# SARAF AGENCIES PRIVATE LTD
# KOLKATA

## TECHNO ECONOMIC FEASIBILITY REPORT

## FOR

## INTEGRATED 36000 TPA HIGH TITANIUM SLAG, 20,000 TPA PIG IRON, 30000 TPA TITANIUM DIOXIDE PIGMENT PLANT

## IN

## ODISHA

## NOVEMBER 2014


**DEVELOPMENT CONSULTANTS PRIVATE LIMITED**

***CONSULTING ENGINEERS***

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**KOLKATA ◆ MUMBAI ◆ DELHI ◆ CHENNAI**

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## PROJECT AT A GLANCE

| | | |
|---|---|---|
| ➔ Project Title | : | 36000 TPA HIGH TITANIUM SLAG,<br>20,000 TPA PIG IRON,<br>30000 TPA TITANIUM DIOXIDE PIGMENT PLANT |
| ➔ Owner | : | SARAF AGENCIES PVT LTD |
| ➔ Project Location | : | Chhatrapur, Dist. Ganjam, Odisha |
| - Nearest Rail Station | : | Chhatrapur (5 Km) |
| - Nearest Highway | | NH-16 (0.6 Km) |
| - Nearest Town | : | Chhatrapur (4 Km) |
| - Nearest Port | : | Paradeep : 260 Km.<br>Vizag : 250 Km.<br>Gopalpur Port –under construction (12 Km) |
| - Nearest Airport | : | Bhubaneswar : 150 Km. |
| - Survey of India Map | : | 74 A/15 |
| ➔ Capacity of Plant | : | 36000 TPA Titanium Slag, 20,000 TPA Pig Iron, 30000 TPA Titanium Dioxide (both Anatase & Rutile Grade) |
| ➔ Technology Source/know-how for Titanium Project | :<br>:<br>: | CHINA<br>HPWY (CHINA) for Titanium Slag Plant<br>Chong Qung Chemical Engineering Design and Research Institute (CCDRI) will supply Process Technology, Basic & Detailed Engineering for Titanium Dioxide Plant. |
| ➔ Market | :<br>:<br>: | Domestic Demand of Pigment: Around 2,00,000 TPA<br>Present production level : 50,000-60,000TPA<br>Short fall : Around 1,50,000 TPA |
| ➔ Land Requirement | : | 39 Acres required for Titanium Slag plant, 30 Acres for Titanium Dioxide plant, within the existing land of 260 Acres |

| | | |
|---|---|---|
| ➔ Water Requirement | : | Around 7,700 $M^3$/day<br>[800 $M^3$/day for Titanium slag plant from ground water.<br>6900 $M^3$/day for Titanium Dioxide plant]<br>Water shall be sourced from Rushikulya River. |
| ➔ Power Requirement | : | Around 23MVA<br>[16MVA for slag plant,<br>7 MVA for dioxide] |
| ➔ Man Power Requirement | : | Total 946<br>[356 for Ti Slag<br>590 for TiO2] |
| ➔ Total Cost | : | Rs. 779.5 Crore |
| ➔ Debt : Equity Ratio | : | 2:1 |
| - Debt | : | Rs. 518.57 Crore (from Banks / Financial Institutions including L/C Facility for import of Machineries ) |
| - Equity | : | Rs. 260.93 Crore |
| ➔ Interest Rate | : | 14% |
| ➔ Tenure (Term loan) | : | 12 months moratorium |
| | : | 84 monthly installments after moratorium period |
| ➔ Working Capital | : | Around Rs 106.38 Crore cash. Credit facility against raw material, finished goods, spare parts etc. & outstanding dues from customers. |
| | : | Around Rs. 72.19 Crore Bank guarantee / L.C facility for import of consumables. |
| ➔ Financial Results | : | |
| - IRR | : | 22.64% |
| - Break even point | : | 60.41% |
| - Cash Break even point | : | 50.27% |
| ➔ Project Completion Time | : | 24 months |

| | | |
|---|---|---|
| ➔ Present Status | : | SARAF has peaceful possession of 260 acre land in Chhatrapur in Ganjam District. |
| | : | SARAF has SEZ approval for setting up Titanium Complex manufacturing various titanium products. |
| | : | SARAF has already applied for statutory clearances / approvals from Pollution Control Board and environment department. |
| | : | SARAF has obtained approval for supply of water and power. |
| | : | High Titanium Slag will be used as feedstock for Pigment Plant. |
| ➔ Special Highlight of the Project | : | Eco friendly Plant |
| | : | Waste Acid treatment facility Comprising both concentration and gypsum conversion facilities (to be used in Cement factory) |
| | : | SARAF will manufacture Zirconium coated $TiO_2$ Pigment for first time in India. |

# SECTION – 1

## INTRODUCTION & EXECUTIVE SUMMARY

# SECTION – 1

## INTRODUCTION & EXECUTIVE SUMMARY

### 1.1.0 INTRODUCTION

Saraf Agencies Pvt. Ltd (SAPL) is a unit of Saraf Group of Companies with interests in Real Estate & Manufacturing. Real Estate development interest includes construction & development of shopping malls, multiplexes and specialized IT buildings built to suit IT & ITES Companies.

Manufacturing activities include Asbestos Cement Roofing sheets, Asbestos pressure pipes, Salt gazed stoneware pipes.

SAPL is proposing to expand its activity in adding values to ilmenite, a mineral of Titanium available in Odisha, so far not being explored due to lack of entrepreneurship and availability of proper technology.

SAPL is in the process of installation of a plant having capacity of 36,000 TPA High Titanium Slag and 20,000 TPA High Purity Pig Iron. SARAF is also intending to set up a 30,000 TPA Rutile grade $TiO_2$ pigment plant based on Sulphate Route in the Titanium Complex keeping a provision for future expansion.

The proposed complex will be implemented at Chhatrapur, within the SEZ premises of SAPL in the state of Odisha in proximity to premises of Indian Rare Earth Limited (IREL).

1.1.2 **Production Capacity**

36,000 TPA Titanium Slag, 20,000 TPA Pig Iron, 30,000 TPA Rutile grade Titanium Dioxide Pigment Plant based on Sulphate route.

1.2.0 **EXECUTIVE SUMMARY**

Section-2 highlights Market Scenario of products. Present global $TiO_2$ production capacity is around 5.0 MTPA which is likely to be increased to around 7.5million tonnes/year by 2016. There is a definite growth potential for Titanium Dioxide pigment specially in India where demand (around 2,00,000 TPA) surpasses indigenous production (around 62,000 TPA).

Section-3 depicts plant site and infrastructure. Site is located near Chhatrapur in Ganjam district of Odisha. Site is well connected with Rail & Road. Estimated land requirement for Titanium Slag, Pigment is around 69 acres within premises of SEZ area.

Section-4 depicts details of process for the plant. SARAF desires to implement the project based on Chinese Technology.

Section-5 highlights requirement of various raw materials, products, requirement of utility & auxiliary services.

Section-6 depicts plant layout & civil work particulars.

Section-7 highlights pollution & environmental control features. The Plant has been designed to be environ friendly.

Section-8 highlights manpower requirement for the total project estimated at 946.

Section-9 highlights schedule of implementation. Implementation time for the plant is 24 months.

Section-10 highlights cost estimation and financial analysis.

For total plant with rated capacity, the cost has been estimated as Rs. 779.5 crore. Breakeven point is 60.41%. IRR is 22.64% while considering interest rate of 14%.

Considering the financial parameters which are conducive for implementation of the project, it is recommended to go in for execution of the Project.

### 1.3.0 Background of the Promoters

Saraf Group is engaged in business as contractors, developers, lessors and builders of real estate. The registered office of the company is located at 4/1, Red Cross Place, Kolkata, West Bengal. The promoters of the group are reputed businessmen of Kolkata with excellent track record for execution of large ticket real estate projects. They have been allotted 260 acres of land at Chhatrapur, Dist.: Ganjam, Odisha by Odisha Government for developing an SEZ and setting up manufacturing facilities for various titanium products. The SEZ has been named as **"Saraf Titanium Park"**. SARAF is in the process of setting up a green field project for producing 36,000 TPA High Purity Titanium Slag and 20,000 TPA High Purity Pig Iron. Now further forward integration of the High Purity Titanium Slag into Titanium Dioxide ($TiO_2$) Pigment is envisaged.

**SHRI S. M. SHROFF**

Shri S. M. Shroff, Heads the Saraf Group and provides vision, strength and vigour to the group. Under his leadership, the group has now consolidated itself over a broad category of manufacturing and construction activities. With business experience of over 50 years in diverse fields Shri Shroff provides long term vision and guidance to the group. A graduate from Presidency College, Calcutta University and a Gold Medalist in Philosophy, Shri Shroff is a man of wide and diverse experience in many fields.

**SHRI RAHUL SARAF**

Shri Rahul Saraf is futuristic developer who believes in staying ahead of time. He joined the family business at the age of 22 when its real estate foray was at a nascent stage and transformed the business into a successful enterprise with landmark projects that established Forum Group as a niche and responsible developer in the real estate fraternity. Dynamic and forward thinking, Shri Rahul Saraf realized the tremendous scope of creating next generation real estate projects. He developed the first green IT infrastructure in the world **Technopolis** which is registered under the United Nations Framework Convention on Climate Change as a Clean Development Mechanism (CDM) project eligible to earn carbon credits. He also built Kolkata's first computer integrated building and the country's second IT Park project called **Infinity**. Realizing the impact of the emerging organized retail sector in India, he developed **Forum**, Kolkata's first shopping mall and the first mall in India to integrate cinemas with shopping, ushering in a new retail revolution in the East. He went on to develop **Forum Mart**, in Bhubaneswar the country's first shopping mall in a tier three city. The India Today magazine rightfully acknowledged him as the "Mall Man of the East". Continuing with his

objective to build specialized and 'iconic' infrastructure, he recently announced an ultra-luxury residential condominium called **ATMOSPHERE** in Kolkata with an executive club Deya, structured like a could hanging at 500 ft. between two towers, a never before sculpture seen in the sky. Shri Rahul Saraf received the Tiega Award in 2006 – for entrepreneurship for creating state of the art IT infrastructure. And more recently he received the Special Jury Award from **ZEE Business –RICS Real Estate Awards 2011** – for the **Young Icon of the Year** and **Achievers & Leaders Awards** at the **India Leadership Summit 2012** – organized by EILM.

**SHRI VIDYUT SARAF**

Mr. Vidyut Saraf has just joined the business on his return from Wharton Business School, University of Pennsylvania. He was inclined to the family business and has immediately taken over the responsibility of execution of the ongoing and upcoming projects. With aptitude in finance and design, he has already made his mark in the business and has given an impetus to the ongoing projects.

**SHRI NIRMAL KUMAR LUNAWAT**

Shri N. K. Lunawat, a B. Com (Hons.) graduate and CA, is responsible as Executive Director for the Group's total accounts, finance, income tax matters, service tax matters, legal systems, information technology, HR and administration. He has professional experience of 32 years and is ably supporting Shri Rahul Saraf in the Real Estate Development and Construction activities of SARAF. He has worked with companies like Simplex Infrastructure, GATI, SPML and S. K. Bangur Group of Companies.

**SHRI AJEET RAJ MEHTA**

Shri A. R. Mehta holds a Master's Degree in Commerce and has to his credit over 35 years of working experience in Forum Group encompassing marketing, administration, finance and personnel. Shri Mehta has been closely coordinating and ably supporting Shri Rahul Saraf in the Real Estate Development and Construction activities of the Company and handles all legal matters.

**MAJOR SHAREHOLDERS OF THE COMPANY**

| Sl. No. | Name of the Shareholders | No. of Shares | Percentage of Holdings |
|---|---|---|---|
| 1 | Rahul Saraf | 3510000 | 37.08% |
| 2 | Rahul Kumar Saraf (HUF) | 1015000 | 10.72% |
| 3 | Kamna Saraf | 1031500 | 10.90% |
| 4 | Vidyut Saraf | 1077096 | 11.38% |
| 5 | Yash Saraf | 1013102 | 10.70% |
| 6 | Gayatri Devi Saraf | 718351 | 7.59% |
| 7 | Sanwar Mall Saraf (HUF) | 633401 | 6.69% |
| 8 | Sanwar Mull Shroff | 217050 | 2.29% |
| 9 | H. J. Properties Pvt. Ltd. | 250000 | 2.64% |
| | Total : | 9465500 | 100.00% |

**KEY TECHNICAL PERSONNEL**

SARAF has In their payroll qualified & experienced professionals comprising Project-In-charge, Director Project, VP – Titanium Dioxide Pigment, General Manager, Managers – Mechanical, Electrical, Instrumentation, HRA & Public Relations etc. This details of Key

Personnel along with their designation, qualification & experience are given in the following Table:

| Name | Designation | Qualification | Experience |
|---|---|---|---|
| Mr. A. R. Mehta | Project In-Charge | Master's Degree in Commerce | More than 35 yrs. In Saraf Group encompass-ing marketing, administration, finance and personnel and also handles the legal matters of the Company. |
| Mr. B. K. Panigrahi | Director Project | B. Tech in Metallurgy. | 20 yrs. Experience in Project Execution and Process Management of Submerged Electric Arc Furnaces. He has worked in 10, 16.5, 24, 27 & 48MVA size furnaces. He is familiar with Elkem, Pyromet, Bateman, Ghalsasi and RgCON design furnaces. He has experience in ferro chrome, ferro silicon, silico manganese and ferro-manganese processes. In his previous organization he was involved in project execution of HTS Plant of 25.5 MVA capacity. He has served industries like Indian Metals and Ferro Alloys Ltd., T.S. Alloys, Visa Steel, Visa Bao and Stork Ferro and Mineral Industries Pvt. Ltd. |
| Mr. S. Parthiban | Vice President - Titanium Dioxide Pigment Plant | Graduate – Chemical Engineer (B.Tech. – Chemical Engineering) graduated from Regional Engineering College, Tiruchirapalli in 1990. | 23 yrs. of relevant work experience in various Chemical Industries, by serving Industries namely Southern Petrochemical Industries Corporation Ltd., Kilburn Chemicals Ltd., and SDR Polymers Private Ltd., of which having 15 yrs of rich experience in the Titanium Dioxide Pigment Plant with Kilburn Chemicals Limited. During the above period, he has handled Process |

| | | | |
|---|---|---|---|
| | | | Operations, Maintenance of Equipment and Capacity Expansion Projects for the Titanium Dioxide Pigment Plant in Senior Management position. |
| Mr. Shanker Lal Modi | Vice President-Commercial | B. Com – Inter Chartered Accountant. | 43 yrs working experience (11 years with Orissa Fertilizer & Chemicals Ltd, and 32 yrs with Saraf Group) in Finance, Accounts, Taxation, Central Excise, Marketing, Administration and Liasioning at various levels. |
| Mr. D. G. Patnaik | Dy. General Manager - Mechanical | Degree in Mechanical Engineering | 16 yrs experience in Project & Maintenance in Ferro Alloys. He has worked for companies like GMR Technologies & Industries Ltd., Hyderabad, Jindal Stainless Ltd., Visakhapatnam, Adhunik Metalicks Ltd., Rourkela, SPS Steel & Power Ltd. Jharsuguda, Visa Bao Ltd., Jajapur Road. |
| Mr. Arun Satapa-thy | Manager - HRA | MBA in Human Resource Management | Industrial experience of 9 years. He has previously worked in United Spirits Limited, Essel Mining & Industries Ltd., Arya Iron & Steel Co. Ltd., and Terans Peb Health Care. He has experience in Managing various HR, Personnel and IR activities. |
| Mr. Bhagi-rathi Hota | Sr. Manager - Public Relations | Graduate in Commerce from BJB College under Utkal University in | 23 Yrs. of working experience in liasioning work, land Acquisition, Mining Lease matter, Diversion Proposal, other follow-up work with Govt. |

| | | | |
|---|---|---|---|
| | | 1988 | Department (IDCO, IPICOL) Collectorate, Director of Mines, Revenue Department, Industries Deptt. all Bank related matters. He has previously worked with Shivani Oil & Gas Ltd., New Delhi, Neelachal Cement Ltd., Bolangir and Nabadurga Industry, Rairangapur. |
| Mr. Hari Rana Bhat | Manager – Electrical and Instrumenta-tion | Diploma in Electrical Engineering | 9 yrs. Experience in project and operation. He has previously worked in Indian Metals and Ferro alloys and Stork Ferro and Mineral Industries Pvt. Ltd. In Stork Ferro and Mineral Industries Pvt. Ltd. he was involved in execution of 25.5 MVA Titanium Slag Furnace Project. |

