	46.50
16	Nepheline syenite	14.00
17	Plastic clay	N.E
18	Pyrolusite (Manganese ore)	2.50
19	Quartz	4.00
20	Roofing tiles clay	N.E
21	Siderite	4.60
22	Silica sand	N.E

N.E = Not Estimated

3. Recovery of paper coating clay as per BIS standard depends on the genesis of china clay deposit. If the particle size of kaolin is uniform, recovery will be good.
4. Soft water requirement for preparing slurry per day will be 50,000 litres per day with high pressure pump.

PRICE TARIFF OF THE MOZLEY MODELS

	C-1010(Pound) (A) (Lab. Model)	C-1030(Pound)(B) (Pilot Model)
Ex-works UK Price	434.70	6,035.12
CIF Bombay charges	<u>160.00</u>	<u>276.00</u>
	<u>594.70</u>	<u>6,311.12</u>
	<u>10 MM hydrocyclones</u> (Pounds)	<u>1' hydrocyclones</u> (Pounds)
A. Price of system (Ex works UK)	31,050.00	6,920.00
B. CIF charges	2,442.00	2,442.00
C. System commissioning charges	<u>1,630.00</u>	<u>1,630.00</u>
Total	<u>35,122.00</u>	<u>10,992.00</u>
+ Import Duty @ 20%.		

ATTAPULGITE

Location	Muldhari Vallabhipur Bhavnagar (1)	Panvi Vallabhipur Bhavnagar (2)	Polarpur Dhandhuka Ahmedabad (3)	Patna Vallabhipur Bhavnagar (4)	Lunadhra Vallabhipur Bhavnagar (5)
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CHEMICAL COMPOSITION:

Constituents (%)

SiO ₂	21.80	53.43	45.42	54.46	19.18
Al ₂ O ₃	6.03	10.37	10.09	5.83	3.44
Fe ₂ O ₃	3.76	6.20	6.40	4.64	2.24
TiO ₂	0.47	-	-	0.83	0.47
CaO	21.67	2.38	7.55	3.30	23.81
MgO	13.30	11.16	12.83	14.69	15.84
P ₂ O ₅	0.01	0.03	0.01	Ab	-
SO ₃	Ab	0.03	0.01	Ab	Nil
Na ₂ O	0.43	0.28	0.38	0.48	0.18
K ₂ O	0.09	0.36	0.19	0.18	0.03
L.O.I	32.43	15.58	17.28	15.58	33.96

PHYSICAL PROPERTIES:

Moisture at 105°C	4.60	8.34	8.55	7.63	3.77
Specific gravity	2.48	2.21	2.28	2.05	2.21
Liquid limit	-	-	-	-	-
pH 30°C	10.65	9.05	9.80	8.40	10.10
Gel value	10.00	11.00	10.00	10.00	9.00
Swelling index	10.00	12.00	18.00	7.50	9.00
Base exchange cap.Meq/100 gm.	18.04	20.15	37.61	3.28	15.84
Viscosity 600 RPM	-	-	-	-	-
Exchangeable Ca ⁺⁺ ion	0.12	0.15	0.28	0.08	0.15

PRODUCTION OF VARIOUS MINERALS OF GUJARAT

[Quantity in Tonnes]

Sl.No.	Mineral	1990-91	1991-92	1992-93	1993-94*	1994-95*
1.	Attapulgit	-	-	-	-	-
2.	Bauxite	8,65,852	8,16,800	5,86,445	8,49,674	6,08,430
3.	Bentonite	2,04,124	2,33,148	2,44,831	2,73,448	2,65,464
4.	Chalk	1,33,613	1,28,518	1,04,106	1,10,827	1,08,114
5.	China clay	29,239	27,505	43,427	46,034	48,621
6.	Dolomite	4,23,363	3,78,628	3,26,026	3,00,126	3,16,340
7.	Fire clay	2,25,406	2,25,340	1,36,593	1,51,309	1,65,817
8.	Fluorite	1,30,094	1,23,768	1,51,726	1,20,524	1,73,418
9.	Graphite	-	-	-	-	-
10.	Lignite	23,22,370	32,67,562	32,97,245	38,39,479	33,11,026
11.	Limestone	82,35,884	80,75,870	76,25,403	98,41,049	91,25,007
12.	Nepheline synite	NP	NP	NP	NP	NP
13.	Plastic clay	11,509	10,548		9,410	6,800
14.	Pyrolusite ore (Manganese ore)	-	645	13,500	9,116	3,500
15.	Quartz	20,519	17,743	8,145	8,364	10,895
16.	Roofing tiles clay (Pipe clay)	4,699	5,424	2,856	3,047	2,612
17.	Sidernite	NP	NP	NP	NP	NP
18.	Silica sand	1,37,756	1,46,310	1,38,112	1,43,510	2,20,235

N.P = No Production

* Provisionsl

BAUXITE

Ref.No.	Lab/91-/92/ D-3	Lab/91-92/ D-6	Lab/91-92/ D-5	Lab/92-/92 D-9	Lab/91-92/ D-14
Location:	Ajad-Tapu Jamkham- bhaliya Jamnagar	Ajad-Tapu Jamkham- bhaliya Jamnagar	Ajad-Tapu Jamkham- bhaliya Jamnagar	Lamba Kalyanpur Jamnagar	Lamba Kalyanpur Jamnagar

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	2.01	2.59	1.80	23.77	15.15
Al ₂ O ₃	55.05	59.81	61.42	47.51	51.23
Fe ₂ O ₃	9.52	1.38	1.08	1.44	2.52
TiO ₂	2.50	2.83	2.50	3.66	3.25
CaO	0.28	0.14	0.14	0.14	0.43
MgO	Ab	0.06	Ab	0.05	0.47
P ₂ O ₅	0.09	0.04	0.09	0.07	0.07
SO ₃	Ab	0.08	Ab	0.06	Ab
MnO	0.01	0.01	0.01	0.01	0.01
Na ₂ O	0.79	0.56	0.78	0.68	0.15
K ₂ O	0.03	0.01	0.03	0.01	0.05
L.O.I	29.83	32.61	32.49	22.55	25.87

Ref.No.	M-118/1-A	M/67/1C	M-79/1B	JBS M/30	JSM-M 33
Location:	Mewasa Kalyanpur Jamnagar	Mewasa Kalyanpur Jamnagar	Mewasa Kalyanpur Jamnagar	Mewasa Kalyanpur Jamnagar	Mewasa Kalyanpur Jamnagar

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	0.84	2.71	3.22	2.64	1.85
Fe ₂ O ₃	0.24	2.40	2.52	2.40	2.80
Al ₂ O ₃	60.28	58.05	59.98	62.18	62.12
TiO ₂	3.16	1.72	1.89	2.62	4.17
CaO	0.42	3.35	3.63	Tr	1.01
MgO	Tr	Tr	Tr	Tr	Tr
L.O.I	32.02	30.57	30.05	30.26	28.00
Total	98.96	98.80	99.29	100.00	99.95

(1)	(2)	(3)	(4)	(5)
MINERAL COMPOSITION (X-ray diffraction) :				
The sample contains Dolomite associated with Attapulgitic. It also contains Calcite & Quartz as impurities.	The sample contains Attapulgitic and impurities of Dolomite & Calcite.	The sample contains Attapulgitic and impurities of Dolomite & Calcite.	The sample contains mainly Attapulgitic some Dolomite and little Quartz also present.	The sample contains Dolomite is associated with Attapulgitic. It also contains Quartz & Calcite as impurities.
THERMAL BEHAVIOR - DTA :				
Endothermic peak at 120°C, 240°C (Sh), 770°C, 830°C Exothermic peak no clear peak was obtained. Sample contains Dolomite associated with Attapulgitic.	Endothermic peak at 125°C, 245°C 450°C Exothermic peak abroad at 855°C peak temp. suggest that the sample contains Attapulgitic.	Endothermic peak at 125°C, 240°C 450°C, 755°C Exothermic peak abroad & small at 850°C peak temp. suggest that the sample contains Attapulgitic & Calcite.	Endothermic peak at 125°C, 245°C 450°C, 700°C Exothermic peak at 850°C. Sample contains Attapulgitic and small quantity of Calcite.	Endothermic peak at 125°C, 240°C 755°C, 830°C Exothermic peak very small hump at 850°C. Sample contains Attapulgitic & Dolomite.
INFRARED SPECTROSCOPY :				
Sample contains Attapulgitic and impurities of Calcite & Quartz.	Sample contains Attapulgitic and impurities of Calcite Dolomite & Quartz.	Sample contains Attapulgitic and impurities of Dolomite & Quartz.	Sample contains Attapulgitic with impurities of Calcite Dolomite & Quartz.	Sample contains Attapulgitic and impurities of Calcite & Quartz.
ELECTRON MICROSCOPY :				
Clay sample was examined at 1400 magnification. Electron micrograph showed well formed needles with sharp edges perfect parallel growth and particles are bound to aggregates shows the presence of Attapulgitic.	Clay sample was examined at 3100 magnification. Electron micrograph showed well formed needles with sharp edges perfect parallel growth and particles are bound to aggregates shows the presence of Attapulgitic.	N.D.	Clay sample was examined at 5250 magnification. Electron micrograph showed well formed needle with sharp edges, perfect parallel growth and particles are bound to aggregate shows the presence of Attapulgitic.	Clay sample was examined at 11000 magnification. Electron micrograph showed the fibrous structure shows the presence of Attapulgitic.

BENTONITE

Ref.No.	VGM-11	VGM-16	VGM-17	VGM-23	VGM-24
Location:	Budhel	Thordi	Thordi	Thordi	Thordi
	Bhavnagar	Bhavnagar	Bhavnagar	Bhavnagar	Bhavnagar

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	48.18	46.61	48.56	40.97	47.17
Al ₂ O ₃	23.87	19.37	20.75	12.97	18.95
Fe ₂ O ₃	5.36	10.88	12.00	16.08	15.60
Ti ₂ O ₃	4.27	3.45	3.95	3.45	3.25
CaO	3.30	4.80	3.30	1.24	1.63
MgO	1.16	0.72	1.07	1.30	0.24
P ₂ O ₅	0.26	0.03	0.05	0.16	Ab
SO ₃	0.14	0.05	0.13	6.05	0.08
Na ₂ O	2.30	2.10	2.00	2.40	1.50
K ₂ O	0.30	0.13	0.13	0.75	0.28
L.O.I	10.29	10.61	8.56	13.34	11.00

PHYSICAL PROPERTIES :

Moisture at 105°C	6.97	9.77	9.45	8.35	6.44
Specific gravity	2.44	2.43	2.47	2.51	2.50
Liquid limit	593.60	302.00	500.00	547.50	494.50
pH 30°C	10.30	10.10	9.70	9.55	10.05
Gel value	15.00	17.00	21.00	10.00	9.00
Swelling index	24.00	12.00	21.00	29.00	23.00
Base exchange	51.74	71.42	74.59	68.90	51.48
cap.meq/100 gm.					
Viscosity					
(a) 600 RPM	58.00	19.00	18.50	18.00	13.50
(b) 300 RPM	50.00	13.00	10.50	11.00	9.00
Filter loss ml.	24.00	24.00	24.00	18.50	25.50
Exchangeable	0.08	0.33	0.17	0.15	0.16
ca++ion					

Ref.No.	PMC/37(KT-9)	0/2(71-72)	0/6(71-72)	0/20(71-72)	0/22(71-72)
Location:	Lala Talav Nakhatrana Kachchh	North Fulra Lakhapat Kachchh	South Fulra Lakhapat Kachchh	Panandro Lakhapat Kachchh	Panandro Lakhapat Kachchh

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	1.03	3.62	3.13	15.50	8.20
Al ₂ O ₃	59.05	60.96	60.33	51.50	50.47
Fe ₂ O ₃	1.43	2.40	1.04	3.80	5.76
TiO ₂	6.47	2.40	3.04	4.96	0.96
CaO	0.14	0.83	0.21	0.20	6.37
MgO	0.08	Trace	Trace	Trace	Trace
P ₂ O ₅	Ab	Nd	Nd	Nd	Nd
SO ₃	Ab	Nd	Nd	Nd	Nd
MnO	Ab	Nd	Nd	Nd	Nd
Na ₂ O	0.33	Nd	Nd	Nd	Nd
K ₂ O	0.03	-	Nd	Nd	Nd
L.O.I	28.25	28.81	31.68	23.90	27.30

Ref.No.	VMG-43 (89-90)	JVB/(87- 88)ABDS/ 88/18	JVB/(87- 88)ABDS/ 88/19	JVB/(87- 88)ABDS/ 462/10	JVB/(87- 88)ABDS/ 471/12	JVB/(87- 88)ABDS/ 480/16
Location:	Talgajarda Bhavnagar	Khanpur Kapadvanj Kheda	Khanpur Kapadvanj Kheda	Ambaliyara Sabarkantha	Ambaliyara Sabarkantha	Ambaliyara Sabarkantha

CHEMICAL COMPOSITION:

Constituents (%)

SiO ₂	9.04	4.70	2.40	6.79	3.35	6.03
Al ₂ O ₃	50.65	55.74	42.63	47.59	42.69	43.03
Fe ₂ O ₃	1.44	4.84	22.88	11.40	9.64	13.04
TiO ₂	4.16	3.17	6.68	5.11	10.23	12.94
CaO	4.97	0.07	0.21	1.58	5.00	0.27
MgO	0.05	0.17	0.06	0.32	0.45	0.10
P ₂ O ₅	0.02	Nd	Nd	Nd	Nd	Nd
SO ₃	0.80	Nd	Nd	Nd	Nd	Nd
MnO	0.03	Nd	Nd	Nd	Nd	Nd
Na ₂ O	0.18	0.85	0.40	0.38	0.58	0.33
K ₂ O	0.10	0.03	0.10	0.03	0.05	0.03
L.O.I	28.85	30.39	24.28	26.29	27.96	24.49

(1)	(2)	(3)	(4)	(5)
MINERAL COMPOSITION (x-ray Diffraction) :				
The sample contains mainly Kaolinite, Montmorillonite & Quartz.	The sample contains mixture of Montmorillonite Calcite, Quartz & Anatase.	The sample contains mainly Montmorillonite, Kaolinite little quantity of Hematite & Rutile.	The sample contains mainly Natrojarosite Montmorillonite and Anatase.	The sample contains mainly Quartz, Montmorillonite Kaolinite and little quantity of Anatase.
THERMAL BEHAVIOR - DTA :				
Endothermic peak at 120°C 530°C, 700°C exothermic hump at 955°C Sample contains Montmorillonite and small amount of Calcite & Kaolinite.	Large Endothermic peak at 130°C, 510°C 720°C, 850°C No clear exothermic peak was obtained hump at 900°C Sample contains Montmorillonite and Calcite.	Large Endothermic at 125°C, 510°C Exothermic hump at 900°C. These peaks are characteristic of Montmorillonite.	Large Endotherm at 120°C 610°C No clear exothermic peak was recorded on thermogram sample contains Montmorillonite.	Medium Endotherm at 115°C 285°C, 510°C slight exothermic hump at 950°C sample contains Montmorillonite & small amount of Goethite & Kaolinite.
INFRARED SPECTROSCOPY :				
Sample mainly contains Montmorillonite Kaolinite, Silica and Rutile are present as impurities.	Sample contains Montmorillonite Quartz, Kaolinite & Calcite are present as associated minerals	Sample contains mainly soil Montmorillonite, Kaolinite & Quartz are present as impurities.	N.D	N.D
ELECTRON MICROSCOPY :				
The sample was examined at 2400, 3100, 000 magnification. The electron micrograph showed very thin irregular lamellae of different sizes. These lamellae confirm the presence of montmorillonite.	The sample was examined at 4000 magnification. The electron micrograph showed very thin irregular lamellae of different sizes. These confirms the presence of montmorillonite.	The sample was examined at 4000, 11000, 14000 & 18000 magnification. The electron micrograph showed very thin irregular lamellae of different sizes. These lamellae confirm presence of montmorillonite.	The sample was examined at 2400, 11000 & 14000 magnification. The electron micrograph showed very thin irregular lamellae of different sizes. These lamellae confirm the presence of Montmorillonite.	The sample was examined at 2400, 3100, 5000 magnification. The electron micrograph showed thin platy particles without characteristic features and it also showed feather like appearance confirming the presence of mixture of soil, Montmorillonite and Montmorillonite.

Ref.No.	VGM-38	VGM-31	VGM-40	VGM-52	VGM-53
Location:	Mathavada Talaja Bhavnagar	Mathavada Talaja Bhavnagar	Mathavada Talaja Bhavnagar	Otha Mahuva Bhavnagar	Otha Mahuva Bhavnagar

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	56.14	47.94	49.29	40.81	50.33
Al ₂ O ₃	17.17	22.97	18.97	16.05	24.18
Fe ₂ O ₃	9.72	11.04	10.88	26.56	7.04
TiO ₃	2.15	2.30	1.65	1.56	1.81
CaO	0.96	1.10	3.02	1.64	1.92
MgO	2.36	2.38	3.61	1.57	2.71
P ₂ O ₅	0.63	0.01	0.02	0.01	0.02
SO ₃	Ab	Ab	Ab	Ab	Ab
Na ₂ O	2.10	1.05	1.25	1.23	1.60
K ₂ O	0.68	0.38	0.68	0.23	0.28
L.O.I	7.66	9.41	9.42	9.94	10.12

PHYSICAL PROPERTIES :

Moisture at 105°C	11.25	9.63	10.06	10.52	9.74
Specific gravity	2.39	2.45	2.46	2.35	2.25
Liquid limit	539.40	357.00	373.00	394.00	568.75
pH 30°C	10.00	9.40	10.00	9.45	10.00
Gel value	14.00	10.00	10.00	5.00	6.00
Swelling index	30.00	32.00	23.00	24.00	30.00
Base exchange cap.meq/100 gm.	85.26	72.28	73.32	67.34	70.20
Viscosity					
(a) 600 RPM	17.50	6.50	11.00	-	37.00
(b) 300 RPM	11.00	3.50	7.00	-	27.50
Filter loss ml.	23.00	23.00	29.00	-	22.00

(1)	(2)	(3)	(4)	(5)
MINERAL COMPOSITION (x-ray Diffraction) :				
The sample contains mainly Montmorillonite, Quartz & Anatase.	The sample contains mainly Montmorillonite, Hematite, Quartz and little quantity of Rutile.	The sample contains mainly Montmorillonite, Kaolinite, Quartz, little quantity of Calcite and Hematite.	The sample contains mixture of Montmorillonite, Goethite, Kaolinite, Quartz and Anatase.	The sample contains mainly Montmorillonite, Kaolinite, Quartz, Calcite.
THERMAL BEHAVIOR - DTA :				
Endothermic 130°C, 175°C 500°C, Exothermic hump at 900°C. Sample contains Montmorillonite and Goethite.	Endothermic 125°C, 515°C Exothermic hump at 910°C. Sample contains Montmorillonite and Quartz.	Endothermic 130°C, 515°C Exothermic hump at 900°C. Sample contains Montmorillonite.	Endothermic 140°C (broad) 285°C, 515°C broad. Exothermic hump at 900°C. Sample contains Montmorillonite.	Endothermic 145°C (broad) 530°C, Exothermic hump at 925°C. Sample contains Montmorillonite and small amount
INFRARED SPECTROSCOPY :				
Sample mainly contains Montmorillonite. Kaolinite, Silica, Rutile and Calcite are present as impurities.	Sample contains mainly Montmorillonite. Silica, Kaolinite & Rutile are present as impurities.	Sample contains mainly Montmorillonite. Silica, Kaolinite, Rutile & Calcite are present as impurities.	Sample contains mainly Montmorillonite. Silica, Kaolinite and Rutile are present as impurities.	Sample contains mainly Kaolinite, Montmorillonite. Calcite, and Rutile are present as impurities.
ELECTRON MICROSCOPY :				
The sample was examined at 1400 & 5000 magnification. The electron micrograph showed very thin lamellae of different sizes, which confirms the presence of montmorillonite.	The sample was examined at 1800, 4000 & 18000 magnification. The electron micrograph showed very thin lamellae of different sizes, which confirms the presence of montmorillonite.	The sample was examined at 2400, 14000, & 31000 magnification. The electron micrograph showed very thin irregular lamellae of different sizes which confirms presence of Montmorillonite. Few elongated bundles of Laths are also observed which indicate presence of Attapulgite with Montmorillonite.	N.D	The sample was examined at 5000, 11000 & 24000. The electron micrographs showed very thin irregular lamellae of different sizes, which confirms the presence of Montmorillonite.