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## NETWORTH OF THE GROUP AS PER AUDITED BALANCE SHEET ON 31ST MARCH 2013

| Summary of Net Worth as on 31st March, 2013 for the Group Companies as per Balance Sheet | | |
|---|---|---|
| **Sl. No.** | **Particulars** | **Rs. in Crore** |
| 1 | Forum Projects Pvt. Ltd. | 122.06 |
| 2 | Forum Project Holdings Pvt. Ltd. | 69.06 |
| 3 | Forum Shopping Mall Pvt. Ltd. | 15.66 |
| 4 | Saraf Agencies Pvt. Ltd. | 14.83 |
| 5 | Titanium Mineral Products Pvt. Ltd | 15.52 |
| 6 | Techno polis Infrastructure Pvt. Ltd. | 39.30 |
| 7 | Forum Infrastructure Pvt. Ltd. | 10.09 |
| 8 | Forum IT Parks Pvt. Ltd. | 89.98 |
| 9 | Forum Riviera & Constructions Pvt. Ltd. | 7.54 |
| 10 | Forum Retail Pvt. Ltd. | 4.95 |
| 11 | Heilgers Pvt. Ltd. | 1.65 |
| 12 | Forum Venture Pvt. Ltd. | 71.80 |
| 13 | Forum Reality Pvt. Ltd. | 72.48 |
| 14 | Safari Retreat Pvt. Ltd. | 48.11 |
| 15 | Saraf Services Pvt. Ltd. | 3.85 |
| 16 | Heilgers Development & Const. Co. Pvt. Ltd. | 6.73 |
| 17 | Forum Shopping Centres Pvt. Ltd. | 14.72 |
| 18 | Vidyut Electricals & Electronics Pvt. Ltd. | 3.15 |
| 19 | Multiplex Equipments & Services Pvt. Ltd. | 3.18 |
| 20 | Hind Ceramics Pvt. Ltd. | 5.90 |
| | **Total :** | **620.56** |

**MARKET VALUE OF LAND & BUILDING HELD BY THE GROUP AS ON 31ST MARCH, 2013.**

| Description of Property | Unit | Qty. | Market Value (Rs. in crores) |
|---|---|---|---|
| Technopolis (Industrial Park), Salt Lake, Kolkata | Sqft | 6,30,000 | 790.00 |
| Forum Mall(Shopping Mall), Elgin Road, Kolkata | Sqft | 1,45,000 | 150.00 |
| Court Yard (Shopping Mall), Elgin Road, Kolkata | Sqft | 1,75,000 | 160.00 |
| Forum Mart (Shopping Mall), Bhubaneswar | Sqft | 1,05,000 | 80.00 |
| Vanijya Bhawan(Office), BBD Bag , Kolkata | Sqft | 54,479 | 39.00 |
| Nilgunge Road (Ware House) , Kolkata | Sqft | 3,08,197 | 30.00 |
| Constantia(Office), U. N. Brahmchari St, Kolkata | Sqft | 22,791 | 29.00 |
| Beliaghata (Ware House), Kolkata | Sqft | 45,672 | 4.50 |
| Berger House(Office), Park Street, Kolkata | Sqft | 4,227 | 3.00 |
| Ballygunj Park Road, Kolkata | Cottah | 25.50 | 75.00 |
| Forum II ( Land for Shopping Mall), E.M.By Pass, Kolkata | Acres | 10.00 | 750.00 |
| Bantala Land for Residence, Kolkata | Acres | 25.00 | 175.00 |
| IT SEZ Bantala Land , Kolkata | Sqft | 17,50,000 | 200.00 |
| Atmosphere (Land), E. M. By Pass, Science City , Kolkata | Sqft | 6,50,000 | 300.00 |
| Belur, Howrah (Commercial + Residence) | Sqft | 14,24,000 | 250.00 |
| Rasulgarh (Land for Shopping Mall & Office ), Bhubneswar | Acres | 5.56 | 50.00 |
| Adityapur (Land for City Centre), Jamshedpur | Acres | 21.70 | 150.00 |
| Rourkela (IT Office-Shopping Mall) | Acres | 3.12 | 25.00 |
| **Total Market Value of Real Estate Business** | | | **3260.50** |

# SECTION – 2

## MARKET SCENARIO

# SECTION – 2

# MARKET SCENARIO

## 2.1.0 INTRODUCTION

Saraf is implementing a 36000 TPA Titanium Slag Plant at Chhatrapur. SARAF is also proposing to set up a 30000 TPA Titanium Dioxide Pigment Plant based on Sulphate route which would utilize both ilmenite & slag.

Titanium Slag, depending on $TiO_2$ content can be used as sulphatable or chlorinatable slag. Sulphatable slag generally contains $TiO_2$ of the order of 75-85% and around 7-8% Ferrous Oxide, whereas Chlorinatable slag contains more than 85% $TiO_2$. Chlorinatable slag commands higher price because of high $TiO_2$ content and less FeO content. Chlorinatable slag production requires high quality of ilmenite and more intense processing conditions.

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## 2.2.0 TITANIUM SLAG

For production of Chlorinatable Titanium Slag with more than 85% $TiO_2$ content, another competitor also emerges – i.e., Synthetic Rutile (SR). Where Titanium Slag is manufactured through Electro-Metallurgical route, Synthetic Rutile (SR) is manufactured through Hydrometallurgical / Pyroprocessing route. Synthetic Rutile (SR) is upgraded ilmenite whose iron is selectively leached and removed from natural ilmenite ($FeTiO_3$) to a titanium Oxide purity of over 90%. Both are used as feed stock for the manufacture of Titanium Dioxide Pigment and Titanium Sponge.

Large scale production of Titanium Slag is carried out in Canada, (QIT, FER-TITANE) Republic of South Africa, (RBM, TICOR etc.) & Norway (TINFOSS). Other Countries like Russia, Kazakhastan, Japan manufacture slag to the extent required for Sponge Production.

2.2.1 From the recent trend of Pigment Manufacturers, it is observed that feed stock production by the Pigment manufacturers is not encouraged by them, they tend to outsource the feed stock. With such change in trend, there is potential for growth in the feed stock production – either Titanium Slag or Synthetic Rutile.

2.2.2 World Production of Titanium Feed Stock.

In manufacturer's opinion, the smelting of ilmenite into slag is more beneficial than the Synthetic Rutile production. As in slag production, a marketable high value product pig-iron is formed where as in Synthetic Rutile Production, iron is to be disposed off. This factor determines higher production capacities of titanium Slag compared to production of Synthetic Rutile.

**Table – 2.2.2**

**Present Feed Stock Production Capacities**

| Sl.No. | Material | Production |
|---|---|---|
| 1. | Ilmenite | 7.8 MTPA |
| 2. | Slag | 2.6 MTPA |
| 3. | Synthetic Rutile (SR) | 0.8 MTPA |

The growth potential of titanium slag is conditioned by customer's demand and price in the market.

### 2.2.3 Titanium Dioxide Pigment

Titanium Dioxide Pigment has the highest whiteness, brilliance and hiding power among all known pigments, which determines its wide application in manufacture of paints, plastics and other products.

Use pattern of the $TiO_2$ pigment is as follows :

- Coating Industry (use pattern around 57%)
- Plastics (around 24%)
- Paper (around 10%)
- Inks (around 3%)
- Cosmetics
- Medicine/pharmaceuticals
- Synthetic fibre
- Rubber
- Refractories
- Electronic use
- Miscellaneous uses.

(around 6%)

According to data available present production capacity of Pigment is to the tune of 5 MTPA. Leaving aside crisis period of 2008-2009, the situation of Global Titanium Dioxide Market has improved.

USA and China are global leaders by both Titanium Dioxide production volumes and utilized capacities. Production capacities of USA and China stay almost at the same levels – about 1.4 – 2.0 million tonnes / year. In USA most of the producers produce Pigment by Chloride route.

It is expected that future demand of the pigment will grow at the rate of 3% yearly and will reach around 6.97 million tonnes / year by 2016.

In case if all planned Projects are launched, total Titanium Dioxide production capacity will reach 7.3 – 7.5 MTPA by 2015, 66 – 70% of which will be produced by Chloride route.

**Table: 2.2.3** provides capacity break down of Titanium Dioxide capacity at present level.

**Table : 2.2.3**

**Titanium Dioxide Plant Capacity**

| Sl.No. | Country | Capacity Tonnes/ annum |
|---|---|---|
| 1. | USA | 1,470,000 |
| 2. | Australia | 281,000 |
| 3. | Belgium | 74,000 |
| 4. | Canada | 90,000 |
| 5. | China (Estimated) | 2,000,000 |
| 6. | Finland | 130,000 |
| 7. | France | 125,000 |
| 8. | Germany | 440,000 |
| 9. | Italy | 80,000 |
| 10. | Japan | 309,000 |
| 11. | Kazakasthan | 1,000 |
| 12. | Mexico | 130,000 |
| 13. | Russia | 20,000 |
| 14. | Spain | 80,000 |
| 15. | Ukraine | 120,000 |
| 16. | UK | 300,000 |
| 17. | Other Countries | 900,000 |
| | **TOTAL :** | **6,550,000** |

Leading countries in the Titanium Dioxide Pigment product are USA, Germany, France, Japan, UK and China. Approximately 64% of all Titanium Dioxide is produced by five (5) companies namely. Dupont (largest & oldest producer), Cristal Global, Tronox Inc (642000 TPA 12% global market), Huntsman Tioxide, Kronos World-wide Inc. Others are ISK, Kemira, Kerr Mcgee.

With the development of technology, consumption growth to the extent of 1% of Global production (about 50,000 TPA) is envisaged for Nano Titanium Dioxide – one of the most important ingredients in cosmetics.

**Indian Scenario**

In India, first 18000 TPA Anatase grade $TiO_2$ Plant of Travancore Titanium Products Ltd. (TTPL) was commissioned in 1951 based on Sulphate route. In 1984, Kerala Minerals & Metals Ltd, (KMML) commissioned 22000 TPA Plant based on Chloride route with basic technology from Kerr-Mcgee, USA. KMML is presently producing 40000 TPA of Pigment and intends to augment by 20000 TPA totaling 60000 TPA.

V.V. Titanium Pigment Pvt. Ltd. In Tuticorin produces around 12000 TPA anatase grade pigment based on sulphate route.

Kolmak Chemicals Kolkata has installed capacity of 4800 TPA Anatase grade pigment.

BMC Titania, Tuticorin have also commenced operations of 15000 TPA Anatase Titanium Dioxide Plant.

Trimex Sands Ltd., one of the major producers & exporters of ilmenite in India (Presently having 200,000 TPA ilmenite separation capacity) intends to set up a Titanium Dioxide Pigment plant based on sulphate route in AP and is awaiting financial closure. Public Sector companies like NALCO, IREL also intend to enter into Titanium area due to strategic requirement of such product and considering abundance of the valuable raw material in India.

As regards specific pigment consumption is concerned, per capita consumption of $TiO_2$ in India is around 56gms compared to 2 kg for industrialized countries. Demand presently surpasses the indigenous production. Present demand is estimated around and 150000 TPY against production of around 61000 – 62000 TPY from installed capacity of 82300 TPY.

As regards price of Pigment, it could be concluded that the price for Titanium Dioxide pigment will depend on the market equilibrium of this product in the long-term outlook. But at the same time it is considered that the successful functioning of this industry is only possible when the prices are at the definite level. During the period 2007-2011 price in USA has augmented from price index of 162 to 252.

# SECTION – 3

## PLANT SITE & INFRASTRUCTURE

## SECTION – 3

## PLANT SITE & INFRASTRUCTURE

### 3.1.0 INTRODUCTION

The site is located near Chhatrapur in Ganjam district of Odisha. The site is near to OSCOM plant of Indian Rare Earths Limited. The aerial distance of the site from coastal line of Bay of Bengal is around 2.5 Km.

The proposed site is about 6 km from Chhatrapur railway station and 2 km (aerially) from Gopalpur Fair Weather Port. The project boundary of the site is surrounded as follows :

| | | |
|---|---|---|
| East | : | Chhatrapur Town and Rushikulya river. |
| West | : | Berhampur Town and Gopalpur Municipality. |
| North | : | NH – 16 |
| South | : | NH – 317 |

The proposed site falls under the in Survey of India Topo Sheet No. A 74---- 15 and the approximate longitude-latitude of the proposed site are as follows :

| | | |
|---|---|---|
| Latitude | : | 19° 20′ 03″ N (approx.) |
| Longitude | : | 84° 57′ 32″ E (approx.) |

The nearest rail station is at Chhatrapur. Being located near NH -16, Berhampur of East Coast Railway, is an important Railway Station in between Kolkata & Chennai. Paradeep port is about 260 km while the Vizag port is at a distance of 250 km from the project site. The nearest Airstrip is Rangelunda (Bhanja Vihar) at a distance of about 5 km from project site and

the nearest airport is located at Bhubaneswar, which is at about 150 km from the project site. NH-16 (National Highway from Kolkata to Chennai) is at a distance of 0.5 km from the project site.

Berhampur town is at a distance of 17 km towards the west and same railway town named Berhampur. The town has got enough importance from administrative and commercial point of view. Many of Government offices of district or higher level like those of water resources, PHED are located at Berhampur.

From all the above considerations site is ideally suited. It is surrounded by NH-16, railway track of IREL, Gopalpur Port Road and IREL Complex.

### 3.2.0 Meteorological data

The meteorological data site is similar to those prevailing at Gopalpur as indicated below :

| | | |
|---|---|---|
| Maximum Mean daily Temperature | : | 32.2°C |
| Minimum Mean daily Temperature | : | 16.6°C |
| Absolute Maximum Temperature | : | 43.3°C |
| Absolute Minimum Temperature | : | 10.0°C |
| RH (Maximum) | : | 87% |
| RH (Minimum) | : | 65% |
| Average yearly rainfall | : | 1210 mm |
| Maximum daily rainfall | : | 511 mm |
| Maximum hourly rainfall | : | 50.5 mm |
| Maximum 15 mm rainfall | : | 22.5 mm |
| Maximum Mean monthly wind velocity | : | 25.4 km/hr. |

### 3.3.0 Advantages of SEZ Unit

The proposed Titanium complex Plant will be set up within an approved notified SEZ. Being a SEZ unit, the plant will enjoy various tax exemptions and other benefits as stated below :

1) No payment of import duty on import of plant, machineries, equipment, spare parts etc.
2) Exemption from Excise Duty.
3) Exemption from payment of Sales Tax / Central Sales Tax, Octroi, Entry Tax etc.
4) Exemption from payment of Income Tax for a period of 10 (ten) years.
5) Being a SEZ unit, the project will be exempted from payment of State Electricity Duty which is Rs. 0.25/unit.

# SECTION – 4

## PROCESS & PLANT PARTICUARS

## SECTION – 4

## PROCESS & PLANT PARTICULARS

4.1.0 Initial product from the complex is Titanium Slag (36,000TPA) and pig iron (20,000TPA). Titanium Di-oxide ($TiO_2$) is produced from Titanium slag. It is one of most important Pigment materials. Titanium Di-oxide has the highest refractive Index among the known materials and hence it imparts best pigment properties such as hiding power, opacity etc. Titanium Di-oxide is the whitest of the white pigments.

Titanium Di-oxide is produced and marketed in two grades, these are ANATASE & RUTILE. RUTILE has closed packed structure whereas ANATASE has more open structure. Rutile has higher density, higher refractive index, and better resistance to chalking & higher hardness. Their relevant properties are highlighted in table-4.1.0. Table-4.1.0 shows that the Rutile grade is superior in many respects.

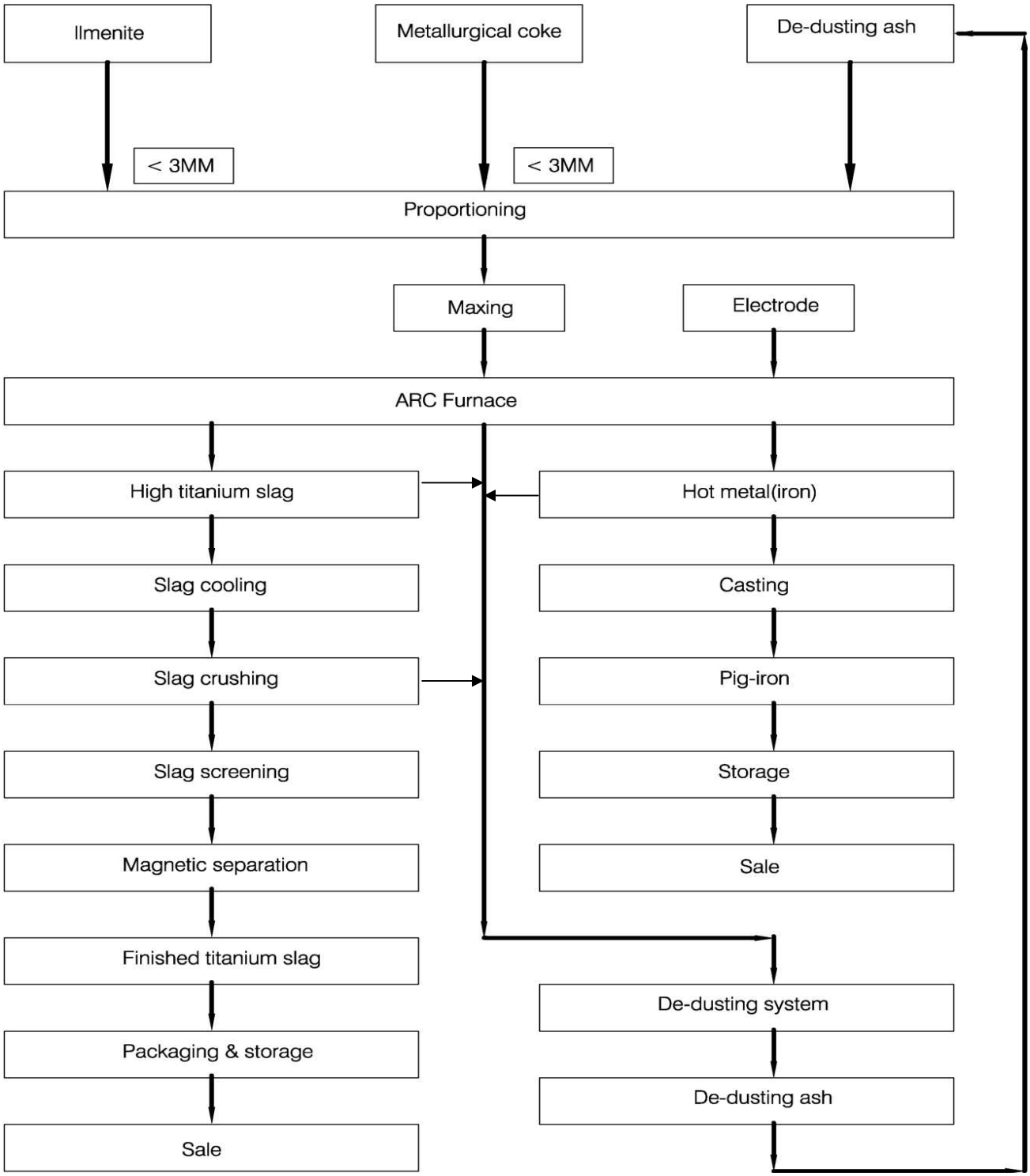
### Table – 4.1.0

### TYPICAL PROPERTIES OF ANATASE & RUTILE GRADE

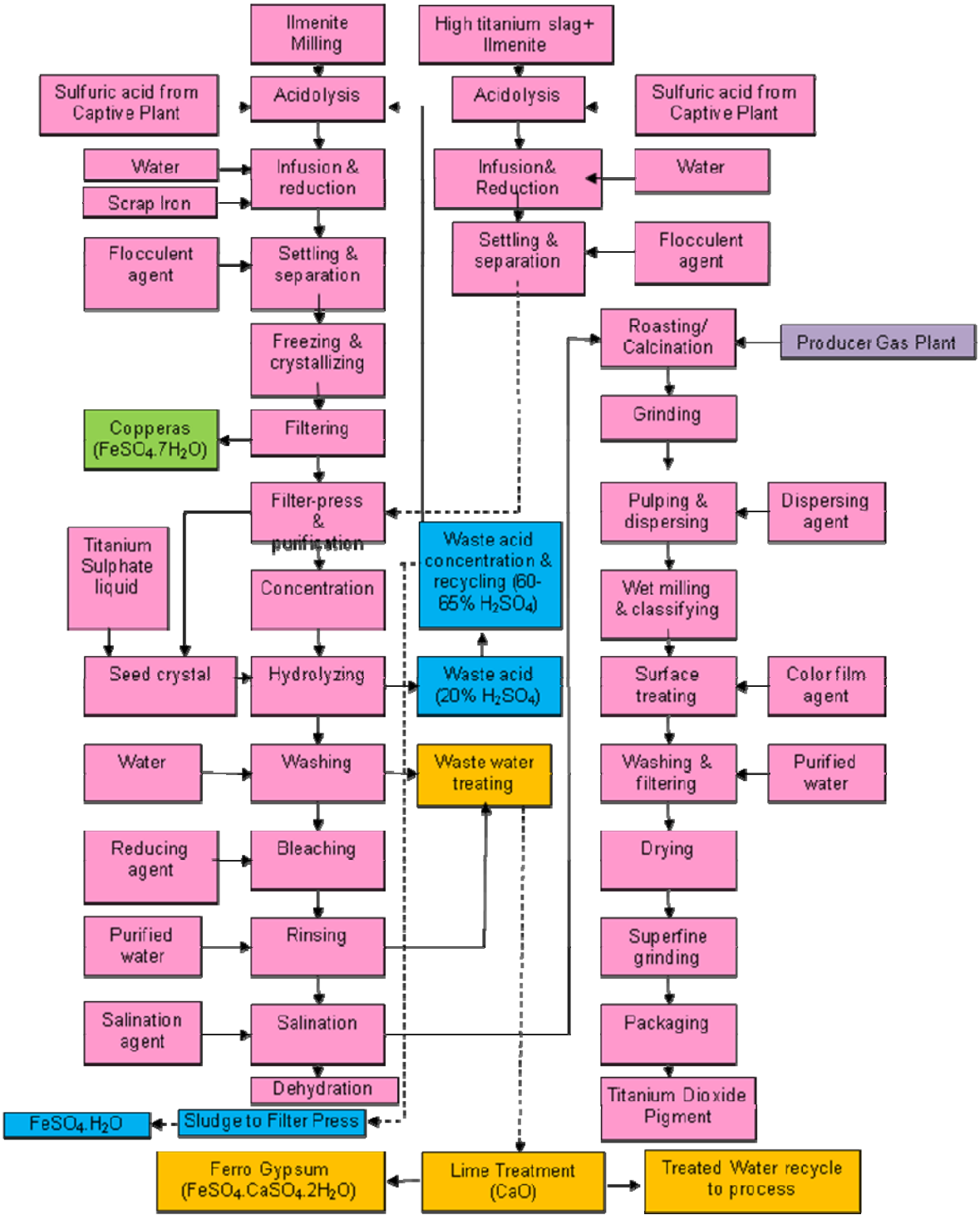
| SL. NO. | PROPERTY | ANATASE | RUTILE |
|---|---|---|---|
| 1. | Density (gm / $cm^3$) | 3.87 | 4.24 |
| 2. | Hardness (Moh Scale) | 5 - 6 | 6 - 7 |
| 3. | Refractive Index | 2.55 | 2.76 |
| 4. | Melting Point | Unstable | 1830° ± 15C |
| 5. | Specific heat (Cal/ degC / gm) | 0.17 | 0.17 |
| 6. | Dielectric constant | 48 | 114 |
| 7. | Tinting strength (ability to obscure a colorant) | Poor | Good |
| 8. | Mean particle size range (microns) | 0.3 | 0.2 – 0.3 |
| 9. | Gloss (measure of surface furnish, depends on particle size) | - | Better |
| 10. | Chalking Resistance (Phenomenon | Poor | High Degree of |

| SL. NO. | PROPERTY | ANATASE | RUTILE |
|---|---|---|---|
| | of appearance of free pigment particles on coating surface due to disintegration of organic binder in presence of UV light & moisture) | | Photochemical inertness |
| 11. | Hiding Power (ability to obscure a back ground of contrasting color) | 78 (Zinc oxide : 14, Zinc Sulphate 39) | 100 |
| 12. | Opacity (opacify the medium on which pigment is dispensed). | Less | Better |

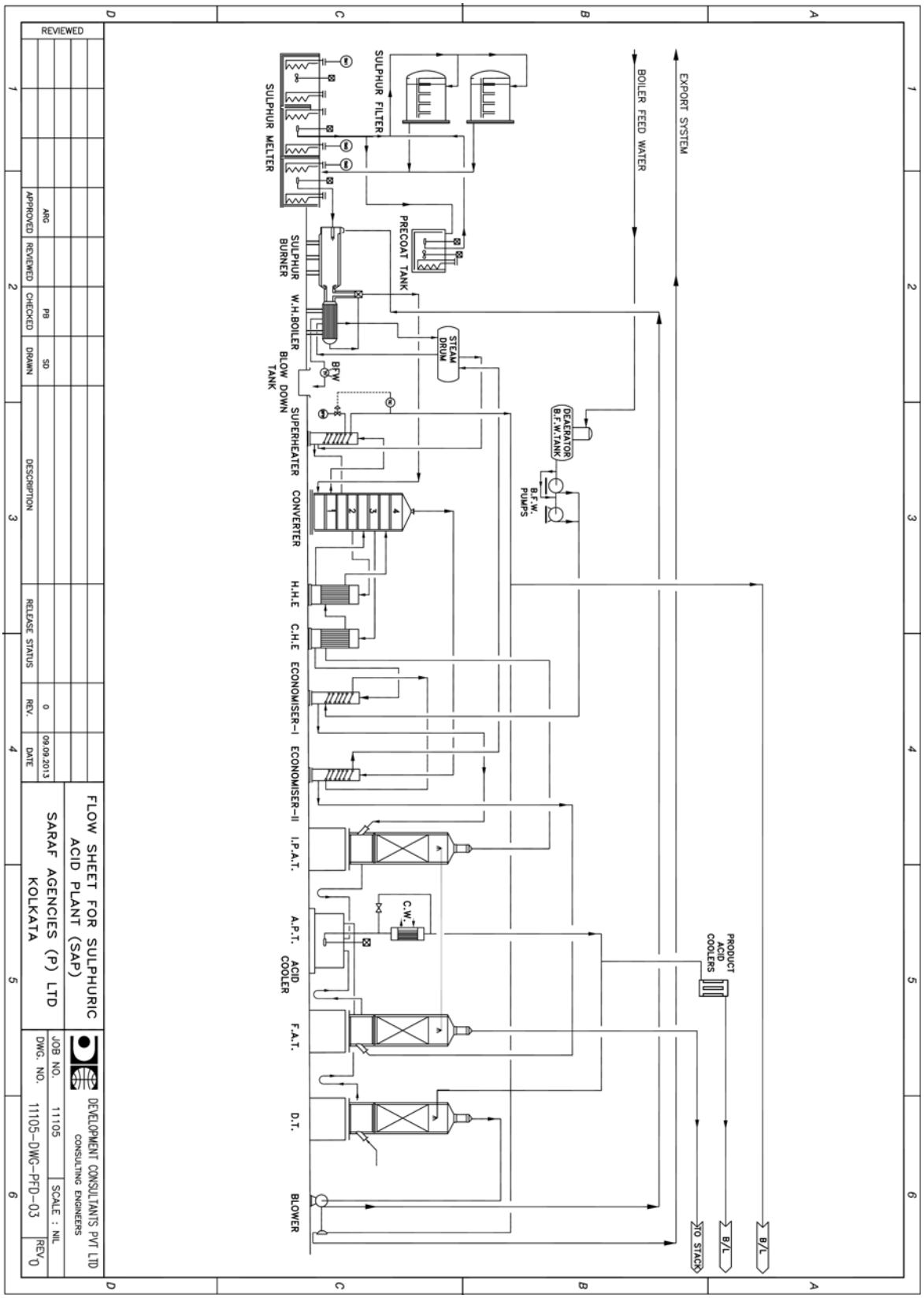
# Process Flow Diagram for Titanium Slag Plant



# Process Flow Diagram for Titanium Dioxide Plant



# Process Flow Diagram for Sulphuric Acid Plant



### 4.1.1 Manufacturing Process

**a) Brief Process Description for Titanium Slag comprises the following steps:**

i) Receipt of raw materials like Ilmenite and Anthracite coal/ coke and their storage.
ii) Batching of raw materials and feeding to electric smelting furnace with tapping of slag and Pig Iron metal at regular intervals.
iii) Gas Purification System for exhaust gases from smelting furnace.
iv) After tapping, cooling will be done by water spray for disintegration.
v) Crushing/ Screening of Titanium Slag to required size fraction.
vi) Packing & despatch of Titanium Slag.
vii) Production of Pig Iron.

**b) Process Description for preparation of Titanium Dioxide Pigment**

There are two (2) distinct technologies which are used for manufacture of Titanium Dioxide Pigment. These are :

i) Sulphate Process
ii) Chloride Process

Sulphate Process is a classical one. In this process the feedstock is first digested in strong Sulphuric Acid which converts Titanium compounds to Titanium Sulphate and Iron into Iron Sulphate. With Ilmenite (mixed oxide of Titanium, Ferric & Ferrous Iron) as feed stock, a reduction step is required in which iron is added to convert any ferric iron to ferrous form to aid separation from process.

The overall chemistry of the process can be represented by the following equations:

1. $FeO, Fe_2O_3, TiO_2 + 5H_2SO_4 \rightarrow FeSO_4 + Fe_2(SO_4)_3$ (Digestion)
   Ilmenite Sulphuric Acid $+ TiOSO_4 + 5H_2O$

2. $Fe(Scrap) + H_2SO_4 \rightarrow FeSO_4 + 2H$ } Reduction
3. $Fe_2(SO_4)_3 + 2H \rightarrow 2\,FeSO_4 + H_2SO_4$ }
4. $TiOSO_4 + 2H_2O \rightarrow TiO(OH)_2 + H_2SO_4$ } Hydrolysis
5. $TiO(OH)_2 \rightarrow TiO_2$ (Pigment) $+ H_2O$ (Calcination).