Ref.No.	Lab/87-88	Lab/87-88	Lab/87-88	Lab/88-89	Lab/88-90
	D-32	D-78	D-79	D-13	D-14
Location:	Murchabana	Saran	Hamla	Kharoda	Saran
	Lakhpatt	Lakhpatt	Mandvi	Lakhpatt	Lakhpatt
	Kachchh	Kachchh	Kachchh	Kachchh	Kachchh

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	48.22	53.91	50.97	54.22	53.98
Al ₂ O ₃	14.35	16.64	17.94	14.38	14.63
Fe ₂ O ₃	15.12	13.20	12.36	14.64	14.72
TiO ₂	2.87	3.16	0.95	2.83	3.00
CaO	0.87	1.07	3.61	1.32	1.32
MgO	2.74	2.43	3.33	2.15	2.12
P ₂ O ₅	0.06	N.D.	N.D.	N.D.	N.D.
SO ₃	1.06	N.D.	N.D.	Ab.	Ab.
Na ₂ O	3.30	2.50	1.65	1.80	1.80
K ₂ O	0.15	0.05	0.02	0.05	0.05
L.O.I	10.29	6.49	9.01	7.87	7.56

PHYSICAL PROPERTIES :

Moisture at 105°C	12.03	12.64	10.84	11.87	9.47
Specific gravity	2.56	2.51	2.56	2.52	2.63
Liquid limit	335.00	516.00	307.00	546.50	593.00
pH 30°C	8.70	8.95	10.10	9.20	9.00
Gel value(%)	100.00	99.00	86.00	60.00	71.00
Swelling index ml	23.00	27.00	20.00	28.50	32.00
Base exchange	87.36	82.32	86.56	87.36	83.22
cap.meq/100 gm.					
Viscosity					
(a) 600 RPM	79.00	149.00	42.00	176.00	152.00
(b) 300 RPM	73.00	141.00	45.00	166.00	139.00
Filter loss ml.	21.00	16.00	20.00	17.50	19.00
Exchangeable	0.48	0.50	0.58	0.43	0.53
Ca++ion					

(1)	(2)	(3)	(4)	(5)
MINERAL COMPOSITION (x-ray Diffraction) :				
The sample contains mainly Montmorillonite confirmed by glycol treatment.	The sample contains mainly Montmorillonite confirmed by glycol treatment.	The sample contains mainly Montmorillonite confirmed by glycol treatment. It contains Cancite as associated mineral.	The sample contains mainly Montmorillonite confirmed by glycol treatment. It contains Quartz and Anatase as associated mineral.	The sample contains mainly Montmorillonite confirmed by glycol treatment. It contains Attapulgite and Anatase as associated mineral.
THERMAL BEHAVIOR - DTA :				
Endothermic peak 145°C, 320°C. Exothermic peak 950°C. Sample contains Montmorillonite.	Endothermic peak 148°C, 500°C, 602°C. Exothermic peak 950°C. Sample contains Montmorillonite.	Endothermic peak 145°C, 500°C, 730°C. Exothermic peak 950°C. Sample contains Montmorillonite.	Endothermic 145°C, 520°C. Exothermic peak 950°C. Sample contains Montmorillonite.	Endothermic peak 140°C, 525°C. Exothermic peak 950°C. Sample contains Montmorillonite.
INFRARED SPECTROSCOPY :				
Sample mainly contains Montmorillonite. Quartz & Attapulgite are present as associated mineral.	Sample contains mainly Montmorillonite. Quartz & Attapulgite are present as associated mineral.	Sample contains mainly Montmorillonite. Quartz & Attapulgite are present as associated mineral.	Sample contains mainly Montmorillonite. Quartz & Attapulgite are present as associated mineral.	Sample contains mainly Montmorillonite. Quartz and Attapulgite are present as associated mineral.
ELECTRON MICROSCOPY :				
The sample was examined at 26500, 12500 & 10750 magnification. The electron micrograph showed thin platy lamellae particles which shows presence of montmorillonite.	The sample was examined at 10000, 26500 & 6000 magnification. The electron micrograph showed very thin lamellae of different sizes, which shows the presence of montmorillonite.	The sample was examined at 6000, 10000, & 27500 magnification. The electron micrograph showed very thin lamellae of different sizes, which confirms presence of Montmorillonite.	The sample was examined at 16250 & 94500 magnification. Electron micrograph showed very thin irregular lamellae of different sizes and particles. Cleavage plane with pseudo hexagonal particle shows the presence of mixture of Montmorillonite and Kaolinite.	The sample was examined at 1650 & 10000. The electron micrographs showed very thin irregular lamellae of different sizes, which shows the presence of Montmorillonite.

Ref.No.	Lab/91-92	Lab/91-92	Lab/91-92	Lab/92-93	Lab/92-93
	D-234	D-238	D-239	D-2	D-3
Location:	Tajpuri	Derol	Tajpuri	Pathari	Kapadvanj
	Himatnagar	Himatnaga	Himatnagar	Gandevi	Kapadvanj
	Sabarkantha	Sabarkantha	Sabarkantha	Bulsar	Kapadvanj

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	65.19	57.12	57.62	36.30	54.64
Al ₂ O ₃	14.38	20.05	15.37	26.32	12.12
Fe ₂ O ₃	5.36	8.52	10.00	18.60	12.72
TiO ₃	3.73	3.24	3.89	5.67	2.50
CaO	0.85	0.62	0.97	0.56	5.25
MgO	Ab	0.37	0.32	Ab	0.11
P ₂ O ₅	0.03	0.06	0.11	0.05	0.12
SO ₃	0.03	0.11	0.63	Ab	0.10
Na ₂ O	0.28	1.00	2.10	0.84	1.16
K ₂ O	0.70	0.47	0.55	0.03	0.80
L.O.I	8.63	7.20	7.27	11.76	9.48

PHYSICAL PROPERTIES :

Moisture at 105°C	14.21	12.62	5.38	13.22
Specific gravity	2.65	2.70	2.93	2.82
Liquid limit	195.50	-	-	89.00
pH 30°C	9.00	9.20	8.80	9.70
Gel value(%)	50.00	10.00	13.00	14.00
Swelling index	18.00	10.00	13.00	14.00
Base exchange cap.meq/100 gm.	47.04	-	-	23.03

(1)	(2)	(3)	(4)	(5)
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MINERAL COMPOSITION (x-ray Diffraction) :

The sample contains mainly Quartz and accessory mineral are Kaolinite & Anatase.	The sample contains mainly Quarts and accessory minerals are Montmorillonite, Kaolinite and Anatase.	The sample contains mainly Quartz & accessory minerals are Montmorillonite, Kaolinite and Anatase.	The sample contains mainly Quartz & accessory minerals are Kaolinite, Anatase and Calcite.	The sample contains mainly Quarts and accessory minerals are Kaolinite, Calcite and Montmorillonite.
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THERMAL BEHAVIOR - DTA :

Endothermic peak at 110°C, 520°C, 570°C. Broad Exothermic peak at 940°C. Sample contains disordered Kaolinite and small amount of Montmorillonite and Quarts.	Endothermic peak at 115°C, 510°C, 570°C. Exothermic peak at 900°C. Sample contains Montmorillonite & Quartz.	Endothermic peak at 125°C, 510°C, 580°C. Exothermic broad peak at 900°C. Sample contains Montmorillonite & Quartz.	Endothermic 100°C, 320°C, 525°C, 565°C. Exothermic peak at 930°C. Sample contains disordered Kaolinite & some amount of Gibbsite and Quartz.	Endothermic 120°C, 300°C, 500°C, 570°C, 750°C. Exothermic peak. No clear peak is observed. Sample contains Montmorillonite, Quartz, Calcite and Goethite.
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Ref.No.	S/1	S/12	S/24	S/25	S/28
Location:	Asotamota	Asotamota	Asotamota	Asotamota	Asotamota
	Kalyanpur	Kalyanpur	Kalyanpur	Kalyanpur	Kalyanpur
	Jamnagar	Jamnagar	Jamnagar	Jamnagar	Jamnagar

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	47.61	44.45	46.72	48.28	48.02
Al ₂ O ₃	15.06	16.59	13.98	16.99	15.83
Fe ₂ O ₃	15.20	14.04	14.28	16.60	16.92
Ti ₂ O ₃	1.04	0.87	1.04	1.21	1.75
CaO	2.42	1.71	2.00	1.68	2.04
MgO	4.47	1.47	4.15	4.19	5.19
P ₂ O ₅	N.D	N.D	N.D	N.D	N.D
SO ₃	N.D	N.D	N.D	N.D	N.D
Na ₂ O	2.30	1.63	1.00	1.30	1.60
K ₂ O	0.10	0.10	0.08	0.05	0.04
L.O.I	10.26	18.95	16.65	10.16	8.76

PHYSICAL PROPERTIES :

Moisture at 105°C	10.28	12.13	14.35	12.54	10.80
Specific gravity	2.30	2.18	2.42	2.02	2.21
Liquid limit	176.00	180.00	202.00	349.50	150.00
pH 30°C	9.05	8.90	9.60	9.65	9.35
Gel value	32.00	22.00	18.00	30.00	16.00
Swelling index	26.50	22.00	22.00	27.00	14.00
Base exchange cap.meq/100 gm.	97.92	87.36	97.92	94.08	97.00

Ref.No. Location:	S/4 Hadamatia Amreli	S/9 Chhapari Amreli	S/12 Kadial Amreli	S/19 Khambharia Amreli	S/20 Khambha- ria, Amreli
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CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	54.55	66.60	46.31	54.36	54.47
Al ₂ O ₃	12.64	13.05	16.55	15.16	15.79
Fe ₂ O ₃	15.20	3.16	7.60	10.56	10.08
Ti ₂ O ₃	2.71	0.39	4.85	2.33	2.33
CaO	1.55	5.36	7.05	1.95	3.07
MgO	3.45	Tr	1.19	3.61	3.58
P ₂ O ₅	-	-	-	-	-
SO ₃	-	-	-	-	-
Na ₂ O	2.30	1.00	2.22	2.16	2.00
K ₂ O	0.40	0.86	0.80	1.26	1.12
L.O.I	5.90	9.05	13.00	7.19	7.00

PHYSICAL PROPERTIES :

Moisture at 105°C	8.17	6.96	7.70	10.14	8.66
Specific gravity	2.34	2.01	2.18	2.21	2.40
Liquid limit	418.00	91.00	265.00	378.00	435.00
pH 30°C	9.60	10.00	10.30	9.80	10.20
Gel value	54.00	16.00	31.00	41.00	44.00
Swelling index	24.00	45.00	17.00	24.00	23.00
Base exchange cap.meq/100 gm.	78.25	81.25	58.25	84.75	79.75
Na/Ca Ratio	1.54	0.19	0.33	1.17	0.68

Ref.No. Location:	S/1 Asotamota Kalyanpur Jamnagar	S/12 Asotamota Kalyanpur Jamnagar	S/24 Asotamota Kalyanpur Jamnagar	S/25 Asotamota Kalyanpur Jamnagar	S/28 Asotamota Kalyanpur Jamnagar
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CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	47.61	44.45	46.72	48.28	48.02
Al ₂ O ₃	15.06	16.59	13.98	16.99	15.83
Fe ₂ O ₃	15.20	14.04	14.28	16.60	16.92
Ti ₂ O ₃	1.04	0.87	1.04	1.21	1.75
CaO	2.42	1.71	2.00	1.68	2.04
MgO	4.47	1.47	4.15	4.19	5.19
P ₂ O ₅	N.D	N.D	N.D	N.D	N.D
SO ₃	N.D	N.D	N.D	N.D	N.D
Na ₂ O	2.30	1.63	1.00	1.30	1.60
K ₂ O	0.10	0.10	0.08	0.05	0.04
L.O.I	10.26	18.95	16.65	10.16	8.76

PHYSICAL PROPERTIES :

Moisture at 105°C	10.28	12.13	14.35	12.54	10.80
Specific gravity	2.30	2.18	2.42	2.02	2.21
Liquid limit	176.00	180.00	202.00	349.50	150.00
pH 30°C	9.05	8.90	9.60	9.65	9.35
Gel value	32.00	22.00	18.00	30.00	16.00
Swelling index	26.50	22.00	22.00	27.00	14.00
Base exchange cap.meq/100 gm.	97.92	87.36	97.92	94.08	97.00

Ref.No. Location:	S/4 Hadamatia Amreli	S/9 Chhapari Amreli	S/12 Kadial Amreli	S/19 Khambharia Amreli	S/20 Khambha- ria, Amreli
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CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	54.55	66.60	46.31	54.36	54.47
Al ₂ O ₃	12.64	13.05	16.55	15.16	15.79
Fe ₂ O ₃	15.20	3.16	7.60	10.56	10.08
Ti ₂ O ₃	2.71	0.39	4.85	2.33	2.33
CaO	1.55	5.36	7.05	1.95	3.07
MgO	3.45	Tr	1.19	3.61	3.58
P ₂ O ₅	-	-	-	-	-
SO ₃	-	-	-	-	-
Na ₂ O	2.30	1.00	2.22	2.16	2.00
K ₂ O	0.40	0.86	0.80	1.26	1.12
L.O.I	5.90	9.05	13.00	7.19	7.00

PHYSICAL PROPERTIES :

Moisture at 105°C	8.17	6.96	7.70	10.14	8.66
Specific gravity	2.34	2.01	2.18	2.21	2.40
Liquid limit	418.00	91.00	265.00	378.00	435.00
pH 30°C	9.60	10.00	10.30	9.80	10.20
Gel value	54.00	16.00	31.00	41.00	44.00
Swelling index	24.00	45.00	17.00	24.00	23.00
Base exchange cap.meq/100 gm.	78.25	81.25	58.25	84.75	79.75
Na/Ca Ratio	1.54	0.19	0.33	1.17	0.68

Ref.No.	AKB/SKPR/3	D-25	D-87(85-86)
Location:	Sukhpar Surendranagar	Sukhpar Surendranagar	Jiva Surendranagar

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	47.91	46.02	48.00
Al ₂ O ₃	19.70	16.18	22.85
Fe ₂ O ₃	14.20	14.56	10.80
Ti ₂ O ₃	3.66	3.80	3.85
CaO	1.20	1.53	0.68
MgO	3.16	3.68	1.97
P ₂ O ₅	0.03	0.05	N.D
SO ₃	0.02	0.07	0.17
Na ₂ O	2.10	2.30	1.40
K ₂ O	0.25	0.20	0.05
L.O.I	7.20	11.21	9.09

PHYSICAL PROPERTIES :

Moisture at 105°C	12.32	9.38	7.37
Specific gravity	2.72	2.78	2.46
Liquid limit	238.60	315.60	222.00
pH 30°C	9.40	8.40	9.50
Gel value	99.00	100.00	99.50
Swelling index	20.00	24.00	16.00
Base exchange cap.meq/100 gm.	87.04	89.92	71.32

Ref.No.	D-102	BSD-24	BSD-28	BSD-32
Location:	Pedhamli Vijapur Mehsana	Morvad Prantij Sabarkantha	Morvad Prantij Sabarkantha	Morvad Prantij Sabarkantha

CHEMICAL COMPOSITION :

Constituents (%)

SiO ₂	56.53	48.81	60.18	55.52
Al ₂ O ₃	16.96	14.91	16.10	16.65
Fe ₂ O ₃	8.66	20.08	11.32	13.52
Ti ₂ O ₃	2.70	2.16	2.48	2.63
CaO	2.82	1.11	0.63	1.20
MgO	1.47	3.14	1.20	1.61
P ₂ O ₅	0.03	N.D	N.D	N.D
SO ₃	Ab	Ab	Ab	Ab
Na ₂ O	1.10	1.13	1.00	1.10
K ₂ O	0.88	0.42	0.95	0.65
L.O.I	8.19	7.34	6.60	7.27

PHYSICAL PROPERTIES :

Moisture at 105°C	12.32	7.12	4.89	6.83
Specific gravity	2.72	2.57	2.26	2.22
Liquid limit	238.60	224.60	208.20	265.50
pH 30°C	9.40	10.10	9.70	10.30
Gel value	99.00	99.00	99.00	99.00
Swelling index	20.00	14.00	14.00	17.00
Base exchange cap.meq/100 gm.	87.04	45.12	41.57	52.22

CHALK

Ref.No.	RVQ-46	PC-86	RVQ-44	RVQ-64	RVQ-38
Location:	Adityana Ranavav Junagadh	Adityana Ranavav Junagadh	Adityana Ranavav Junagadh	Khajavadri Ranavav Junagadh	Adityana Ranavav Junagadh

CHEMICAL COMPOSITION :

Constituents :

SiO ₂	6.80	5.98	5.76	6.42	6.18
Al ₂ O ₃	1.08	3.42	0.78	0.48	0.54
Fe ₂ O ₃	0.95	0.64	0.87	0.95	0.96
TiO ₂	-	-	-	-	-
CaO	50.19	50.25	50.35	50.88	50.48
MgO	0.59	Tr	1.05	Tr	1.01
P ₂ O ₅	-	-	-	-	-
SO ₃	-	-	-	-	-
MnO	-	-	-	-	-
Na ₂ O	-	-	-	-	-
K ₂ O	-	-	-	-	-
L.O.I	40.60	39.86	39.89	40.74	40.80

CHINA CLAY

Amreli China Clay :

Sl.No.	Properties	Balaniwav/92-93/D-12
1.	Raw colour & impurities	Dull white
2.	Slaking nature	-
3.	Levigated colour	-
4.	Plasticity by hand feel	Fair
5.	% water of plasticity(dry basis)	45.26
6.	Dry shrinkage at 110°C	4.00
7.	Fired properties at 1250°C	
	i. Fired colour	Light cream colour. No cracks, but many brown specks are available.
	ii. Total shrinkage	22.00
	iii. Vitrification	Fair
8.	Fired properties at 1400°C	
	i. Fired colour	Sunshine colour, many cracks are developed like spider web but match due to vitrification.
	ii. Total shrinkage	22.00
	iii. Vitrification	High
9.	Chemical analysis	
	SiO ₂	42.17
	Al ₂ O ₃	37.46
	Fe ₂ O ₃	2.16
	TiO ₂	0.22
	CaO	Ab
	MgO	Ab
	Na ₂ O	0.35
	K ₂ O	0.03
	L.O.I	13.54
10.	Specific gravity	2.66
11.	Particle size :	
	45 Micron	6.2
	40 - 45	0.4
	30 - 40	0.8
	25 - 30	0.8
	20 - 25	1.2
	15 - 20	1.9
	10 - 15	3.0
	8 - 10	1.8
	5 - 8	5.1
	3 - 5	7.3
	2 - 3	6.6
	2	64.9

Mineralogical Composition (X-ray diffraction) :

Sample contains mainly Kaolinite and accessory mineral is Anatase.

Thermal Behaviour - DTA :

Endothermic 530°C sharp. Exothermic peak at 970°C. Sample contains Kaolinite.

Kachchh China Clay :

Sl. No.	Properties	D-59 (83-84) Mamuara (3)	D-58 (83-84) Nadapa (4)	D-43 (84-85) Raminhas- (5)	D-46 (84-85) Gogadian (6)	D-9 (87-88) Kanderai (7)
(1)	(2)					
1.	Raw colour & impurities	White, fairly hard lumps, black particles are visible.	White, fairly hard lumps. Many small black particles are visible. Mica particles also visible.	Salmon pink.	White	White
2.	Slaking nature	Nonslaking	Nonslaking	-	-	-
3.	Levigated colour	-	-	-	-	-
4.	Plasticity by hand feel	Moderate (Moderate to fair)	Moderate (Moderate to fair)	Fair (Moderate to fair)	Moderate to fair	Fair
5.	% water of plasticity (dry basis)	38.50	35.43	28.11	26.81	27.31
6.	Dry shrinkage at 110°C	4.0	4.0	4.0	4.0	5.0
7.	Fired properties at 125°C :					
7.1	Fired colour	White light colour. Very small light brown specks, some cracks visible.	White light colour. Very small light brown specks, some cracks are visible.	Brown colour due to very small brown specks spread on test pieces. No cracks.	White. No cracks occasionally some brown specks.	White colour. No cracks or specks are visible.
7.2	Total shrinkage	19.00	16.00	9.00	7.50	6.00
7.3	Vitrification	None	None	None	None	None
8.	Fired properties at 1450°C :					
8.1	Fired colour	White. Brown specks & many cracks.	White. Many small brown specks, some cracks are visible.	Light salmon pink to brown. No cracks. Many small brown specks.	Yellowish white. Small brown specks. Some cracks.	Champagne colour. No cracks or specks are visible.
8.2	Total shrinkage	21.00	19.00	14.00	10.00	12.00
8.3	Vitrification	Fair	Fair	High	Fair	Fair

(1)	(2)	(3)	(4)	(5)	(6)	(7)
9.	Chemical analysis :					
	SiO ₂	45.43	43.14	61.85	63.28	61.21
	Al ₂ O ₃	35.50	39.43	25.72	24.49	25.84
	Fe ₂ O ₃	0.65	0.40	0.74	0.74	1.04
	TiO ₂	1.58	1.42	1.59	1.82	1.32
	CaO	0.34	0.27	0.20	0.07	0.41
	MgO	Nil	Nil	0.07	0.02	0.10
	Na ₂ O	0.28	0.62	0.41	0.17	0.50
	K ₂ O	0.03	0.03	0.30	0.19	0.63
	L.O.I	13.99	14.16	9.27	8.99	9.10
10.	DTA Endothermic					
	Peak temp.	530°C	530°C	100°C	100°C	
				525°C	530°C	
	Exothermic	985°C	970°C	955°C	980°C	
11.	Constituent	Kaolinite	Kaolinite	Kaolinite	Kaolinite	

Mehsana China Clay :