In case of Titanium Slag as feed material, the reduction & crystallization step would not be required because of lower concentration of Iron. Sulphuric Acid quality & process conditions would also vary

The main reactions for Ti-Slag would be –

$TiO_2 + H_2SO_4 - TiO\,SO_4 + H_2O$

$TiO_2 + 2H_2SO_4 - Ti(SO_4)_2 + 2H_2O$

$Ti_2O3 + 3H_2SO_4 - Ti_2(SO_4)_3 + 3H_2O$

$FeO + H_2SO_4 - FeSO_4 + H_2O$

In view of higher content of titanium oxide in slag, higher acid quantity to ore is needed during digestion. Temperature of reaction is higher as also the temperature of intense reaction initiation and curing. This is the main difference between ilmenite and slag acidolysis.

In chloride process, the following process steps are required :

i) Chlorination of high quality Ti-Slag to produce Titanium Tetrachloride.
ii) Purification of Titanium Tetrachloride.
iii) Oxidation of pure Titanium Tetrachloride
iv) Finishing of raw Titanium Dioxide.

Main Chemical reactions involved are -

$TiO_2 + C + 2Cl_2 – TiCl_4$ (g) + $CO_2$ (g) (Slag)

$TiO_2 + 2\ C + 2\ Cl_2$ - $TiCl_4$(g) + 2CO(g)

} Chlorination & Purification

$TiCl_4 + O_2$ -> $TiO_2$ + 2 $Cl_2$ Oxidation

4.1.2 Choice of Technology

In view of the foregoing discussions, both the processes, Chloride route and sulphate route processes are in vogue. The following may be highlighted in respect of both the processes.

Chloride Route Process

i) Process is complex and requires high titanium oxide containing (>85% $TiO_2$) feed stock

ii) Process is hazardous due to use of chlorine. Handling of $TiCl_4$ is also prone to hazard

iii) Technology for chloride process is closely guarded by a few process licensors

iv) Process produces only Rutile Grade pigment

v) Process produces less pollutants

vi) In USA most pigment plants are based on Chloride route.

Sulphate Route Process

i) Process is simple

ii) It produces both Anatase and Rutile Grade depending on special chemical additives & calcination condition

iii) The process is flexible to provide anatase grade which is required for paper, textile and few other applications

iv) Application of up-to-date technology in pollution control measures in areas of recovery of copperas ($FeSO_4$, $7H_2O$), concentration and recycling of waste sulphuric acid or neutralisation with lime for production of gypsum have rendered the process eco-friendly one

vi) Slag (sulphatable quality, $TiO_2$<85%) may also be used besides ilmenite ore

vii) China, one of the leading global producers of titanium dioxide pigment, produces mostly in Sulphate route

In view of the above, SARAF has preferred to select sulphate route for production of $TiO_2$ pigment. SARAF has also scouted for most advanced 'Sulphate' technology in China for use of both raw materials ilmenite ore and slag.

SARAF and their Consultants DCPL have held detailed discussions with Chong Qung Chemical Engineering Design and Research Institute (CCDRI) – A Leading Research Institute in China. CCDRI have developed their in-house technology, know-how and plant equipment specifications for Titanium Dioxide pigment Plant on sulphate route. Several plants in China, built on CCDRI's technology / know how, are running smoothly. SARAF'S team have also visited a running plant using CCDRI technology and quite satisfied with the performance. It has been decided to engage the services of CCDRI to provide the Technology / know-how.

## 4.2.0 Titanium Di-Oxide Plant

### 4.2.1 Process Description

Ilmenite & Titanium Slag shall be extracted from respective storage areas in the plant shall be stored in bins and measured quantities will be taken to the mill feed bins depending on slag to ilmenite ratio to be processed. For this project option with 50% ilmenite and 50% slag has been envisaged for optimum acid & reductant requirement. The material will be ground to fine powder (-325 mesh) in separate air swept ball mills fitted with classifier and cyclone. The mixed material will be reacted with concentrated Sulphuric Acid in specially designed digesters (or Acidolysis Tanks). Titanium goes into solution as Titanium Oxysulphate ($TiOSO_4$). Ferric Iron present is reduced to Ferrous completely using scrap iron, as ferric iron interferes in subsequent step.

Reduced crude liquor is dosed with settling agents & passed through settling Tanks to remove unreacted ilmenite and silica. The clear liquor is subject to Crystallisation step to separate out ferrous sulphate as copperas ($FeSO_4, 7H_2O$).

The solution is further concentrated in vacuum concentrator / evaporator to required value for precipitation. The concentrated liquor is charged to precipitation tanks. Specific chemicals are added to help precipitation. At high temperature, Titanium gets precipitated as hydrated titania. Any ferric iron still present is reduced to washable ferrous form by leaching the pulp with dilute Sulphuric Acid & Aluminium Powder. It is further washed and treated with specific chemicals. The treated pulp is dewatered and fed to producer gas fired rotary kilns. Hydrated Titania is converted to Titanium Di-oxide – Anatase or Rutile grade depending on additives & calcination conditions.

The Kiln discharge is taken to a rotary cooler and pulverized. Surface coating chemicals are then added to the pigment, filtered & dried in a spin flash dryer. Dried product is milled in a jet mill (motive power – steam) and packed for dispatch. Organics are added to Mill for special coating purpose.

### 4.2.2 Major Equipment & Facilities

Sulphate process is simple and there is less criticality of the type of Equipment. Major equipment & facilities have been indicated in Table 4.2.2 with possible source.

Table 4.2.2

Major Equipment list for Titanium Slag & Titanium Dioxide Plant

| Sl. No. | Equipment/System | |
|---|---|---|
| | | |
| **A** | **Titanium Slag** | |
| 1. | Raw Material Store Yard & Handling & batching Equipment | |
| | Smelting Arc Furnace | |
| | Conveying System | |
| | Cooling Water System with pumps, piping, cooling towers | |
| | Titanium slag handling equipment | |
| | GPS for Furnace unit including cooling arrangement | |
| | EOT cranes, electric hoist etc | |
| **B** | **Titanium Dioxide** | |
| 1. | Air Swet Ball Unit with all accessories | |
| 2. | Digestors /Acidolysis /Hydrolysis Vessels | |

| | | |
|---|---|---|
| 3. | Clarifier / Sedimentation Tank | |
| 4. | Crystallisers | |
| 5. | Concentration Plant | |
| 6. | Pressure filter | |
| 7. | Calciner/Cooler | |
| 8. | Raymond Mill | |
| 9. | Coating System | |
| 10. | Dryer | |
| 11. | Microniser | |
| 12. | Packing Machines | |
| 13. | Various Tanks /Vessels | |
| 14. | Piping | |
| 15. | Pumps /Compressor /Vacuum pump | |
| 16. | Acid Concentration Plant<br>(bought as a special package) | |
| 17. | Sulphuric Acid Plant<br>(bought as a special package) | |
| 18. | Producer Gas Plant | |
| | | |
| D | Electricals | |
| | | |
| E | Field Instrumentation | |
| | | |

## 4.3.0 WASTE ACID CONCENTRATION PLANT

### 4.3.1 Design Basis

The Plant is designed with the following process features :

- Two effect, three stage evaporation, with the first stage with seed crystals.

The design concept will keep the crystal existing in the first effect circulation system, which makes the majority of titanium dioxide colloid hydrolyzed from titanyl sulphate and calcium sulphate crystal precipitated from waste acid adhering to the surface of ferrous crystals, which can be removed from the system with their precipitation. Meanwhile, with the circulation of acid containing the fine ferrous crystals, certain amount of titanium dioxide and calcium sulfate adhering to the heater wall will also be washed down. This will reduce the fouling of the first-effect heater and extends the operational period.

- Low energy consumption

By adopting two-effect co-current evaporation process, vapour from the first effect is used as the heating medium of the second effect. Evaporation capacity of two-effect can achieve to 0.65 ton vapour / ton water. The process design reasonably distributes three effects water evaporating amount, thus the total water evaporating capacity is achieved to the extent of 0.84 ton vapour /ton water. Moreover, the process solution makes full utilization of heat recovery of the condensate, after it flows through two levels of pre-heaters, the process solution can reach 80°C. Thus, the process saves 20% steam consumption than the conventional process.

- Use of Fluorinated resin impregnated graphite material for heat transfer equipment.

The material has better pressure-resistance, temperature-resistance, chemical-resistance and wear-resistance properties than the common impermeable material.

- Utilization of water jet atomization condenser.

It replaces the traditional combination "condenser and vacuum pump", which cut down the energy consumption.

4.3.2 **Brief Process Description**

Titanium dioxide pigment

| | | |
|---|---|---|
| Annual capacity | : | 30,000 TPA |
| Waste acid to treat | : | 30% $H_2SO_4$ 108000 $m^3$/year |
| Sulfuric acid outlet concentration | : | 60-65% $H_2SO_4$ |
| Sulfuric acid outlet (calculated as 65%)flow rate | : : | Approximate 56800 t/year |
| Solid Ferrous Sulphate Crystals | : | 4.0 – 4.5 t/hr. |

High calcium, magnesium, titanium, ferrous concentration in the waste acid, fouls and blocks process holes of graphite block during evaporation. To utilize "two-effect, three stage evaporation process technology with crystal seed brought in the first stage", the technical problem of fouling and blocking is solved.

#### 4.3.2.1 Solution flow

The dilute waste sulfuric acid from washing process flows into clarification and filtration processes, then is pre-concentrated to 30% and enter into dilute acid storage tank, after that it is pumped to evaporation plant. Flowing through pre-heaters, it is eventually sent to the first stage concentration, then the second stage negative pressure, medium temperature concentration. The final is the third stage concentration. During the concentration, adding the crystal seeds in the first stage leads to over saturation of $TiO_2$, CaSO4 crystals which adhere to the seed surface. This greatly reduces the fouling rate on the block holes in the heaters and extends the operational period. After the solution flowing through three-stage concentrations, it flows through different vessels and is cooled down and keeps crystallising and then pumped to the filter press. The filtrate from filter press flows to 65% acid storage tank and is recycled by the acid pump. The solid salt (ferrous sulfate monohydrate) is filtered.

#### 4.3.2.2 Steam flow

The first stage heater works with live steam, but the vapour from the first stage evaporator works as heating medium for the second stage heater. The third stage concentration also utilizes live steam which evaporates in the negative pressure. The vapour generated from separators is condensed by water jet pump and the inert gas from it forms a vacuum. The sub-acidic condensate from Jet Pump is cooled down and recyclable.

4.3.3. **Equipment list of Sulfuric Acid Concentration Plant**

**LIST OF MAIN EQUIPMENT**

| Sl.No. | Name of Equipment | Quantity |
|---|---|---|
| 1. | Pre-heater | 2 |
| 2. | Heater | 3 |
| 3. | Evaporator | 3 |
| 4. | Circulation Pump | 3 |
| 5. | Water Jet Pump | 3 |
| 6. | Flashing Vessel | 1 |
| 7. | Cooling Water Tower | 1 |
| 8. | Filter Press | 2 |
| 9. | Slaking Vessel<br>Solution Vessel | 3<br>1 |
| 10. | Dilute Acid Tank | 2 |
| 11. | Finished Acid Tank | 2 |
| 12. | Solution Tank | 3 |
| 13. | Solution Pump | 2 |
| 14. | Conveying Pump | 8 |

## 4.4.0 SULPHURIC ACID PLANT

### 4.4.1 PROCESS FEATURES

#### 4.4.1.1 Manufacturing Technology

Historically there are two main processes for manufacture of sulphuric acid – the chamber & the Contact process. Both processes are based an sulphur dioxide, both are catalytic, both use air as the source of oxygen for making sulphur trioxide ($SO_3$), both have been operated continuously on a large scale for many years. Chamber process gradually paved the way for contact process for requirement of higher strength acid. Contact process is now most widely used process and the same is being contemplated for this project.

4.4.1.2 The contact process initially was based Single Contact Single Conversion which was converted to Double contact Double Absorption (DCDA) for better conversion efficiency and less emission. The same process has been envisaged for this project. Also newer & improved catalysts, better materials of construction have added to the development of $H_2SO_4$ manufacturing technology.

#### 4.4.1.3 Chemistry of the Process :

Chemistry is well described by the set of equations in Table – 4.4.1.3. The same also indicates the heat of reaction or physical change in KCal/gm mole of $H_2SO_4$ and the range of temperatures. The total heat evolution theoretically amount to 528.7 KCal/gm mole of $H_2SO_4$, about 1.3 million Kilocalories to heat is evolved.

**Table – 4.4.1.3**

| Sl. No. | Process Step | Reaction | Heat & reaction Kcal/gm mole $H_2SO_4$ | Range of Temp. °C |
|---|---|---|---|---|
| 1. | Sulphur melting | S(s) -------> S(I) | 0.38 | 130° - 140°C |
| 2. | Sulphur burning | S(I) + $O_2$(g) - > $SO_2$(g) | - 70.6 | 800°-1000°C |
| 3. | $SO_2$ Oxidation | $SO_2(g)+½O_2(g)=SO_3(g)$ | - 23.7 | 380°-620°C |
| 4. | $SO_3$ Absorption | $SO_3(g)+H_2O(I)=H_2SO_4(I)$ | - 31.7 | 70° - 250°C |
| 5. | Dilution to 98% $H_2SO_4$ | $H_2SO_4(I)+H_2O(I)=98\%H_2SO_4(I)$ | - 0.88 | 60° - 280°C |

4.4.2.1 **Process Description for Sulphur Feed**

The process comprises 3 steps :

i) Combustion of Sulphur

ii) Conversion of $SO_2$ to $SO_3$

iii) Absorption of $SO_3$ to Sulphuric Acid

There is provision for waste heat utilization for generation of Steam and Power.

4.4.2.2. **Sulphur Section**

Sulphur Section consists of Sulphur Melter, Dirty Sulphur Pit, Sulphur Filter and Clean sulphur Day Tank.

Solid sulphur is fed to sulphur melter. Sulphur melter is provided with steam coils and an agitator. Here sulphur is melted by steam at 7 kg/cm$^2$g pressure under intense agitation. Molten sulphur overflows above a baffle into dirty sulphur Pit. After filtration, the molten sulphur is pumped into the Clean Sulphur Day Tank. Clean Sulphur Tank is

provided with two numbers clean sulphur pumps which pumps Molten Sulphur to sulphur furnace.

A precoat pit with one no. of precoat pump and one no. of precoat agitator is also provided for performing precoating operation in Sulphur Filter before starting filtration operation.

#### 4.4.2.3 Gas Section

Combustion of Molten Sulphur is carried out in Sulphur Furnace in the presence of dry air to produce Sulphur Dioxide gas containing 11.5% of $SO_2$ concentration. Dry air required for the combustion is supplied by a Centrifugal Main Air Blower which sucks atmospheric Air through the drying Tower. Hot combustion gas from the Sulphur Furnace is cooled down to auto ignition temperature of the catalyst in Waste Heat Boiler before feeding it to the first pass of the Converter.

The conversion of $SO_2$ to $SO_3$ is an exothermic oxidation reaction and it is carried out in the presence of vanadium pentoxide catalyst in a multi pass converter. The extent of the reaction is limited by the gas temperature rise and by the formation of $SO_3$. The extent of efficiency of conversion is increased by carrying out the reaction in successive passes with partial cooling between passes. The $SO_2$ to $SO_3$ conversion is further optimized by providing intermediate absorption stage for the removal of $SO_3$ formed in the first three passes of the converter and thus making conditions more favourable for the final conversion in the fourth pass.