Sl. No.	Properties	Eklera	Arsodia	Daavad
(1)	(2)	(3)	(4)	(5)
1.	Raw colour & impurities	Pale white with grey grit particles.	Pale white with grey grit.	Pale white with grey grit and felspathic impurities.
2.	Slaking nature	Fair	Fair to quick	Quick
3.	Levigated colour	Yellowish white	Pale white	Pinkish white
4.	Plasticity by hand feel	Good	Good	Good
5.	% water of plasticity (dry basis)	39.21	33.27	33.74
6.	Dry shrinkage at 110°C(%)	6.00	5.00	5.01
7.	Fired properties at 1250°C :			
7.1	Fired colour	White with brown specks.	White	Pale white with small brown patches
7.2	Total shrinkage (%)	16.00	11.00	12.00
7.3	Vitrification	None	None	None
8.	Fired properties at 1450°C :			
8.1	Fired colour	Buff white	White	Pale with full of brown patches.
8.2	Total shrinkages	17.00	14.00	19.00
8.3	Vitrification	Fair	None	Slight

(1)	(2)	(3)	(4)	(5)
9.	Chemical analysis :			
	SiO ₂	46.34	50.34	48.85
	Al ₂ O ₃	32.64	34.52	30.01
	Fe ₂ O ₃	1.12	1.00	1.44
	TiO ₂	1.04	0.50	0.80
	CaO	4.18	0.77	0.32
	MgO	0.31	Tr	1.66
	Na ₂ O	0.22	0.38	-
	K ₂ O	0.36	0.20	0.24
	L.O.I	14.26	11.78	13.90
10.	DTA Endothermic	98°C	65°C	75°C
	Peak temp.	560°C	580°C	565°C
	Exothermic	180°C	225°C	175°C
	peak	992°C	1005°C	1005°C
11.	Dominant mineral	Kaolinite with Halloysite	Kaolinite	Kaolinite
12.	Impurities	Calcite	-	Calcite

Sl. No.	Properties	Kadoli	Kot	Ransipur
(2)	(2)	(3)	(4)	(5)
1.	Raw colour & impurities	Yellowish white salt contains sand material.	Pale white.	Pale white.
2.	Slaking nature	Quick	-	-
3.	Levigated colour	Pale white.	Yellowish white.	White (slightly pinkish).
4.	Plasticity by hand feel	Good	Good	Good
5.	% water of plasticity (dry basis)	35.79	38.90	43.25
6.	Dry shrinkage at 110°C(%)	5.00	6.00	7.00
7.	Fired properties at 1250°C :			
7.1	Fired colour	Pale white rarely very small brown patches, some cracks.	White	White
7.2	Total shrinkage (%)	18.00	13.00	13.50
7.3	Vitrification	None	None	None

(2)	(2)	(3)	(4)	(5)
8.	Fired properties at 1450°C :			
8.1	Fired colour	Greyish white with brown patches. Cracks developed.	Buff white with some brown patches.	White (with buff tinge).
8.2	Total shrinkages	19.00	15.00	20.00
8.3	Vitrification	Fair	Fair	Fair
9.	Chemical analysis :			
	SiO ₂	47.25	48.32	32.65
	Al ₂ O ₃	36.43	31.22	35.68
	Fe ₂ O ₃	0.94	1.10	0.74
	TiO ₂	0.48	0.32	0.33
	CaO	0.56	4.63	3.80
	MgO	0.03	Tr	0.113
	Na ₂ O	0.22	0.18	0.22
	K ₂ O	0.23	0.24	0.06
	L.O.I	13.95	14.05	14.43
10.	DTA Endothermic Peak temp.	70°C	90°C	140°C
	Exothermic peak	570°C	565°C	560°C
		240°C	1000°C	1005°C
11.	Dominant mineral	Kaolinite with Halloysite	Kaolinite Halloysite	Kaolinite Halloysite
12.	Impurities	-	Calcite, Quarts Albite	Calcite, Quartz Albite

Surendranagar China Clay :

Sl. No.	Properties	Bavli	Kankavati	Khod
(1)	(2)	(3)	(4)	(5)
1.	Raw colour & impurities	Fairly hard white lumps.	Fairly hard white brittle lumps.	Moderately hard brittle white & pale white lumps.
2.	Slaking nature	Fair	Moderate	Moderate to fair
3.	pH	8.35	8.50	8.30
4.	BEC Meq/100 gm	6.57	3.55	3.03
5.	Whiteness	69	75	70
6.	Plasticity by hand feel	Moderate	Moderate	Moderate
7.	Water of plasticity % (Dry basis)	26.93	24.22	25.87
8.	Dry shrinkage at 110°C(%)	5.00	3.00	5.00
9.	Atterberg number	25	16	19
10.	Grit content retained on 45 micron sieve %	4.90	29.64	19.80
11.	Fired properties at 1250°C :			
11.1	Fired colour	Pale white with small brown specks.	White with small small brown specks.	White with small small brown specks.

(1)	(2)	(3)	(4)	(5)
11.2	Total shrinkage (%)	9.00	7.00	9.00
11.3	Vitrification	None	None	None
11.4	Water absorption %	11.09	15.11	16.18
12.	Fired properties at 1400°C :			
12.1	Fired colour	Beige	Yellow with brown small specks.	Yellowish brown with brown specks.
12.2	Total shrinkages	13.00	10.50	11.00
12.3	Vitrification	High	Fair	Fair
12.4	Water absorption %	2.16	5.53	6.72
13.	Chemical analysis % :			
	SiO ₂	60.75	64.56	61.72
	Al ₂ O ₃	26.50	24.94	26.44
	Fe ₂ O ₃	1.04	0.88	0.80
	TiO ₂	1.41	1.40	1.41
	CaO	0.13	0.13	0.13
	MgO	0.03	0.03	0.03
	Na ₂ O	0.53	0.53	0.53
	K ₂ O	0.45	0.33	0.23
	L.O.I	9.11	7.43	8.46
14.	Rational analysis % :			
	Kaolinite	61.39	57.61	62.74
	Muscovite	3.83	2.76	1.90
	Albite	4.47	4.41	4.45
	Hematite	1.04	0.80	0.80
	Rutile	1.41	1.40	1.41
	Calcite	0.23	0.23	0.23
	Magnesite	0.06	0.06	0.06
	Free quartz	27.57	32.73	28.41
15.	Particle size analysis %			
	undersize in microns :			
	45	8.60	41.58	30.85
	40-45	1.50	1.60	2.10
	30-40	5.30	5.20	6.10
	25-30	4.30	3.40	4.00
	20-25	5.60	4.00	4.50
	15-20	6.90	4.60	5.50
	10-15	8.50	6.00	6.50
	8-10	4.10	3.20	3.20
	5-8	7.30	4.80	5.10

(1)	(2)	(3)	(4)	(5)
	3-5	5.70	3.00	4.10
	3	42.20	22.62	28.05
16.	DTA Endothermic peak temp.	530°C	528°C	538°C
	Exothermic peak	980°C	985°C	982°C
17.	Dominant mineral	Kaolinite	Kaolinite	Kaolinite
18.	Impurities	Quartz Muscovite.	Quartz Muscovite & Pyrophyllite.	Quartz Muscovite & Pyrophyllite.

DOLOMITE

Ref.No.	SPN/PRP (90-91)/69	SPN/PRP (90-91)/72	SPN/PRP (90-91)/76	VMG-3 (90-91)
Location:	Nageshwar Okhamandal Jamnagar	Rangasar Okhamandal Jamnagar	Rangasar Okhamandal Jamnagar	Shalpur Rd. Bhavnagar Bhavnagar

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	17.19	7.43	5.42	9.72
Al ₂ O ₃	2.70	0.51	0.83	2.08
Fe ₂ O ₃	5.84	4.20	3.88	0.99
TiO ₂	0.13	0.08	0.08	0.08
CaO	24.88	32.17	32.34	29.83
MgO	12.89	13.86	14.24	15.84
P ₂ O ₅	0.31	0.08	Ab	0.01
SO ₃	Ab	0.02	Ab	Ab
MnO	0.32	0.23	0.21	Ab
Na ₂ O	0.35	0.10	0.58	0.25
K ₂ O	0.85	0.33	0.28	0.05
L.O.I	34.33	40.98	42.24	41.12

Ref.No.	Lab/91-92 D-47	Lab/88-89 D-12	Lab/88-89 D-44	Lab/88-89 D-51
Location:	Mathak Anjar Kachchh	Mathak Anjar Kachchh	Vira Anjar Kachchh	Sanghad Anjar Kachchh

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	35.59	26.27	33.52	43.84
Al ₂ O ₃	2.97	2.44	2.05	3.17
Fe ₂ O ₃	2.57	1.95	1.90	1.42
TiO ₂	0.49	0.16	0.25	0.31
CaO	18.21	24.27	21.51	17.55
MgO	11.26	12.12	10.18	8.91
P ₂ O ₅	0.08	Nd	Nd	Nd
SO ₃	0.10	Nd	Nd	Nd
MnO	0.14	Nd	Nd	Nd
Na ₂ O	0.70	0.38	0.76	0.38
K ₂ O	0.68	0.35	0.50	0.29
L.O.I	26.47	31.39	28.20	23.52

Ref.No.	Lab/92-93 D-109	Lab/92-93 D-110	Lab/91-92 D-200	Lab/91-92 D-124
Location:	Vanar Chhotaudepur Vadodara	Jadiyan Chhotaudepur Vadodara	Chathawala Chhotaudepur Vadodara	Moti Lakhwad Tasadan Rajkot

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	3.07	1.02	2.62	6.73
Al ₂ O ₃	1.06	0.07	0.54	0.07
Fe ₂ O ₃	0.48	0.38	1.08	1.74
TiO ₂	Ab	Ab	0.08	0.08
CaO	29.71	29.86	35.37	27.92
MgO	20.57	21.23	15.58	19.33
P ₂ O ₅	Ab	0.07	Nil	0.05
SO ₃	Ab	Ab	Nil	0.03
MnO	0.01	0.03	0.05	1.26
Na ₂ O	0.58	0.60	0.03	0.18
K ₂ O	0.20	0.05	0.01	Ab
L.O.I	44.10	45.88	44.03	42.55

FIRE CLAY

Comparison of Fire Clays from Rajkot District :

Sl. No. (1)	Properties (2)	Vinaygadh (3)	Makansar (4)	Sartanpur (5)
1.	Raw colour & appearance	Grey hard lumps with carbonaceous matter.	Pinkish white	Buff white with pinkish tinge.
2.	Slaking nature	Fair	Slor	Slow
3.	pH	8.30	9.40	8.00
4.	BEC Meq/100 gm	8.84	N.D	N.D
5.	Residue on 150 BS Mesh	6.31	21.80	11.40
6.	Plasticity by hand feel	Fair	Moderate	Fair
7.	Atterberg's Number	13	7	16
8.	Water of plasticity % (Dry basis)	27.08	23.75	25.99
9.	Dry shrinkage at 110°C (%)	6.00	7.00	7.00
10.	Fired properties at 1250°C :			
10.1	Fired colour	Pale white with small brown specks.	White with light small brown specks.	White
10.2	Total shrinkage (%)	10.00	10.00	9.00
10.3	Vitrification	None	None	None
10.4	Water absorption %	13.05	13.74	16.04
11.	Fired properties at 1400°C :			
11.1	Fired colour	Pale white with small brown specks.	Brownish yellow with small brown specks.	Yellowish white with brown specks.
11.2	Total shrinkages	13.00	12.00	11.00
11.3	Vitrification	None	None	None
11.4	Water absorption %	8.01	8.31	8.25

(1)	(2)	(3)	(4)	(5)
12. Chemical analysis % :				
SiO ₂		57.80	63.73	63.50
Al ₂ O ₃		26.21	21.75	23.76
Fe ₂ O ₃		0.84	1.13	1.13
TiO ₂		1.55	1.37	0.86
CaO		0.55	1.56	1.53
MgO		Tr	Tr	Tr
SO ₃		1.17	ND	ND
Na ₂ O		0.24	0.42	0.10
K ₂ O		0.34	0.27	0.41
L.O.I		11.84	9.07	8.70

Comparison of Fire Clays from Sabarkantha District :

Sl.No. (1)	Properties (2)	Himatnagar (3)	Illol (4)	Pedhamli (5)
1.	Raw colour & appearance	Mixture of brownish pink, and yellowish white hard lumps alongwith small micaceous particles.	Light buff red lumps with micaceous particles.	Dark red lumps.
2.	Slaking nature	Non slaking	Non slaking	Non slaking
3.	pH	8.40	6.50	6.80
4.	BEC Meq/100 gm	6.40	ND	ND
5.	Plasticity by hand feel	Low	Poor	Poor
6.	Attenberg's Number	11	7	4
7.	Water of plasticity % (Dry basis)	29.22	24.13	23.00
8.	Dry shrinkage at 110°C (%)	5.50	3.56	4.36

(1)	(2)	(3)	(4)	(5)
9.	Fired properties at 1250°C :			
9.1	Fired colour	Pale to cream white.	Dull white.	Pale white.
9.2	Total shrinkage (%)	10.00	8.12	6.83
9.3	Vitrification	None	None	None
9.4	Water absorption %	13.36	12.91	16.70
10.	Fired properties at 1300°C :			
10.1	Fired colour	Light yellowish brown with grey tinge.	Creamish white.	Buff white.
10.2	Total shrinkages	15.00	9.08	10.20
10.3	Vitrification	Very high	None	None
10.4	Water absorption %	0.20	9.64	10.91
11.	Chemical analysis % :			
	SiO ₂	56.55	55.22	55.00
	Al ₂ O ₃	28.21	25.50	27.17
	Fe ₂ O ₃	2.04	3.10	1.80
	TiO ₂	1.55	2.40	1.75
	CaO	0.55	3.10	2.90
	MgO	Tr	Tr	0.32
	SO ₃	1.57	ND	ND
	Na ₂ O	0.32	1.08	0.34
	K ₂ O	1.56	2.63	2.35
	L.O.I	8.11	6.88	8.27
12.	P.C.E	ND	Between Orton Cone 26-27	Between Orton Cone 29-30

Comparison of Fire Clays from Surendranagar District :

Sl. No.	Properties	Songadh	Mull	Sadla	Sartanpur
(1)	(2)	(3)	(4)	(5)	(6)
1.	Raw colour & properties	Grey coloured medium hard lumps with visible micaceous impurities.	Brownish grey lumps with carbonaceous particles.	Grey lumps with fine micaceous particles.	Dull white lumps with occasional brown specks.
2.	Slaking nature	Fair	Moderate	Moderate	Slow to non-slaking.
3.	pH	6.70	8.30	7.40	7.70
4.	BEC Meq/100 gm	19.80	13.956	12.65	6.04
5.	Residue on 150 BS Mesh	15.19	12.15	8.00	24.99

(1)	(2)	(3)	(4)	(5)	(6)
6.	Plasticity by hand feel	Fair	Fair	Fair	Moderate to fair.
7.	Atterberg's Number	17	15	16	13
8.	Water of plasticity % (Dry basis)	31.18	27.08	27.57	26.29
9.	Dry shrinkage at 110°C(%)	9.00	8.00	8.00	7.00
10.	Fired properties at 1250°C :				
10.1	Fired colour	White with small brown specks.	Yellowish white.	Yellowish white.	White.
10.2	Linear shrinkage (%)	13.00	11.00	11.00	8.00
10.3	Vitrification	None	None	None	None
10.4	Water absorption %	17.36	12.48	12.14	16.59
11.	Fired properties at 1400°C :				
11.1	Fired colour	Light white with yellow tinge with brown specks.	Yellow with grey patches.	N.D	Yellowish white with brown specks.
11.2	Linear shrinkage(%)	15.00	15.00	N.D	10.00
11.3	Vitrification	None	Fair	N.D	14.77
11.4	Water absorption %	12.56	3.72	N.D	14.77
12.	Chemical analysis % :				
	SiO ₂	57.84	61.05	62.85	64.55
	Al ₂ O ₃	21.87	24.22	22.76	24.25
	Fe ₂ O ₃	0.24	0.91	1.12	0.48
	TiO ₂	1.89	0.77	0.62	0.77
	CaO	3.32	1.00	1.14	1.00
	MgO	Tr	Tr	Tr	Tr
	SO ₃	1.58	-	-	-
	Na ₂ O	0.20	0.24	0.52	0.12
	K ₂ O	0.40	0.68	0.60	0.36
	L.O.I	12.54	9.70	9.25	7.65

FLUORITE

Ref.No.	T-1/1	T-1/2	T4-1/3	T-42/1	T-1/5
Location :	Dungargaon Chhotaudepur Vadodara	Dungargaon Chhotaudepur Vadodara	Nanititor Chhotaudepur Vadodara	Nanititor Chhotaudepur Vadodara	Nanititor Chhotaudepur Vadodara

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	41.30	37.60	32.36	37.47	36.04
Al ₂ O ₃	3.74	3.59	1.60	1.19	5.91
Fe ₂ O ₃	5.52	5.68	6.20	6.36	5.44
TiO ₂	12.99	13.74	13.15	11.27	11.42
CaO	27.20	30.27	33.06	32.43	27.76
MgO	2.11	1.82	1.46	0.73	3.56
P ₂ O ₅	Tr	Tr	Nil	Nil	Tr
O \equiv F	5.46	5.77	5.77	4.96	4.80
Na ₂ O	ND	ND	ND	ND	ND
K ₂ O	ND	ND	ND	ND	ND
L.O.I	12.12	12.61	15.01	13.87	15.35

GRAPHITE

Ref. No. Location:	PGD/BH-2/52 Sevaniya Devgadhbaria Panchmahal	PGD/BH-2/53 Sevaniya Devgadhbaria Panchmahal	PGD/BH-2/54 Sevaniya Devgadhbaria Panchmahal
Moisture (%)	1.08	1.25	1.25
Volatile matter %	5.17	6.22	5.12
Ash (%)	62.08	66.87	64.32
Fixed carbon by diff. (%)	31.67	25.66	29.31

LIGNITE

Statement showing details of Lignite deposits of Gujarat State consists of Area, Reserves Quality (Proximate Analysis)

Details	Bhavnagar Lignite Deposits	Surat Lignite Deposits	Jhagadia Lignite Deposits	Panandhro Lignite Deposits
District	Bhavnagar	Surat	Broach	Kachchh
Taluka	Bhavnagar	Mangrol	Jhagadia	Lakhpat
Village	Kharsaliya & 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
Area (Sq.Kms.)	60.00	11.64	3.18	8.2
Reserves (in Million Tonnes)	Over- Reserve burden ratio	Over- Reserve burden ratio	Over- Reserve burden ratio	Over- Reserve burden ratio
	Upto 78.17 1:10	Upto 11.08 1:10	1:9 19.91	94
	1:10 to 40.30 1:15	1:10 to 48.00 1:15		
	1:15 to 50.18 1:20			
	Above 50.90 1:20			
	Total 219.55 i.e. 220.00			
Proximate Analysis (%) :				
Moisture	21.55	18.30	32.50	35.40
Ash	26.40	13.40	12.50	8.10
Volatile matter	35.79	38.90	33.10	30.43
Fixed carbon	17.97	30.20	21.80	22.25
Calorific value(K.Cal/Kg)	4072	4587	3700	4187
Sulphur	1.34 to 6.00	0.22 to 2.00	-	2.5 to 5.4
Ultimate analysis :				
Carbon	29-45.67	50.36	-	61.28
Hydrogen	2.62-3.55	0.03	-	4.87
Sulphur	4.00-6.07	0.36	-	2.05
Nitrogen	0.39-0.60	0.78	-	0.91
Ash analysis :				
SiO ₂	5.76-57.48	10.27-46.96	-	16.26
Fe ₂ O ₃	5.04-52.50	5.36-20.32	-	37.9
Al ₂ O ₃	3.37-37.58	9.42-30.60	-	12.2
CaO	0.54-20.69	5.83-26.75	-	11.0
TiO ₂	0.38-8.25	0.64-3.15	-	-
SO ₃	0.29-26.80	1.89-24.02	-	11.4

Details	Akrimota Lignite deposits		Umarsar Lignite deposits		Matanmadh Lefri Lignite deposits	
District	Kachchh		Kachchh		Kachchh	
Taluka	Lakhapat		Lakhpat		Lakhpat	
Village	Akrimota (120 kms.North West of Bhuj)		Umarsar		Matanomadh & around (100 Kms.North West of Bhuj)	
Area(Sq.Kms.)	3.14		15.00		20.00	
Reserves(in MillionTonnes)	Over- burden ratio	Reserve	Over- burden ratio	Reserve	Over- burden ratio	Reserve
	Upto 1:5	35	1:10	13.70	1:20	33.00
	Upto 1:8	50				

Proximate Analysis (%) :

Moisture	10-15	27.89	11.71
Ash	10-25	12.272	20.05
Volatile matter	30-50	37.98	41.70
Fixed carbon	15-25	21.90	26.20
Calorific value(K.Cal/Kg)	3440-5080	4182	4187
Sulphur	2.5-5.4	2.5-5.4	2.5-5.4

Ultimate analysis :

Carbon	-	-	45.88
Hydrogen	-	-	3.78
Sulphur	-	-	5.40
Nitrogen	-	-	0.50

Ash analysis :

SiO2	20.6	-	-
Fe2O3	21.3	-	-
Al2O3	11.6	-	-
CaO	13.0	-	-
TiO2	-	-	-
SO3	18.5	-	-

LIMESTONE

Ref.No.	Lab/91-92/ D-221	Lab/91-92/ D-225	Lab/91-92/ D-230	Lab/91-92/ D-231	Lab/91-92/ D-23
Location :	Babarkot Jafrabad Amreli	Alidar Kodinar Amreli	Valva Kodinar Amreli	Dolasa Kodinar Amreli	Vakia Babara Amreli