Heat generated due to conversion of $SO_2$ to $SO_3$ in first and second pass is removed in Superheater and Hot Heat Exchanger, respectively. Heat generated in third pass is removed in Cold Heat Exchanger followed by Economizer. Gas from Economizer is passed through Inter Pass



Absorption Tower (IPAT) to absorb $SO_3$ in the circulation stream of 98.5% Sulphuric Acid. Gas from IPAT is heated to the reaction temperature in Cold Heat Exchanger followed by Hot Heat Exchanger before feeding to fourth pass. Heat generated in the fourth pass is recovered in Economizer. The gases are taken to Final Absorption Tower (FAT) to absorb $SO_3$ generated in the fourth pass by the circulating stream of 98.5% Sulphuric Acid. Exit gas from FAT is vented to atmosphere through the stack with maximum $SO_2$ of 2 Kg/ton of 100% acid.

#### 4.4.2.4 Acid Section

Acid section consists of the common acid pump tank, a common acid Circulation Pump and an Anodically Protected Acid Cooler. Hot acid from the acid pump tank is pumped by vertical submersible acid circulation pump through the acid cooler. Cooled acid is then circulated through IPAT and FAT for absorption of $SO_3$ from the converter gas and through DT for the removal of moisture from atmospheric air. Outlet acid from IPAT and FAT becomes concentrated due to formation of Sulphuric Acid by the reaction of $SO_3$ and $H_2O$ while, outlet acid of DT becomes dilute due to addition of moisture from the air.

Acid level in acid pump tank is automatically controlled by addition of dilution water to acid pump tank thereby controlling product discharge rate, as well.

#### 4.4.2.5 Heat Recovery System

Heat of combustion produced in sulphur furnace and heat of reaction of $SO_2$ to $SO_3$ conversion in Converter is utilized to generate 40kg/$cm^2$g saturated steam in the steam & water section. These include Economizers through which Boiler Feed Water is fed to the steam drum of Waste Heat



Boiler where saturated steam is produced. The steam generated in the boiler is superheated by the Superheater. The superheated steam can be taken to a TG. Set for generation of power and other uses in the process area.

### 4.4.3.0 Salient Features of the Plant

### 4.4.3.1 Capacity

The plant will be designed for the production of 300 TPD Sulphuric Acid. Table 4.4.3.1 indicates major Equipment List.

### 4.4.3.2 Operating Schedules

3 shifts, continuous 8 hrs. / shift.

**Table – 4.4.3.1**

**EQUIPMENT LIST**

| Sl. No. | Section | Number |
|---|---|---|
| 1. | **Sulphur Section** | |
| | • Sulphur Filter for Molten Sulphur application, capacity – 300 MT/Cycle, with hydraulically retractable / steam jacketed shell. 2 Nos. Left filter plates in SS-304, vibrators & accessories, brick lined complete with Burner & Burner Management System | 1 No. |
| | • Melter coils for Melter | Required Sets (4 nos.) |
| | • Clean sulphur pump | 2 nos. |
| | • Sulphur Valves | |
| | • Sulphur Piping | |
| | • Sulphur Gun | |
| 2. | **Gas Section** | |
| | • Air Filters & Silencers | |
| | • Main Air Blower, centrifugal type steam Turbine driven steam inlet = 40 Kg/cm$^2$, Exhaust Steam = 7 Kg/Cm$^2$g | 1 Lot |

| Sl. No. | Section | | Number |
|---|---|---|---|
| | | with governor, 10 System, cooling system & all accessories | |
| | • | Drying Tower | |
| | • | IAT | |
| | • | FAT | |
| | • | Brink Mist Eliminator | 3 Sets |
| | • | Acid Distributors | 3 Sets |
| | • | Sulphur Furnace | |
| | • | Converter & Grids | |
| | • | Catalysts | |
| | • | Hot Heat Exchanger (HHE) | |
| | • | Cold Heat Exchanger (CHE) | |
| | • | Alkali Scrubber | |
| | • | Caustic Tank | |
| | • | Stack on Scrubber | |
| | • | Hot Gas Bypass Valve | |
| | • | Mist Eliminator for Scrubber | |
| | • | Tower Packing of Intalox saddles | |
| | • | Ducting / Bends | |
| | • | Bellows (SS0304) & Ducting (SS) | |
| | • | Gas Valves | |
| | • | Insulation | |
| | • | Gratings, Spring Supports, Converter, Quartz & Structural Steel | |
| | • | Hot Gas Filter | |
| 3. | **Acid Section** | | |
| | • | Acid Pump Tank | |
| | • | Acid Cooler | |
| | • | Plate Heat Exchanger for Acid Cooling | |
| | • | Dilute Water Tank | |
| | • | Acid Valves | |
| | • | CI Pipes | |

# SECTION – 5

## RAW MATERIALS, PRODUCTS, UTILITY & AUXILIARY SERVICES

## SECTION – 5

## RAW MATERIALS, PRODUCT, UTILITY & AUXILIARY SERVICES

5.1.0 Raw Materials for Titanium Slag & Pig Iron are derived from natural ilmenite through Electro Smelting Process. Ilmenite is principal raw material. Besides this, other raw materials like anthracite coal/ pet coke.

5.1.1 Titanium Dioxide Pigment is produced by Sulphate Process with raw materials like natural Ilmenite and Titanium slag. Ilmenite and Ti-slag are principal raw materials. Besides those, other raw materials like Sulphuric Acid, Iron Powder, Sodium Hydroxide, Aluminium Powder etc. are also required.

5.1.2 **Major Raw Materials required for Titanium Slag are as follows**.

| SL. No. | Item | Consumption in MT per MT of Slag |
|---|---|---|
| a) | Ilmenite | 2.05 |
| b) | Anthracite Coal/ coke | 0.35 |
| c) | Graphite | 0.025 |

Typical composition of Ilmenite is shown below :

| | Components | Weight % |
|---|---|---|
| 1 | $TiO_2$ | 50.50 |
| 2 | FeO | 34.20 |
| 3 | $Fe_2O_3$ | 12.20 |
| 4 | $Cr_2O_3$ | 0.052 |
| 5 | $P_2O_5$ | 0.03 |

| | | |
|---|---|---|
| 6 | $SiO_2$ | 0..80 |
| 7 | $Al_2O_3$ | 0.45 |
| 8 | CaO | 0.052 |
| 9 | MnO | 0.55 |
| 10 | MgO | 0..78 |
| 11 | $V_2O_5$ | 0.22 |
| 12 | Moisture | 2.20 |

5.1.3 **Major Raw Materials & Utilities required for Titanium Dioxide Pigment are as follows**

| Sl. No. | Item | Consumption in Kg per MT of Pigment |
|---|---|---|
| a) | Ilmenite | 851.0 |
| b) | Sulphur | 726.0 |
| c) | High Titanium Slag | 851.0 |
| d) | Iron Powder | 110.0 |
| e) | Sodium Hydroxide | 270.0 |
| f) | Diatomite | 5.3 |
| g) | Flocculating Agent | 7.1 |
| h) | Charcoal Powder | 0.59 |
| i) | Aluminium Powder | 0.61 |
| j) | Potassium Hydroxide | 5.0 |
| k) | Zinc Oxide | 6.0 |
| l) | Hydrochloric Acid (30%) | 115.0 |
| m) | Zirconium Sulphate | 23.0 |
| n) | Sodium Meta Aluminate | 52.0 |
| o) | Lime | 173.93 |
| | | |

5.2.0 **Sources of Raw Materials & Utilities**

Source Potential of various major raw materials is given below :

| Raw Materials | | *Source* |
|---|---|---|
| Ilmenite | | IREL(Transport by Road) |
| Anthracite Coal | | Imported/Market |

| Raw Materials | | *Source* |
|---|---|---|
| Sulphur | | Imported/ Market |
| High Titanium Slag | | Own Production |
| Iron Powder | | Market |
| Sodium Hydroxide | | Market |
| Diatomite | | Market |
| Flocculating Agent | | Market |
| Charcoal Powder | | Market |
| Aluminium Powder | | Market |
| Potassium Hydroxide | | Market |
| Zinc Oxide | | Market |
| Hydrochloric Acid (30%) | | Market |
| Zirconium Sulphate | | Market |
| Sodium Meta Aluminate | | Market |
| Lime | | Market |

**Ilmenite** is the titanium bearing mineral. It is the raw material required for production of Titanium products. Ilmenite is recovered from Beach Sand as one of the Constituent of Heavy Mineral Concentrate. Indian Rare Earths Ltd (IREL) is holding mining lease rights over 32 km stretch of Coastal Belt near Gopalpur Port, for mining of Beach Sand Minerals. IREL have set up a large mining and mineral separation plant known as OSCOM plant at Chhatrapur for recovery of Heavy Mineral Concentrate, including Ilmenite from Beach Sands. Currently OSCOM Plant's annual production of Ilmenite is about 2,20,000 tonnes ilmenite from IREL will be used for this Project. Indian Rare Earths Ltd. (IREL) has also other mining units at Chavara, Kerala (1,54,000 TPA ilmenite). Manvala Ruridhi, Tamilnadu (90,000 TPA Ilmenite).

Besides, Kerala Minerals & Metals Limited is also engaged in ilmenite production at Chavara (ilmenite 40,000 TPA).

M/s. Trimex Sands, Chennai has separation plant at Srikakulam, AP and having 2,00,000 TPA ilmenite production. Trimex Sands is contemplating expansion by another 2,00,000 TPA ilmenite production.

Other players are VV Minerals, Beach Minerals Co., Indian Ocean Garnet Sands in Tamilnadu producing around 4,00,000 TPA ilmenite totally.

One month's inventory for ilmenite shall be provided. Ilmenite will be received through trucks.

5.2.1 **PRODUCTS**

| | |
|---|---|
| Titanium Slag | - 36,000 TPA |
| Pig Iron | - 20,000 TPA |
| Titanium Dioxide | - 30,000 TPA |

5.2.2 Chemical composition data of Ti-slag (Sulphateable grade)

| Components | Weight % |
|---|---|
| $TiO_2$ | around 85 |
| Fe | $\leq$7.0 |
| $MnO_2$ | $\leq$4.5 |
| CaO + MgO | $\leq$1.5 |
| Al | $\leq$0.4 |
| V | $\leq$0.04 |

Quality of Titanium Dioxide shall conform to Rutile grade with $TiO_2$ content of 93-97% depending on qualities.

Typical composition shall be as follows:

| | | |
|---|---|---|
| $TiO_2$ content | : | Minimum 93% |
| Tint Reducing Power | : | 100% |
| Oil absorption (gm/ 100gm) | : | 22 max. |

| | | |
|---|---|---|
| pH value | : | 6.5 to 8.0 |
| 45 micron sieve residue | : | 0.1% min |
| Water soluble matter | : | 0.3% max |
| Volatile matter | : | 0.75 max |

### 5.2.3 Handling of Raw Materials & Products

In the plant various raw materials, intermediate products & final products will be handled. Materials will be in various forms like liquid, powder, solid and the same shall be suitably handled & stored within plant premises, while taking care of its specific properties, hazardous nature and stability.

## 5.4.0 ELECTRICAL SUPPLY & DISTRIBUTION

### 5.4.1 GENERAL

Power demand for the proposed Titanium Complex has been estimated on the basis of equipment required for the proposed plant.

Power distribution arrangement has been designed to take care of estimated loads and their locations within the plant area. In case of any major change in type, nature, or rating of the loads or in the location of load centers, corresponding change may be necessary in the power distribution arrangement of the plant.

Total power demand for the plant shall be around 23MVA.

### 5.4.2 Power Supply

Electrical power for the plant is drawn at 33kV. For this purpose, 33kV power will be made available at the terminal point of main receiving substation (MRSS) in plot area of the Titanium Dioxide Plant. From the terminal point, the power will be received through 33kV switchyard and then stepped down to Primary & Secondary distribution voltage levels to feed plant equipment & auxiliaries.

### 5.4.3 Main Receiving Sub-Station (MRSS)

Power is envisaged to be made available in the plant through overhead 33kV line from the OPTCL substation. This line will be terminated at Line Gantry located at west side of Plant area. A 33kV, single bus configuration, outdoor switchyard will be constructed in Plant MRSS to receive power from above Line gantry.

Two (2) nos. Station Transformers of 25MVA 33/6.9kV have been considered in the MRSS to step down 33kV to 6.6kV level, considering redundancy. One 6.6kV Switchyard control room is envisaged to accommodate Switchboards as well as Switchyard Auxiliaries, namely, Control and Relay Panel, Battery & battery charger, UPS, PMCC, DCDB, ACBD, PDB etc as required.

Two (2) nos. Oil/ Dry type LT Transformer along with PMCC shall be located inside MRSS. This PMCC shall be used to cater Plant and auxiliary power required for the substation

### 5.4.4 Utilisation Voltage

Primary distribution system is envisaged as 6.6kV, 3 phase, 3 wire, non-effectively earthed i.e., the neutral of the Station Transformer secondary side is earthed through resistance to limit Earth Fault Current of 400A. Utilisation voltage for few equipment shall also be 6.6kV.

In general the electrical loads for various equipment of the plant shall mostly comprise of LT Motors & other LT auxiliaries fed from 415V Voltage level. The Medium Voltage (415V) system shall be solidly earthed.

LT Motors rated below 110 KW shall generally be Switch Fuse-Contactor Controlled and rated 110 KW & above shall generally be Air Circuit Breaker (ACB) controlled. Motors shall generally be started with Direct Online (DOL) Method unless there is specific requirement of special assisted starting to meet system / process requirement. Above 160KW, all drives shall generally be fed from HV switchgear, i.e. 6.6kV System.

### 5.4.5 Power Distribution Scheme

HT & LT power distribution system shall be through XLPE armoured Aluminium cables. PMCC shall be fed through non-segregated phase Busduct from LT transformers.

LT Switchgear shall feed respective MCC of the Process section / sub-section, which in turn will feed power to the various loads of the process section.

In addition to the MCC, there will be AC Distribution board & DC Distribution board which will cater the non process loads. For

Illumination system, there shall be separate lighting distribution board connected to the lighting transformer located in proposed substation building.

### 5.4.6 Motors

Motors shall generally be Squirrel Cage Induction type motors. All motors shall be suitable for voltage variation of ± 6% and frequency variation of ± 3% and shall be capable of starting and accelerating the driven equipment smoothly at 80% of the rated voltage.
Enclosure protection class of the motor shall be suitable for the industry.

### 5.4.7 Protective Equipment

Suitable protective relays and devices as per standard practice will be provided for all the electrical equipment. Protective relays shall be numerical type.

The power transformer will have the following protections:

- IDMTL relays for overload and earth fault protection with instantaneous element for short circuit protection.
- Differential protection as applicable
- Restricted earth fault / stand by earth fault protection as applicable
- Buchholz relays with alarm and trip contacts.
- Oil and winding temperature indicator (local) with alarm and trip contacts.

H.T. motors and LT motor rated 110kW & above will be protected by composite Motor Protection Relay and under voltage relay.

IDMTL over current, earth fault protection for incoming / outgoing feeders shall be considered. Zero sequence CT operated sensitive earth fault protection shall be considered for non-effectively earthed system.

### 5.4.8 Metering

For purpose of tariff metering, dedicated metering along with CT and PT will be provided on the 33kV side as per requirement by Electric Supply Authority. Tariff meters class shall be as per electric supply authority and shall be located at Switchyard control building suitably.

In general multifunction type meters shall be considered, with communication capability if required.
Outgoing motor feeders rated above 30 KW will have ammeter mounted on MCC. The outgoing motor feeders for certain other important machineries, even of lower capacity, may also have ammeter depending on process requirement.

### 5.4.9 Control Voltage

220 Volts DC Voltage for control & indication of switchgear. Set of battery & chargers will be located at MRSS and other process buildings as required.

Single phase 230 Volts AC supply is considered for other control and auxiliary power. 230V AC UPS supply shall be considered as required. Set of UPS will be located at MRSS and other process buildings as required.

5.4.10 **Cabling**

The cables will be normally laid and dressed in suitable ladder type trays for horizontal as well as vertical run. In indoor areas, within a building, cable trays will be laid in the trench in the ground floor and/or suspended from ceiling in case of upper floors. In outdoor area, within the plant site, where such facility is not available, cables will be laid and buried below ground duly protected by precast slabs or bricks. However, whenever possible, these cables will be laid on the suspended brackets attached to the process building structure. Interplant cabling in general may be buried, through formed trench or overhead trestle as suitable. HT cables from Switchyard to Unit Substation buildings shall be run through overhead cable bridge/trestle.

H.T. power cable will be of stranded Aluminium conductor with XLPE insulation, PVC FRLSH outer sheathed and armoured.

L.T. power cables will be generally of stranded aluminium conductor (above 6sq mm) with XLPE insulation, PVC FRLSH outer sheathed and armoured.

Control cables will be of stranded copper conductor having PVC insulation, sheath and armoured.

Selection of size of power cables will be based on allowable voltage drop, thermal rating, fault withstand capacity and method of installation etc.

Besides these, there will be few special cables for instruments and communication.

### 5.4.11 Power Factor Improvement

The system power factor at HT will be maintained around 0.99 by providing capacitor banks at respective level.

### 5.4.12 Illumination System

AC normal, AC emergency and DC emergency lighting shall be provided for illumination of the plant outdoor &indoor. Suitable illumination system will be provided to have efficient lighting. Generally the following level will be provided :

- Administrative office, laboratory : 300 Lux
- Control Room : 300 Lux
- Substation and Process Plant : 200 Lux
- Unloading Bay & Product Despatch Area : 200 Lux
- Process Plant Outdoor Area : 20 Lux
- Outdoor Area (others) : 10 Lux

The following types of lighting fixtures will be used :

**Indoor Area**

- Dust proof fixtures suitable for 2x36 watts compact fluorescent lamps (CFL) for areas of normal height, with electronic ballasts.
- In certain areas similar fixtures suitable for hazardous area.
- In the control room, decorative type fixtures.
- For areas, where ceiling height is above 5 meters, medium / high bay fittings as required with high pressure sodium vapour lamps.

**Outdoor Areas**

Weather proof type street light or flood light fittings of approved type suitable for high pressure sodium vapour lamps at convenient locations for area lighting will be provided. Street lighting with solar cell in strategic areas will be explored.

Emergency lighting including that for safe exit shall be considered in case of loss of normal power.

5.4.13 **Grounding and Lightning Protection**

The actual design of the grounding work will depend on the soil resistivity. The earth electrodes will generally be with vertically driven M.S. rods. These earth electrodes will be interconnected by earth continuity conductors buried below ground. This electrode system will be as per IS-3043: 1966. Adequate number of risers connected to the earthing system will be brought out for eventual connections with the electrical equipment.

All the electrical equipment will be earthed in accordance with the latest Electricity Rules and relevant Indian Standard Specifications.

For Substation Building and Outdoor Switchyard earth-mat will be used to keep the touch voltage and step voltage within acceptable limit.
Earthing system of MRSS and other plant buildings & area will be interconnected through inter plant earthing conductors.

All the Building, Switchyard, Process Building and others, will be protected against direct lightning stroke. This will be achieved by providing required Air Terminals, shield wires, Down Conductors and Grounding System as required. Grounding System will be common for



both Lightning Protection and Equipment Grounding. Lightning protection system shall be as per IS 2309.

5.4.14 **Emergency Power**

Three (3) no. 6.6kV, 1000 KVA DG set are envisaged to provide necessary standby power in case of emergency. This will feed as alternative incoming power for the 6.6kV switchgear with a change over arrangement so that in case of failure of normal power supply, this power can be fed to the emergency loads.

5.4.15 **Cathodic Protection**

Cathodic protection system will be employed as necessary.

5.4.16 **LIST OF EQUIPMENT**

A list of major electrical equipments and accessories.

25MVA 33/6.9kV Transformers
33kV Switchyard, Single BUS
One (1) number 33kV Line Bay consist of LA, CT, PT, Isolator with Earth Switch and SF6 Breaker
Two (2) number 6.6kV Transformer Bay consist of LA, CT, Isolator with Earth Switch and SF6 Breaker
6.6kV HT Panel
6.6/0.433kV LT Transformer
415V LT Board
HT Cables
LT Power & Control Cables
Grounding Materials
Lightning Protection Materials
Illumination System (Lighting Transformer, MLDB, LDB & Fixtures)
Cable Tray Materials

Battery & Battery Charger

UPS

## 5.5.0 INSTRUMENTATION & CONTROL SYSTEM

- **FIELD INSTRUMENTATION**

Instrumentation sensing, transmission, measuring & computing systems will be electronic and final control elements such as control valves etc shall be pneumatic in general.

Signal transmission from field to control room and vice-versa will be in the current mode i.e. 4-20 mA DC. All field Instruments are envisaged to be Smart type giving output with superimposed digital signal conforming to HART protocol. All temperature elements RTD/Thermocouple will be duplex type. Temperature transmitters will be used for all temperature elements to generate 4-20 mA signals.

Measurements of flow on process lines shall be generally Orifice DP / Magnetic Flow Meters. Level measurements shall be Ultrasonic Type for liquid & Radar Type solid. Pressure measurement shall be done through piezoelectric type pressure transmitter.

All field instruments will be terminated in the local junction box. Individual & overall shielded twisted pair cables shall be used for analog signals. Core cable shall be used for Digital signals. Multicore or Multipair cables will be used from local junction box to the marshalling cabinets or Input/output terminal blocks of PLC system.

## CONTROL & AUTOMATION SYSTEM

The Control & Automation System has been envisaged for monitoring and control of significant variables of each process section of the Plant with the help of CRT and keyboard / Mouse based operator's station.

### Integrated Communication system

The communication system has been envisaged for the plant area, which will provide a transparent communication link amongst the users whether they are in plant.

The type of the communication system shall be as follows:

i) EPABX communication system which will have its subscribers in the plant.

ii) Wireless radio network communication system which will have it's closed user group in the plant, and adjoining area.

iii) PA/GA System has been envisaged in the entire plant to communicate in the plant personnel. PA/GA System shall have facility to communicate directly through EPABX System.

## 5.6.0. WATER SUPPLY AND DISTRIBUTION

5.6.1. Requirement of Water

Estimated Break-up of raw water requirement is as follows

| Description | Quantity ($m^3$/ day) | Remarks |
|---|---|---|
| Titanium Slag plant | 800 | Filtered water |
| Process Requirement for Titanium Dioxide | 6900 | Filtered water |
| Total | **7700** | |

5.6.2. Source of Water

Raw water will be supplied from the river Rushikulya. Water will be pumped from the well and stored in a natural pond available at site. From there it will be distributed by several pumps as per requirement

Water Analysis report is furnished hereunder:

- pH 7.2 - 7.8
- turbidity 45 NTU
- Total Dissolved Solids, mg/l 189
- Chlorides, mg/l 86.5
- Sulphate, mg/l 34
- Iron, mg/l 0.9
- Total Hardness, mg/l 188 as CaCO3

5.6.3. Plant Water Reservoir

Intake water received at raw water reservoir inside plant site. The capacity of Raw Water Reservoir shall be suitable for five (5) days

storage. The intake water will be clarified in the flocculator and thereafter stored in clear water reservoir. If the quality of intake water is clear enough, it will be directly stored in the clear water reservoir.

The clear water reservoir will have two compartments. Capacity of one compartment will be around 20,000 cum considering around two (2) days requirement for plant water requirement and another compartment of 2,000 cum reserved for Fire Fighting System.

Plant water distribution system

A pump house will be constructed adjacent to clear water reservoir where Cooling Tower make-up pumps, service water pumps, potable water pumps, fire fighting pumps etc. will be installed for different requirement.

a) Cooling Tower Makeup Water Pumps

Cooling tower make up pumps will supply make up water to CT basin to compensate evaporation loss. Two (2) no. of Pumps (1W + 1S) of suitable capacity shall be provided.

b) Service Water Pumps

Service water pumps will supply water via filtration unit to different process building and other required areas. Two (2) nos of Pumps (1W + 1S) of suitable capacity shall be provided. For continuous supply of service water to different buildings/ facilities one service water overhead tank of adequate capacity will be constructed for continuous supply of service water.

c) Potable Water System

The Drinking water pumps shall be utilised for filling drinking water overhead tank for Plant area. The drinking water from the overhead tank shall be fed to different buildings/units by gravity through piping network. The tank preferably shall be centrally located catering to the requirements. Considering one (1) day's storage, the capacity of OH tank shall be 50 cum. Two (2) no. of Potable Water Pumps (1W + 1S) each 25 cum/hr capacity shall be provided.

d) Cooling Towers and Circulating Cooling Water Pumps

Cooling tower of adequate capacity will be considered to cool the hot water return from heat exchangers, compressors etc. Number of cells also would be decided based on requirement of various process equipment.
Circulating Cooling Water and Auxiliary Cooling Water pumps of adequate capacity & numbers shall be considered for cooling arrangement.

5.6.4. Rain Water Reservoir

A natural pond will be made available at the lowest existing level to collect rain water inside the plant area. Construction of rain water catchment, various drains and re-routing of existing nala etc. would be done to collect rain water. This water will be utilised for rain water harvesting, area cleaning/washing and also for other suitable areas. Also this water may be used as raw water based on its quality and requirement.

## 5.7.0 QUALITY CONTROL LABORATORY

The plant will be equipped with a Quality Control Laboratory for quality control of incoming, outgoing and in-process materials. The laboratory will comprise all necessary segments required for such testing like microscopic analysis, X-ray analysis, spectroscopic & chromatographic analysis, besides standard facilities for sample preparation, general laboratory, requisite safety items, balances, furnaces & ovens, chemicals & glasswares, gas manifold system etc.

Major laboratory equipment would comprise

- Conventional laboratory equipment like Conductivity meter, pH meter, Turbidity meter, microwave furnace, photoelectric Calorimeter etc.
- Metallurgical microscope with necessary attachments
- UV visible spectrophotometer, Gas chromatograph, Atomic Absorption spectrophotometer
- Organic & environmental measurements comprising elemental analyser, portable gas analyser, BOD indicator, COD digestion unit
- X-ray diffractometer & X-ray fluorescence equipment with all attachment
- Carbon & Sulphur analyser

The laboratory shall be complete with all proper and sufficient furniture comprising working table, wall benches, chemical and apparatus cabinet etc.

## 5.8.0 FIRE PROTECTION SYSTEM

Fire Protection and Detection System is required to combat any outbreak of fire and reduce damage. For this type of plant, category of Hazard Classification is ordinary Hazard and the system will be designed accordingly. To combat the fire the following systems have been envisaged.

- Fire Hydrant System
- Spray Water System
- Fire Alarm System
- Portable Fire Extinguisher

### 5.8.1. Fire hydrant system

The Fire Fighting system shall basically consist of a network of underground and over ground pipes fed to different hydrant points located at strategic locations to combat any outbreak of fire within the plant area. The water for the hydrant system and wet riser shall be made available to the hydrant valves by firewater pumps located in the Pump House build for flooded suction pump. Any fall in line pressure in the fire hydrant system shall be compensated through jockey pump installed in the firewater pump room to ensure a nearly constant pressure in the hydrant network.

In the pump house there are two (2) number of Electric Motor Driven Horizontal Centrifugal Fire Water Pump (HP #1, HP#2) serving for hydrant system wet riser & spray system. The Main Fire pumps shall have a suitable discharge capacity and pressure considering the TAC and site requirement. Besides, one (1) number of Diesel Engine Driven Pump

(DP #1) of same head and same capacity as Electric Driven Pump shall also be kept to take care during non-availability of power. Also Two (2) numbers Jockey Pump (JP #1 & JP#2) of suitable capacity and head as per TAC shall be provided to take care of any fall of line pressure in the hydrant system.

The hydrants will be placed at an interval of 45M and required number of hydrant will be installed throughout the plant. Water for spray system would be provided from the ring main for fire hydrant system.

### 5.8.2. Spray Water System

Fixed Water Spray System shall be provided for Transformer area, cable rack etc. as per requirement. It is connected to a reliable source of fire protection water supply and equipped with water spray nozzles for specific water discharge and distribution over the surface or area to be protected. In Water Spray system, nozzles used may be for High Velocity as well as for Medium Velocity Water Spray systems depending on orifice sizes with varying discharge angles so that discharge can be controlled for optimum protection.

### 5.8.3. Fire Alarm System

In the event of a fire, signal from smoke/heat detectors shall give alarm on fire alarm panels. Smoke/Heat detectors shall be mounted at strategic locations in the area to be protected. A number of detection zones shall be provided for each room/area and signal from any detector of a particular zone shall enable the control room to spot the zone under fire. All detectors/devices shall be connected to the Main Fire Control Panel in Fire Control Room for receiving and processing the signals generated by all field devices/detectors spread over the entire area/premises.

Break glass type Manual Call points shall also be provided at various strategic locations such as, at the lobby provided at each floor as manual means of fire detection and raising of fire alarm. System shall also comprise of Sounders/Strobe placed at acoustically conspicuous locations to alert the people in case of fire.

5.8.4. Portable Fire Extinguishers

A number of portable type fire extinguishers (different classes & types) as per requirement shall be provided around different areas to arrest small fires at their incipient stages. All fire extinguishers shall be provided with initial fill, required mounting and accessories.

Based on the class of fire identified in the building, following type of extinguishers are proposed to be installed at suitable locations in the respective premises as per class of fire identified in IS-2190.

- Nine (9) liters capacity water expelling type extinguishers as per IS: 934 for Class-A fire.
- Dry Powder Type Extinguisher as per IS: 2171.
- ABC powder of 2/5 kg capacity as per IS: 13849 shall also be provided.

5.8.5. Fire Station Office

A Fire office will be constructed within plant area where fire personnel would be available for emergency duty and to attend as and when required. Fire Alarm and Control panel will be installed in this building for information of fire zone area and to take necessary actions accordingly. A Fire Tender will be available in this building along with hose and hose reels etc.

## 5.9.0. FUEL OIL /LDO STORAGE AND DISTRIBUTION SYSTEM

Fuel oil/ LDO will be required for D G Sets and other heating purpose. Fuel will be stored in a tank by unloading from tanker. Unloading from tanker and distribution to required points will be done by the same pump with necessary change over arrangement. Capacity of storage tank and pump capacity would be suitable for required system.

## 5.10.0. COMPRESSED AIR SYSTEM

Compressors of suitable capacity will be provided to meet the requirement of process plan air as well as instrument air.

Ten (10) nos. (8 working + 2 stand by) of dry oil free Rotary Screw Type Air Compressors of suitable capacity will be considered for this project. Heat of compression type air dryer will be considered along with the compressor. Air receiver will be installed within the compressor room area and from the receiver compressed air will be supplied to required points.

List of major equipment

1. Dry oil free air-compressor skids with dryer & accessories
2. Heat of Compression type Air Dryer with all mountings and accessories
3. Two (2) nos. of Plant Air Receiver and one(1) no. of Instrument Air Receiver of suitable capacity with all accessories / instruments
4. Piping, valves & fittings

For power plant area, additional service air compressor would be considered as per necessity.