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	18.09	2.27	4.03	3.51	13.22
Al ₂ O ₃	4.09	0.88	1.50	0.83	4.29
Fe ₂ O ₃	3.12	0.88	1.62	1.48	2.56
TiO ₂	0.50	0.08	0.08	0.16	0.17
CaO	40.92	53.05	48.74	50.90	43.84
MgO	0.39	0.41	1.57	1.16	1.66
P ₂ O ₅	0.03	0.12	0.16	0.04	0.12
SO ₃	0.06	0.07	0.11	0.06	Ab
MnO	0.03	Ab	0.04	0.02	0.01
Na ₂ O	0.22	0.15	0.27	0.14	0.40
K ₂ O	0.23	0.14	0.20	0.15	0.28
L.O. I	32.45	42.17	40.74	41.00	33.67

Ref.No.	Lab/91-92/ D-48	OMPDS PRP(90-91)	OMPDS PRP(90-91)	OMPDS PRP(90-91)	OMPDS PRP(90-91)
Location :	Nagpur Kalavad Jamnagar	Okha Okhamandal Jamnagar	Aramda Okhamandal Jamnagar	Mithapur Okhamandal Jamnagar	Lalpur Okhamandal Jamnagar

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	7.08	9.01	0.95	9.81	5.75
Al ₂ O ₃	1.79	0.22	0.97	1.46	0.46
Fe ₂ O ₃	1.82	0.36	0.42	0.61	0.48
TiO ₂	0.08	0.06	0.08	0.16	0.08
CaO	47.82	49.72	53.46	47.32	52.02
MgO	1.14	0.39	0.16	0.91	0.05
P ₂ O ₅	0.03	0.05	0.02	0.11	0.25
SO ₃	0.11	Ab	0.21	0.27	Ab
MnO	0.03	0.01	0.01	0.01	0.03
Na ₂ O	0.25	0.30	0.40	0.60	0.05
K ₂ O	0.15	0.23	0.16	0.36	0.06
L.O.I	38.91	39.41	43.36	38.65	40.60

Ref.No.	Lab/91-92/ D-55	Lab/91-92/ D-45	Lab/91-92/ D-46	Lab/92-/92 D-41	Lab/91-92/ D-90
Location :	Vijapur Junagadh Junagadh	Visavada Porbandar Junagadh	Tukda Miyani Porbandar Junagadh	Lati Veraval Junagadh	Palsva Junagadh Junagadh

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	13.38	3.89	5.46	5.27	7.56
Al ₂ O ₃	3.46	0.79	1.18	0.86	2.33
Fe ₂ O ₃	3.20	0.94	1.08	1.35	1.80
TiO ₂	0.24	0.08	0.08	0.16	0.16
CaO	42.98	52.09	51.09	51.52	48.48
MgO	1.35	0.47	0.46	0.05	0.16
P ₂ O ₅	0.03	0.08	0.09	0.14	0.17
SO ₃	0.03	Ab	Ab	0.04	0.05
MnO	0.07	0.01	0.02	0.04	0.09
Na ₂ O	0.38	0.13	0.13	0.19	0.16
K ₂ O	0.38	0.18	0.13	0.20	0.17
L.O.I	34.52	41.05	40.07	40.35	38.36

Ref.No.	Lab/88-89/ D-85	Lab/91-92/ D-63	Lab/88-89/ D-62	Lab/87-88/ D-115	Lab/82-83/ D-92
Location :	Khanya Abdasa Kachchh	Andhan Bhuj Kachchh	Bhachau Bhachau Kachchh	Bela Rapar Kachchh	Kotadaroha Anjar Kachchh

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	2.09	3.25	23.83	35.44	13.66
Al ₂ O ₃	1.10	0.66	3.54	2.71	2.73
Fe ₂ O ₃	4.84	1.86	1.12	1.08	1.00
TiO ₂	0.16	Ab	0.24	0.16	Nd
CaO	50.78	52.52	38.34	33.81	45.23
MgO	0.44	0.10	0.98	0.04	0.25
P ₂ O ₅	Nd	0.33	Nd	Nil	Nd
SO ₃	Nd	0.08	Nd	Nil	Nd
MnO	Nd	0.05	Nd	Nd	Nd
Na ₂ O	0.20	0.10	0.50	0.15	0.18
K ₂ O	Ab	0.08	0.50	0.15	0.28
L.O.I	40.45	41.22	30.58	26.70	36.02

Ref.No.	Lab/91-92/ D-108	Lab/91-92/ D-171	Lab/91-92/ D-152	Lab/92-92/ D-215	Lab/91-92/ 28/JE-35
Location :	Vatrol Khedbrahma Himatnagar	Padhiyarka Mahuva Bhavnagar	Navinagri Savli Vadodara	Dhokurwa Chotila Surendranagar	Dhagadia Danta Banaskantha

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	23.74	3.10	20.74	8.52	3.84
Al ₂ O ₃	3.44	1.47	1.25	2.97	1.53
Fe ₂ O ₃	2.46	1.15	1.04	2.14	1.01
TiO ₂	0.33	0.08	0.05	0.33	0.07
CaO	39.41	52.60	42.99	46.56	52.08
MgO	0.40	Ab	Ab	1.70	Ab
P ₂ O ₅	Ab	0.19	0.04	0.04	0.06
SO ₃	0.24	Ab	0.02	0.06	Ab
MnO	0.02	0.01	0.07	0.02	0.03
Na ₂ O	0.40	0.19	0.08	0.25	0.20
K ₂ O	0.78	0.13	0.23	0.20	0.13
L.O.I	28.22	40.82	33.50	36.93	41.18

NEPHELINE SYENITE

Ref.No.	Lab/91-92/ D-78	Lab/91-92/ D-176	Lab/90-91/ D-9	Lab/90-91/ D-10	Lab/91-92/ D-94
Location :	Moradungri Pavijetpur Vadodara	Moradungri Pavijetpur Vadodara	Moradungri Pavijetpur Vadodara	Moradungri Pavijetpur Vadodara	Lalpur Chhotaudepur Vadodara

CHEMICAL COMPOSITION :

Constituents (%) :

SiO ₂	58.10	58.20	59.14	57.33	71.16
Al ₂ O ₃	21.68	18.74	20.40	19.48	13.85
Fe ₂ O ₃	6.00	5.68	5.52	6.88	3.52
TiO ₂	0.47	0.28	0.50	0.50	0.42
CaO	0.75	2.62	2.41	2.56	1.42
MgO	0.10	0.39	0.23	0.34	0.14
P ₂ O ₅	0.01	0.03	0.18	0.13	0.06
SO ₃	Ab	Ab	Ab	Ab	Ab
MnO	Nd	0.02	0.10	0.11	0.05
Na ₂ O	6.25	6.50	5.50	5.13	3.00
K ₂ O	6.00	6.00	5.75	5.00	4.25
L.O.I	0.40	1.59	0.32	1.14	1.54

PLASTIC CLAY

Comparative Study of Plastic Clay of Gujarat with Bikaner Clay :

Sl.No. (1)	Properties (2)	Bikaner (3)	Rajpardi (4)	Than (5)	Santhalpur (6)
1.	Raw colour	Light champagne.	Light French grey.	Quaker grey.	Light beige.
2.	Slaking nature	Fair	Fair	Fair	Fair
3.	Plasticity by hand feel	Fair	Fair	Fair	Fair
4.	Water of plasticity % (Dry basis)	31.02	38.52	26.26	31.19
5.	Dry shrinkage at 105°C(%)	6.0	5.0	5.0	5.0
6.	Fired properties at 1250°C :				
6.1	Fired colour	Pale cream.	Portland stone.	Dull white	Beige.
6.2	Total shrinkage (%)	1.50	23.0	9.0	15.0
6.3	Vitrification	Fair	Fair	None	High
7.	Fired properties at 1400°C :				
7.1	Fired colour	Dark stone.	Near light stone.	Beige.	Light stone
7.2	Total shrinkage(%)	13.0	22.0	13.0	12.0
7.3	Vitrification	High	High	Fair	High
8.	Chemical analysis % :				
	SiO ₂	55.31	42.33	62.23	57.78
	Al ₂ O ₃	28.05	35.35	23.93	28.23
	Fe ₂ O ₃	2.14	2.44	0.94	1.81
	TiO ₂	2.66	3.56	1.67	1.67
	CaO	0.82	0.87	0.21	0.21
	MgO	0.06	0.07	Ab	Ab
	Na ₂ O	0.48	0.40	0.58	0.21
	K ₂ O	0.30	0.03	0.25	0.41
	L.O.I	9.56	14.50	9.74	9.84
9.	DTA Endothermic peak temp. Exothermic peak temp.	100°C 525°C 955°C	100°C 530°C 955°C	100°C 530°C 570°C 978°C	520°C 570°C 955°C

(1)	(2)	(3)	(4)	(5)	(6)
10. PCE		Between 31-31 1/2	Between 33-34 26-30 (close to 33)	Between	28
11. Constituent minerals		Kaolinite	Kaolinite	Kaolinite	Kaolinite
12. Impurities		Quartz	Quartz (Comparatively less)	Quartz (Considerable amount)	Quartz (Considerable amount)
13. Particle size %					
25 Microns		8.3	3.2	15.7	6.3
15-20		2.2	1.2	4.5	3.1
10-15		4.1	1.7	7.7	5.3
8-10		2.6	1.0	4.7	3.0
5-8		6.3	2.1	9.5	6.7
3-5		6.6	1.9	8.2	6.7
2-3		4.5	1.4	4.4	4.3
2		65.4	87.5	45.3	64.6

PYROLUSITE (MnO₂)

Ref. No.	Lab/91-92/ D-79	Lab/91-92/ D-109A	Lab/91-92/ D-109B
Location :	Shivrajpur Halol Panchmahal	Shivrajpur Halol Panchmahal	Shivrajpur Halol Panchmahal

CHEMICAL COMPOSITION

Constituents (%) :

SiO ₂	31.33	2.67	52.71
Fe ₂ O ₃	1.02	3.28	0.88
Al ₂ O ₃	-	-	-
TiO ₂	Ab	0.16	0.08
CaO	0.07	0.28	0.14
MgO	Ab	Ab	Ab
P ₂ O ₅	Ab	Ab	Ab
SO ₃	Ab	Ab	Ab
Na ₂ O	0.15	0.09	0.08
K ₂ O	0.90	0.36	0.18
L.O.I	8.21	12.42	6.10
MnO ₂	59.03	93.08	45.48