## 5.11.0 PRODUCER GAS PLANT

It has been contemplated that producer gas shall be used as fuel for calciner. Considering 1620x$10^4$ KJoule /Tonne of Pigment, quantum of energy requirement would be of the order of 16 Million Kcal/hr. Three (3) nos 3.2 M dia, extended shaft, rotating grate, double off-take type gas producer of reputed make have been contemplated. The package will include coal crushing & screening facility, coal bunker, charging arrangement, gasification chamber with rotary grate, air blower & piping, water injection facilities, gas piping, clear gas scrubber, electrostatic precipitator for removal of tar etc. Producer gas shall use preferably 'C' grade coal. The following parameters are expected.

Gas Quantity : 2500-2800 $NM^3$/ton of coal

Net calorific value of gas after detarring : 1450-1500 Kcal/$NM^3$

Probable gas composition

$CO_2$ : 3 - 5%
$O_2$ : 0.2 – 0.4%
CO : 26 – 28%
$H_2$ : 14 – 16%
$CH_4$ : 2 – 3%
$N_2$ : 48 – 52%

✓ If required, pressure shall be boosted for requirement of burner of calciner.

## 5.12.0 MISCELLANEOUS BUILDINGS / FACILITIES

Within the plant complex following non-plant buildings would be available.

1. Canteen Building – The total number of staff & worker will be around 1058 in three shifts. A canteen building is considered for average sitting arrangement of 100 people at a time.

2 First Aid Building – There will be a first aid building within the plant area for attending minor accident of any working personnel.

3. Central Laboratory Building – There will be one Central Laboratory Building in the plant area for testing of raw materials as well as the products etc.

4. Administrative Building – There will be one admin building for taking care of general administration as well as accounts office etc.

# SECTION – 6

## PLANT LAYOUT & CIVIL WORK

## SECTION – 6

## PLANT LAYOUT & CIVIL WORK

### 6.1.0 PLANT LAYOUT

The Plant layout shall comprise facilities for Titanium Slag Plant, Titanium dioxide Plant, Sulphuric Acid Plant, Waste Acid Concentration Plant, Boiler & Steam Generator Plant and all other facilities

The following Buildings shall be considered in the process area for Titanium slag and Titanium Di-oxide Plant.

- Raw Material Storage Yard.
- Ball Mill Shed
- Smelter Shed
- Digester Building
- Reduction Section
- Clarifier Shed
- Vacuum Crystallization Building
- Vacuum Concentration Building & Hydrolysis Building.
- Filtration Building
- Calciner Shed
- Rutile Coating Section
- Finished product storage
- Utility Building/ shed like pump house, compressor house, chemical storage house

6.2.0 **Civil Work**

6.2.1 IS-875 shall be followed for estimating design wind pressure.

6.2.2 **Seismic Design Requirements**

The seismic design of plant and equipment shall conform to IS – 1893 latest edition considering proper zone.

6.2.3 **Standard regulations**

The design and specifications of the proposed civil construction shall, in general, be in conformity with the National Building Code of India. Apart from this, the minimum requirement of the following Codes/Standards and regulations as per their latest amendments/revisions shall be followed for civil and structural design:

Standards and codes of practice of the Indian Standards Institution or in its absence relevant Russian / British / American / German or any other equivalent Standards and Codes of Practices shall be followed:

- Indian Explosives Act 1984.
- Indian Electricity Rules.
- Indian Factories Act, as applicable in Odisha.
- Codes and recommendations of the Indian Roads Congress.
- Fire protection manual, issued by the Mumbai, Kolkata, Delhi and Chennai regional Tariff Advisory Committee.
- Any other law or statutory regulation that may be in force.

A few IS Standards that will be mostly used for civil/structural design are:

(a) IS-456 : Code of Practice for plain and reinforced concrete.

(b) IS-800 : Code of Practice for general construction in steel.

(c) IS-875 : Design loadings for buildings and structures.

(d) IS-1893 : Criteria for earthquake resistant design of structure.

(e) SP-6 : ISI Handbook for structural engineers.

(f) IS-2950 : Code of Practice for design & construction of raft foundation.

(g) IS-1080 : Code of Practice for design & construction of simple spread foundations.

(h) IS-3370 : Code of Practice for Water Resistant Concrete Structures.

(i) SP-16 : ISI Handbook for Designing R.C.C. Sections.

6.2.4 **Design Loads**

**Dead Loads**

Dead loads shall include weight of the structural components and architectural appurtenances incorporated in the structure plus hung loads if any, and any other permanent externally applied loads.

This shall also include the weight of equipment itself. Additional loading of 100 kg/m$^2$ for 50 mm thickness of consolidated dust shall be considered on all roofs and fully exposed operating floors.

Unit weight of all building materials shall be as per IS:1911.

**Superimposed Loads**

Live loads (uniformly distributed) on floors shall be as per Table furnished below:

| **Location of Load** | *** Live Load (Kg/m$^2$)** |
|---|---|
| Operating floors | 500 |
| Roofs | As per IS:875 |

| Location of Load | * Live Load (Kg/m²) |
|---|---|
| Roofs used as operating areas | 500 |
| Office floors for general use, worker's rooms | 300 |
| Stairs, landing, corridors, walkways and balconies for industrial buildings, MCC room | 500 |
| Workshop and stores grade floor and main electric sub-station, switchgear room (including dynamic factor) | 1500 |
| Ground floor for all other industrial buildings | 500 |
| Trench covers indoor and outdoor except for crossing of vehicles | 500 |
| Roads, bridges, culverts ramp, trench crossings | ** As per IRC-6, Class-A loading |
| All other live loads | As per IS:875 |

For calculating floor slabs, beams, girders, columns & footings.

** Actual max. vehicle weight shall be considered for roads meant for "of-highway vehicles".

Apart from these, recommendations of various equipment suppliers shall also be considered to form the basis for assumption-superimposed loads on various floors of the plant structures.

### 6.2.5 Impact and Vibration

Dynamic loads caused by impact and vibration caused by equipment in operation shall be considered during design in addition to live loads discussed earlier. Foundations and structures for heavy machines shall be designed for dynamic loads by proper dynamic analysis. In this regard, recommendations of the various equipment suppliers shall also be taken into account.

### 6.2.6 Wind Load

Basic wind speed shall be taken as per IS:875.

6.2.7 **Seismic Loads**

Seismic loads considered shall be as per IS:1893. The vertical seismic coefficient where applicable shall be taken as 1.5. However, if required seismic forces will be determined by Response Spectrum Method as per IS:1893.

Apart from IS:1893, the stipulations in IS:4326 (Code of Practice for Design and Construction of Earthquake Resistant Buildings) shall also be considered.

6.2.8 **Temperature Effect**

Temperature stresses induced due to service conditions shall be considered for all structures.

Expansion joints shall be provided as required for the expansion and contraction due to temperature. Temperature stresses need not be considered for covered buildings less than 75 m in length.

6.2.9 **Temporary Loads during Construction**

All structures shall safely carry temporary loads due to equipment or wind acting on them during construction. Additional reinforcements shall be provided, if necessary.

Surcharge resulting from the application of temporary construction loads shall also be considered in the design of sub-structures with allowable stress being permitted to exceed normal design limits by 25 percent.

**Special Concentrated Loads**

All structural components shall be designed for anticipated concentrated loads, which may be applied.

Where both concentrated and uniformly distributed loads cannot act simultaneously, the structure or component shall be checked for both conditions of loading and shall be designed for the more critical condition.

6.2.10 **Load Combinations**

For safety and economy in the design of structures, a combination of working loads as stated above, shall be considered along with the probability of their acting together and their disposition in relation to other loads.

Load combinations shall be considered as per the provisions of IS:875 and IS:1893.

6.2.11 **Designated level of buildings and structures**

The plinth level of all buildings and structures shall be at least 300 mm above the surrounding finished ground level.

6.2.12 **Type of buildings and constructions**

Steel/RCC/Masonry structure shall be considered for plant buildings and other structures depending on technological requirements. The roofs shall be either of RCC or minm. 0.5 mm thick GALVALUME sheeting or equivalent. Sloped roofs shall have a minimum slope of 1:3. Sides of buildings shall be claded with brick or minm. 0.5 mm thick GALVALUME sheets depending on technological requirements. Windows, louvers and exhaust dampers shall be provided to meet up the stipulations laid by NBC for ventilation and illumination of industrial buildings.

Most of the plant buildings for the proposed project shall have structural steel roof supported on structural steel columns on isolated or raft foundation.

Non-plant buildings like compressor room, receiving substation, pump house, etc. shall be of RCC framed construction with brick/masonry filler sidewalls.

6.2.13 **Materials of Construction**

Chiefly the following materials will be used for construction:-

All structural concrete will be of M-20 or M-25 grade.

All PCC for building & other work shall be of M-7.5 & M-5 grade.

Structural steel work will be of mild steel having yield stress fy=250 $N/mm^2$.

All reinforcing bars will be of tor-steel with fy=415 $N/mm^2$.

Brick work – first class brick shall be used.

6.2.14 **General Civil and Structural design requirements**

**General**

All steel structures shall be designed by the Working Stress Method. Reinforced Concrete Structures shall be designed using Limit State Method.

**Factor of Safety**

The following minimum factor of safety shall be provided for all structures as applicable:

a) Overturning : 1.5

b) Sliding : 1.4

**Allowable Deflections**

The deflection of structural members shall not impair the strength, efficiency or finish of the structure. Generally, the maximum deflection shall be 1/325$^{th}$ of the span for steel structures. Recommendation of IS:456 shall be followed for concrete structures.

**Ductility of Structure**

All structural components and their connections shall have sufficient ductility. In concrete structures, the members shall be designed to have enough shear strength to withstand cracking and rupture due to bending moment. In steel structures all members shall be connected in a manner which will avoid local failures of the connections.

**Access for Operation, Maintenance and Reports**

Each building and structure shall be designed to provide enough space for operation and maintenance and to provide plant workers a good and safe environment. Full access to machinery shall be provided by means of walkways, platforms, erection hatches, and stairs. All walkways and stairs shall be at least 800 mm wide and shall have clear headroom of 2.1m.

For repair and dismantling, lifting beams and / or suspension hooks shall be provided for all machines with heavy parts. All lifting beams shall be fitted with movable chain pulley blocks.

# SECTION – 7

## POLLUTION & ENVIRONMENTAL CONTROL

# SECTION – 7

## POLLUTION & ENVIRONMENTAL CONTROL

7.1 Titanium Slag Plant

Adequate environmental control shall be considered from selection of technology, Installation of proper gas purification system and utilization of disposed wastes to make zero discharge. Maximum recycle and reuse of water shall be considered.

During production of Titanium slag, following control shall be taken care.

- Control of Fugitive emission in handling areas
- Smelter Gas Cooling & Dust Control

7.2 Titanium Dioxide Pigment Plant

Titanium Dioxide Industry through Sulphate route has attracted considerable attention on account of Pollution aspects. Pollution aspects of such industry is to be taken care of properly. Adequate pollution control aspects have been considered in this project to mitigate solid, liquid & gaseous discharges. In Sulphate process, during manufacture of pigment, the following waste products shall be encountered.

- Ferrous Sulphate Hepta hydrate (copperas)
- Dilute & strong spent Sulphuric Acid
- Gases ($SO_2$ & $SO_3$) during calcination
- Residual Feed stock (un-reacted ilmenite)

## 7.3 Methods of Disposal

### 7.3.1 COPPERAS

There are various options for the disposal

- Crystallize $FeSO_4$, $7H_2O$ & dispatch as salable product.

- Can be used as a source of Sulphur to replace part of elemental Sulphur in Sulphuric Acid Plant.

- Can be converted into by-products such as Iron Oxide (for land fill), red oxide pigment, and Iron hydroxide yellow pigment. For this project, crystallization for recovery of copperas has been contemplated.

### 7.3.2 Spent Acid

The sulphate process produces substantial amount of waste sulphuric acid along with some quantity of Iron Sulphate, which requires proper disposal facility for mitigating pollution. There are various modes of processing/disposal of this waste acid.

- Concentration & Recycle to the plant
- Neutralisation by lime to produce by-product gypsum.

Provisions for both the above modes have been kept in this project. An acid Concentration/Regeneration plant shall be procured as a package unit where by acid will be concentrated from around 30% strength to 60-65% strength together with production of ferrous sulphate crystals. The concentrated acid shall be recycled to the process.

Alternative to the above and as an additional feature, neutralisation facility shall be provided to produce gypsum.

$H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4, 2H_2O$

By control of acidity and concentration of calcium sulphate in the solution, pure variety of gypsum can be produced.
The gypsum production facility shall comprise the following:

i) Lime receipt, slaking and preparation of lime solution.

ii) Reaction of lime & waste sulphuric acid in agitated vessel for a definite period of lime.

iii) Thickening & Filtration

This gypsum will find use in cement plants, manufacture of molds & plaster of paris.

Gypsum production facility has been contemplated in addition to the waste acid concentration facility.

For nuetralisation of 30% acid having capacity to treat waste quantum of 108000$m^3$/year generated for a 30000 TPA pigment plant, around 32000 TPA of gypsum would be generated with requirement of around 22000 TPA of commercial lime. This amount of gypsum would be required for a 1 Million TPA capacity Cement Plant

7.3.3 Gases ($SO_2$ & $SO_3$)

Emission from calcination will be controlled for dust & release of $SO_2$ through ESP and high rising stack as per pollution control norms.

7.3.4 Residual Feed Stock

Un-reacted feed stock & other solid discharges will be impounded in a selected area within plant premises.

7.4 Sulphuric Acid Plant

For the pigment plant a 300 TPD Sulphuric Acid based on DCDA process has been contemplated. The emissions will be as per CPCB norms for such industry.

| | | |
|---|---|---|
| Acid Mist/ sulphur | : | Less than 70 mg/$NM^3$ |
| Trioxide | : | Less than 50 mg/$NM^3$ |
| Sulphur Dioxide | : | 1250 mg/$NM^3$ |

7.5 Producer Gas Plant (as fuel for Calciner)

The producer gas plant will have tar removal facility. The Ash generated in producer gas operation shall be disposal off for land fill.

Suitable pollution control measures shall be adopted to bring emission level to acceptable standard.

7.6 Green belt shall be incorporated all around the plant.

# SECTION – 8

## MAN-POWER

## SECTION – 8

## MAN-POWER

8.1.0 Efficient management control for the plant has been assumed with deployment of optimum man-power.

8.2.0 **Broad division of man-power**

Table 8.2.0 indicates broad man-power requirement for the plant. Estimated man-power is 946.

**Table 8.2.0**

| Sl. No. | Category | Ti Slag | Pigment |
|---|---|---|---|
| 1. | Managers, Executives & Specialists | 11 | 5 |
| 2. | Deputy Managers, Engineers & Supervisors | 75 | 60 |
| 3. | Skilled Worker | 120 | 225 |
| 4. | Unskilled Worker | 150 | 300 |
| | **Total :** | **356** | **590** |

# SECTION – 9

# PROJECT IMPLEMENTATION SCHEDULE

## SECTION – 9

## PROJECT IMPLEMENTATION SCHEUDLE

9.1.0 The estimated completion time for total project is 24 months. Table 9.1.0 gives execution time for major activities for the project.