QUARTZ

Location	Lunawada Panchmahals	Parabada Himatnagar	Vavdi Surendra- nagar	Gughiana Surendra- nagar	Motina- galpara Kachchh	Smugra Anjar Kachchh	Anjar Kachchh
	Quartz	Sandstone	Santstone	Sandstone	Sandstone	Sandstone	Sandstone

CHEMICAL COMPOSITION

Constituents (%) :

SiO ₂	99.52	98.31	96.96	97.66	89.81	96.28	90.80
Al ₂ O ₃	0.12	0.74	1.74	1.14	2.96	1.50	5.01
Fe ₂ O ₃	0.01	0.07	0.13	0.10	0.28	0.13	0.14
TiO ₂	-	0.15	0.18	0.10	0.35	0.10	0.10
CaO	0.08	0.14	0.09	0.01	3.40	0.90	1.45
MgO	Tr	Tr	0.06	0.10	0.32	0.05	0.08
P ₂ O ₅	-	-	-	-	-	-	-
SO ₃	-	-	-	-	-	-	-
Na ₂ O	0.02	0.04	0.03	0.01	0.12	0.02	0.06
K ₂ O	0.01	0.06	0.02	0.02	0.06	0.04	0.12
L.O.I	0.15	0.48	0.81	0.75	2.61	0.90	2.16

ROOFING TILES CLAY

Ref. No.	Lab/87-88 D-3	Lab/87-88 D-4	Lab/87-88 D-5
Location	Morvi Rajkot	Morvi Rajkot	Morvi Rajkot
(1)	(2)	(3)	(4)
Chemical Composition			
Constituents (%)			
SiO ₂	42.42	54.72	46.86
Al ₂ O ₃	20.46	24.38	17.83
Fe ₂ O ₃	25.96	8.68	24.84
TiO ₂	1.63	2.44	1.83
CaO	0.40	0.20	0.47
MgO	0.02	0.02	0.04
P ₂ O ₅	Ab	Ab	Ab
SO ₃	Ab	Ab	Ab
Na ₂ O	0.70	0.53	0.60
K ₂ O	0.55	0.70	0.50
L.O.I	7.91	8.61	6.52
Physical Properties			
1. Colour	Red	Light red	Red
2. Plasticity by hand feel	Fair	Fair	Fair
3. Water of plasticity %	26.27	27.98	24.98
4. Dry linear shrinkage at 105°C	5.0	5.0	-
5. Liquid limit	34.90	39.20	35.45
6. Atterberg's Number	20	22	17
7. BEC Meq/100 gm	4.05	4.30	3.50
8. Fired properties at 900°C			
8.1 Fired colour & visual exam.	Red colour. No cracks or specks are visible.	Red colour. No cracks or specks are visible.	Red colour. No cracks or specks are visible.
8.2 Fired linear shrinkage %	5.0	6.0	4.5
8.3 Water absorption %	19.34	18.53	19.42
8.4 Vitrification	None	None	None
9. Fired properties at 1250°C			
9.1 Fired colour & visual exam.	Red colour. No cracks or specks are visible.	Red colour. No cracks or specks are visible.	Red colour. No cracks or specks are visible.
8.2 Fired linear shrinkage %	12.0	12.0	9.0
8.3 Water absorption %	8.73	7.57	12.03
8.4 Vitrification	None	None	None

(1)	(2)	(3)	(4)
Mineralogical Composition (x-ray diffraction)	Sample contains mainly kaolinite, quartz and hematite. Little muscovite is also present.	Sample contains mainly kaolinite, quartz and hematite. Little muscovite is also present.	Sample contains mainly kaolinite, quartz and hematite. Little muscovite is also present.
Infrared Spectroscopy	Sample contains kaolinite, quartz, calcite & hematite.	Sample contains kaolinite, quartz, calcite & hematite.	Sample contains kaolinite, quartz, calcite & hematite.
Petrographic Study	Ferruginous clay.	Ferruginous cherty clay.	Impure fire clay.

Ref. No.	KRK Rao (89-90)	KRK Rao (89-90)	BSD/87-88 BSD-3	BSD/87-88 BSD-6
Location	Sahebpur Himatnagar Sabarkantha	Bhimpura Vijapur Mehsana	Ged Prantij Sabarkantha	Ged Prantij Sabarkantha
(1)	(2)	(3)	(4)	(5)

Chemical Composition

Constituents (%) :

SiO ₂	62.14	56.59	53.09	55.08
Al ₂ O ₃	19.12	24.32	18.42	17.65
Fe ₂ O ₃	6.40	6.32	13.36	11.68
TiO ₂	1.81	2.60	1.67	2.32
CaO	0.55	0.57	1.00	0.94
MgO	1.29	0.27	1.69	1.32
P ₂ O ₅	0.01	Ab	-	-
SO ₃	Ab	Ab	Ab	Ab
Na ₂ O	0.78	0.70	0.62	1.20
K ₂ O	1.33	0.48	0.92	1.15
L.O.I	5.95	8.37	8.03	8.36

Physical Properties

1. Colour	Beige	Light pink	Near middle stone	Near light stone
2. Plasticity by hand feel	Fair	Fair to good	Fair to good	
3. Water of plasticity %	40.46	39.29	46.39	51.46
4. Dry linear shrinkage at 105°C(%)	11.00	11.00	11.00	13.50

(1)	(2)	(3)	(4)	(5)
5. Liquid limit	98.80	72.00	-	-
6. Atterberg's Number	-	-	-	-
7. pH	8.85	8.10	-	-
8. BEC Meq/100 gm	37.81	30.14	-	-
9. Fired properties at 900°C				
9.1 Fired colour & visual exam. visual exam.	Red. No cracks or specks are visible.	Red. No cracks or specks are visible.	Red.No cracks or specks are visible. Some blistering developed.	Red.No cracks or specks are visible.
9.2 Fired linear shrinkage %	11.0	12.0	13.0	16.0
9.3 Water absorption %	7.62	12.27	3.86	6.04
9.4 Vitrification	Fair	None	Fair	None
10. Fired properties at 1050°C				
10.1 Fired colour & visual exam.	-	-	Red.No cracks or specks are visible. Blistering have developed.	Dark red. No cracks or specks are visible. Some blistering have developed.
10.2 Fired linear shrinkage %	-	-	15.0	16.5
10.3 Water absorption %	-	-	3.28	6.45
10.4 Vitrification	-	-	Fair	Fair

Ref. No.	DBP/89-90 MDS-5	DBP/89-90 MDS-7	DBP/90-91 3	DBP/90-91 5
Location	Mujalao Mandvi Surat	Mujalao Mandvi Surat	Bharan Aknkleshwar Ankleshwar	Bharan Ankleshwar Ankleshwar
(1)	(2)	(3)	(4)	(5)

Chemical Composition

Constituents (%) :

SiO ₂	33.15	30.18	44.85	43.03
Al ₂ O ₃	28.43	26.85	29.04	28.88
Fe ₂ O ₃	20.96	27.20	6.17	9.12
TiO ₂	2.96	3.95	5.67	3.63
CaO	0.39	0.39	0.85	0.57
MgO	0.09	0.04	0.35	0.20

(1)	(2)	(3)	(4)	(5)
P2O5	0.01	0.02	Ab	Ab
SO3	Nil	Nil	0.49	0.20
Na2O	0.23	0.23	0.31	0.75
K2O	0.03	0.10	0.06	0.05
L.O.I	13.66	11.42	11.51	13.19
Physical Properties				
1. Colour	Deep buff.	Leaf brown.	Light grey.	Near light grey.
2. Plasticity by hand feel	Good	Fair to good	Good	Good
3. Water of plasticity %	42.76	38.08	42.66	42.33
4. Dry linear shrinkage at 105°C(%)	6.00	4.5	9.0	9.0
5. Liquid limit	-	-	-	-
6. Atterberg's Number	-	-	-	-
7. pH	7.10	7.25	4.25	4.20
8. BEC Meq/1100 gm	-	-	13.02	17.03
9. Fired properties at 900°C				
9.1 Fired colour & visual exam.	Red colour. Some cracks have developed. No specks are visible.	Red colour. No cracks or specks are visible.	Near middle stone colour. No cracks or specks are visible.	Near salmon pink colour. No cracks or specks are visible.
9.2 Fired linear shrinkage %	11.0	7.00	11.00	11.00
9.3 Water absorption %	30.67	27.86	22.86	22.02
9.4 Vitrification	None	None	None	None
10. Fired properties at 1050°C				
9.1 Fired colour & visual exam.	-	-	Near light stone. No cracks or specks are visible. Test pieces are slightly bent.	Near deep buff colour. No specks are visible. Some cracks are visible. Test pieces are slightly bent.
9.2 Fired linear shrinkage %	-	-	21.50	21.00
9.3 Water absorption %	-	-	1.17	1.07
9.4 Vitrification	-	-	Fair	Fair

Note: These clays can be used for roofing tiles after combination with other clay and other appropriate material as per requirement.

SIDERITE

Ref.No.	R-29/2(31)	R-32/4(38)	R-39/3(72)	K-39(117)	H-38/1(67)
Location:	Ratadia	Ratadia	Ratadia	Ratadia	Hamla
	Mandvi	Mandvi	Mandvi	Mandvi	Mandvi
	Kachchh	Kachchh	Kachchh	Kachchh	Kachchh

CHEMICAL COMPOSITION :**Constituents (%) :**

SiO ₂	2.59	3.11	2.61	2.19	5.00
Fe ₂ O ₃	0.85	2.12	0.91	1.71	1.61
FeO	56.14	53.55	55.55	54.68	52.15
CaO	1.53	1.53	1.48	1.78	1.40
MgO	1.05	1.05	0.97	1.54	2.29
P ₂ O ₅	0.16	0.16	0.18	0.16	0.25
SO ₃	0.10	0.58	0.79	0.69	-
MnO	0.39	0.59	0.65	0.72	1.82
Na ₂ O	Nd	Nd	Nd	Nd	Nd
K ₂ O	Nd	Nd	Nd	Nd	Nd
CO ₂	34.21	31.86	34.16	31.28	31.71
L.O.I	30.01	29.06	30.23	30.01	29.63

SILICA SAND

Ref. No.	D-67 (92-93)	D-92 (88-89)	D-100(88-89)
Location :	Rajpadri Rajpipla Bharuch	Amod Jaghadia Bharuch	Damlai Jaghadia Bharuch

CHEMICAL COMPOSITION

Constituents (%) :

SiO ₂	93.19	97.35	97.04
Fe ₂ O ₃	0.63	0.30	0.47
Al ₂ O ₃	2.39	0.92	0.70
TiO ₂	0.58	0.43	0.33
CaO	0.71	0.21	0.21
MgO	Ab	-	0.02
P ₂ O ₅	Ab	-	-
SO ₃	Ab	-	-
Na ₂ O	0.04	0.03	0.04
K ₂ O	0.01	Ab	Ab
L.O.I	1.66	0.54	0.72