**Table 9.1.0**

| Sl. No. | Milestone | Target Completion Time form Zero date |
|---|---|---|
| 1 | Process know-how & Basic Engineering | 0-4 months |
| 2 | Approval of Basic Engineering by SARAF | 4-6 months |
| 3 | Detailed Engineering | 6-18 months |
| 4 | Tendering, Procurement action, Supply of Plant & Equipment | 7-19 months |
| 5 | Civil & Structural Work | 7-20 months |
| 6 | Erection of Equipment | 14-22 months |
| 7 | Trial Run & Commissioning | 22-24 months |

# SECTION – 10

## COST ESTIMATES & FINANCIAL ANALYSIS

## SECTION – 10

## COST ESTIMATES & FINANCIAL ANALYSIS

10.1.0 Cost Estimates & Financial Analysis have been highlighted in this section. SEZ conditions have been considered.

10.1.1 **Basis**

The following basis has been considered for the estimation of costs & financial analysis:

a) Interest rates :
   - Long Term Loan : 14%
   - Working Capital : 14%

b) Debt **:** Equity : 2 **:** 1

c) Project execution time : 24 months

d) Capacity utilization :
   - 1st year : 70%
   - 2nd year : 80%
   - 3rd year onwards : 90%

e) Variable costs for production, selling prices etc. have been indicated in financial analysis.

The following may be noted:

Product selling prices

- Titanium Slag : Rs. 70,000/ Tonne
- Titanium Dioxide Pigment : Rs. 165,000/Tonne
- Byproduct LC Ferrous Sulphate : Rs. 4000/Tonne
- Pig Iron : Rs. 28,000/ Tonne

i) Electrical Power Cost : Rs. 5.5/Kwh

ii) Water Cost : Rs. 10/$M^3$

iii) Salaries & Wages :

- Manager & Specialists : Rs. 9.0 lakh/year/person
- Dy. Manager, Engineers : Rs. 4.8 lakh/year/person
- Skilled Workers : Rs. 2.64 lakh/year/person
- Unskilled Workers : Rs. 1.44 lakh/year/person

10.1.2.1.1 The cost of project has been indicated in Table – 1. Total Project cost comprising land & land development, plant and machinery, civil works, miscellaneous fixed assets, engineering & preoperative expenses along with interest and margin money for working capital has been estimated as Rs.779.50 Crores.

10.1.2.1.2 Statement of Production & Sales have been indicated in Table – 5

10.1.2.1.3 Selling Price & Revenue

The selling Price & Revenue have been shown in Table – 6

10.1.2.1.4 Profitability Analysis

Estimates of working results for initial ten (10) years of operation have been shown in Table – 10. Depreciation calculation has been shown in Table – 9.

10.1.2.1.5 Taxation

Tax computation is shown in Table – 12

10.1.2.1.6 Cash Flow Statement

Cash flow statement for initial ten (10) years has been indicated in Table – 14.

Balance sheet over 10 years period is given in Table – 15.

10.1.2.1.7 Break Even Analysis

Break even analysis in Table – 17 shows project would break even at 60.41% capacity and cash break even at 50.27%.

10.1.2.1.8 Internal Rate of Return

The internal rate of return has been shown in Table – 18 indicate 22.64% which is acceptable.

10.2.0 CONCLUSION

It is observed from the foregoing results that the project is viable. It is recommended to go in for execution of the Project.

*****

## ASSUMPTIONS & CONSIDERATIONS

**SARAF AGENCIES PRIVATE LIMITED**

**TITANIUM DIOXIDE PLANT**

**CAPACITY - 30000 TPA**

**TITANIUM SLAG PLANT**

**CAPACITY - 36000 TPA**

**PIG IRON PLANT**

**CAPACITY - 20000 TPA**

**SITE - Chhatrapur SEZ**

**SALES TAX EXEMPTIONS**

**NO IMPORT DUTY**

**NO EXCISE DUTY**

**NO INCOME TAX**

**HOWEVER. MAT IS APPLICABLE**

**DEBT - EQUITY 2 : 1**

**INTEREST RATE 14% PA**

**FOR BOTH TERM AND WORKING CAPITAL LOAN**

**WORKING CAPITAL LOAN IS TAKEN AS CASH CREDIT ACCOUNT**

**IMPLEMENTATION PERIOD - 24 MONTHS**

| TABLE 1 :: SUMMARISED PROJECT COST | | |
|---|---|---|
| | | **(Rs. Lacs)** |
| **Sl. No.** | **Cost Head** | **Total** |
| 1 | Land and Land Development | 1783.00 |
| 2 | Building, Civil & Structural Works | 10104.00 |
| 3 | Plant and Machinery | 35728.00 |
| 4 | Miscellaneous Fixed Assets | 7370.00 |
| 5 | Pollution & Environment Control Equipments | 4970.00 |
| 6 | Process Know-how & Engineering Charges | 2161.00 |
| 7 | Pre-operative Expenses | 2915.00 |
| 8 | Sub-Total (1 to 7) | **65031.00** |
| 9 | Contingency @ 5% | 3251.55 |
| 10 | Sub-Total (8 & 9) | **68282.55** |
| 11 | Interest during Construction | 6249.49 |
| 12 | Margin Money for working capital | 3418.74 |
| | **TOTAL PROJECT COST** | **77950.78** |

| TABLE 2 :: MARGIN MONEY REQUIREMENT | | | | | |
|---|---|---|---|---|---|
| | | | | | (Rs. Lacs) |
| Sl. No. | Items | Days | Cost | Bank Finance 75% | Margin Money 25% |
| 1 | Raw Materials | 30 | 1824.61 | 1368.46 | 456.15 |
| 2 | Water | 5 | 11.27 | 8.45 | 2.82 |
| 3 | Packing Materials | 7 | 14.86 | 11.15 | 3.71 |
| 4 | Work in Progress | 3 | 242.83 | 182.12 | 60.71 |
| 5 | Finished Goods | 30 | 3167.07 | 2375.30 | 791.77 |
| 6 | Sundry Debtors | 30 | 4364.40 | 3273.30 | 1091.10 |
| 7 | Sub-total (1 Thru' 7) | | 9625.04 | 7218.78 | 2406.26 |
| 8 | Expenses | 30 | 1012.48 | 0.00 | 1012.48 |
| | | **TOTAL** | **10637.52** | **7218.78** | **3418.74** |

| TABLE 3 :: PHASING OF CAPITAL EXPENDITURE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | (Rs. Lacs) |
| Sl. No. | Items | Implementation Period In Quarters | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | TOTAL |
| 1 | Land and Land Development | 891.00 | 892.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1783.00 |
| 2 | Building, Civil & Structural Works | 0.00 | 2020.40 | 2020.40 | 2020.40 | 2020.40 | 2022.40 | 0.00 | 0.00 | 10104.00 |
| 3 | Plant and Machinery | 1786.85 | 0.00 | 5359.55 | 7145.40 | 7145.40 | 5358.55 | 5359.55 | 3572.70 | 35728.00 |
| 4 | Miscellaneous Fixed Assets | 368.35 | 0.00 | 1106.05 | 1474.40 | 1474.40 | 1105.05 | 1105.05 | 736.70 | 7370.00 |
| 5 | Pollution & Environment Control | 249.00 | 0.00 | 745.00 | 994.00 | 994.00 | 746.00 | 745.00 | 497.00 | 4970.00 |
| 6 | Process Know-how & Engineering Charges | 216.10 | 216.10 | 216.10 | 216.10 | 216.10 | 216.10 | 432.20 | 432.20 | 2161.00 |
| 7 | Pre-operative Expenses | 145.75 | 145.75 | 291.50 | 291.50 | 437.25 | 437.25 | 583.00 | 583.00 | 2915.00 |
| 8 | Sub-Total (1 thru' 7) | 3657.05 | 3274.25 | 9738.60 | 12141.80 | 12287.55 | 9885.35 | 8224.80 | 5821.60 | 65031.00 |
| 9 | Contingency | 182.85 | 163.71 | 486.93 | 607.09 | 614.38 | 494.27 | 411.24 | 291.08 | 3251.55 |
| | **TOTAL** | **3839.90** | **3437.96** | **10225.53** | **12748.89** | **12901.93** | **10379.62** | **8636.04** | **6112.68** | **68282.55** |

| TABLE 4 :: COMPUTATION OF INTEREST DURING CONSTRUCTION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | (Rs. Lacs) |
| | IMPLEMENTATION PERIOD IN QUARTERS | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | TOTAL |
| Capital Expenditure | 3839.90 | 3437.96 | 10225.53 | 12748.89 | 12901.93 | 10379.62 | 8636.04 | 6112.68 | **68282.55** |
| Margin Money | | | | | | | | 3418.74 | **3418.74** |
| Total | 3839.90 | 3437.96 | 10225.53 | 12748.89 | 12901.93 | 10379.62 | 8636.04 | 9531.42 | **71701.29** |
| | | | | | | | | | |
| EQUITY | 1293.33 | 1193.95 | 3515.51 | 4450.06 | 4602.40 | 3858.96 | 3358.40 | 3820.43 | **26093.04** |
| LOAN | 2591.93 | 2376.32 | 7006.53 | 8873.23 | 9190.04 | 7706.87 | 6716.25 | 7396.57 | **51857.74** |
| TOTAL | 3885.26 | 3570.27 | 10522.04 | 13323.29 | 13792.44 | 11565.83 | 10074.65 | 11217.00 | **77950.78** |
| | | | | | | | | | |
| Debt-Equty in each quarter | 2.00 | 1.99 | 1.99 | 1.99 | 2.00 | 2.00 | 2.00 | 1.94 | 1.99 |
| | | | | | | | | | |
| CUMULATIVE EQUITY | 1293.33 | 2487.28 | 6002.79 | 10452.85 | 15055.25 | 18914.21 | 22272.61 | 26093.04 | |
| CUMULATIVE LOAN | 2591.93 | 4968.25 | 11974.78 | 20848.01 | 30038.05 | 37744.92 | 44461.17 | 51857.74 | |
| | | | | | | | | | |
| Debt-Equty (Cumulative) | 2.00 | 2.00 | 1.99 | 1.99 | 2.00 | 2.00 | 2.00 | 1.99 | |
| | | | | | | | | | |
| Interest @14% per annum | 45.36 | 41.59 | 122.61 | 155.28 | 160.83 | 134.87 | 117.53 | 129.44 | 907.51 |
| | | 90.72 | 83.18 | 245.22 | 310.56 | 321.66 | 269.74 | 235.06 | 1556.14 |
| | | | 90.72 | 83.18 | 245.22 | 310.56 | 321.66 | 269.74 | 1321.08 |
| | | | | 90.72 | 83.18 | 245.22 | 310.56 | 321.66 | 1051.34 |
| | | | | | 90.72 | 83.18 | 245.22 | 310.56 | 729.68 |
| | | | | | | 90.72 | 83.18 | 245.22 | 419.12 |
| | | | | | | | 90.72 | 83.18 | 173.90 |
| | | | | | | | | 90.72 | 90.72 |
| **Total** | **45.36** | **132.31** | **296.51** | **574.40** | **890.51** | **1186.21** | **1438.61** | **1685.58** | **6249.49** |

| TABLE 5 :: STATEMENT OF PRODUCTION & SALES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | (MT) |
| | YEAR | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Capacity Utilisation (%) | 70% | 80% | 90% | 90% | 90% | 90% | 90% | 90% | 90% | 90% |
| **Titanium Dioxide Pigment** | | | | | | | | | | |
| Capacity | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 |
| Opening Stock | 0 | 1750 | 2000 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 |
| Production | 21000 | 24000 | 27000 | 27000 | 27000 | 27000 | 27000 | 27000 | 27000 | 27000 |
| Total | 21000 | 25750 | 29000 | 29250 | 29250 | 29250 | 29250 | 29250 | 29250 | 29250 |
| Closing Stock | 1750 | 2000 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 |
| Sale | 19250 | 23750 | 26750 | 27000 | 27000 | 27000 | 27000 | 27000 | 27000 | 27000 |
| | | | | | | | | | | |
| **Ferrous Sulphate** | | | | | | | | | | |
| Capacity | 33000 | 33000 | 33000 | 33000 | 33000 | 33000 | 33000 | 33000 | 33000 | 33000 |
| Opening Stock | 0 | 1925 | 2200 | 2475 | 2475 | 2475 | 2475 | 2475 | 2475 | 2475 |
| Production | 23100 | 26400 | 29700 | 29700 | 29700 | 29700 | 29700 | 29700 | 29700 | 29700 |
| Total | 23100 | 28325 | 31900 | 32175 | 32175 | 32175 | 32175 | 32175 | 32175 | 32175 |
| Closing Stock | 1925 | 2200 | 2475 | 2475 | 2475 | 2475 | 2475 | 2475 | 2475 | 2475 |
| Sale | 21175 | 26125 | 29425 | 29700 | 29700 | 29700 | 29700 | 29700 | 29700 | 29700 |
| | | | | | | | | | | |
| **Titanium Slag** | | | | | | | | | | |
| Capacity | 36000 | 36000 | 36000 | 36000 | 36000 | 36000 | 36000 | 36000 | 36000 | 36000 |
| Opening Stock | 0 | 2100 | 2400 | 2700 | 2700 | 2700 | 2700 | 2700 | 2700 | 2700 |
| Production | 25200 | 28800 | 32400 | 32400 | 32400 | 32400 | 32400 | 32400 | 32400 | 32400 |
| Total | 25200 | 30900 | 34800 | 35100 | 35100 | 35100 | 35100 | 35100 | 35100 | 35100 |
| Closing Stock | 2100 | 2400 | 2700 | 2700 | 2700 | 2700 | 2700 | 2700 | 2700 | 2700 |
| Sale | 23100 | 28500 | 32100 | 32400 | 32400 | 32400 | 32400 | 32400 | 32400 | 32400 |
| | | | | | | | | | | |

| **Pig Iron** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Capacity | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 |
| Opening Stock | 0 | 1167 | 1333 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 |
| Production | 14000 | 16000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 |
| Total | 14000 | 17167 | 19333 | 19500 | 19500 | 19500 | 19500 | 19500 | 19500 | 19500 |
| Closing Stock | 1167 | 1333 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 |
| Sale | 12833 | 15834 | 17833 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 |
| | | | | | | | | | | |

| TABLE 6 :: STATEMENT OF REVENUE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | (Rs. Lacs) |
| Products | Selling Price/T (Rs.) | YEAR | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Titanium Dioxide Pigment | 165000 | 31762.50 | 39187.50 | 44137.50 | 44550.00 | 44550.00 | 44550.00 | 44550.00 | 44550.00 | 44550.00 | 44550.00 |
| Ferrous Sulphate | 4000 | 847.00 | 1045.00 | 1177.00 | 1188.00 | 1188.00 | 1188.00 | 1188.00 | 1188.00 | 1188.00 | 1188.00 |
| Titanium Slag | 70000 | 16170.00 | 19950.00 | 22470.00 | 22680.00 | 22680.00 | 22680.00 | 22680.00 | 22680.00 | 22680.00 | 22680.00 |
| Pig Iron | 28000 | 3593.24 | 4433.52 | 4993.24 | 5040.00 | 5040.00 | 5040.00 | 5040.00 | 5040.00 | 5040.00 | 5040.00 |
| **TOTAL** | | **52372.74** | **64616.02** | **72777.74** | **73458.00** | **73458.00** | **73458.00** | **73458.00** | **73458.00** | **73458.00** | **73458.00** |

| TABLE 7 :: BREAK-UP COST OF RAW MATERIALS (At 90% Utilisation) | | | | | |
|---|---|---|---|---|---|
| **Sl. No.** | **Items** | **Consumption in Kg per MT of Pigment** | **Cost of Materials (Rs)** | **Cost of Materials per MT of Pigment (Rs.)** | **Cost of Materials at 90% Production of Pigment (Rs. Lacs)** |
| 1 | Ilmenite (Titanium Dioxide) | 851.00 | 12000.00 | 10212.00 | 3063.60 |
| 2 | Sulphur | 726.00 | 15000.00 | 10890.00 | 3267.00 |
| 3 | High Titanium Slag | 851.00 | 0.00 | 0.00 | 0.00 |
| 4 | Iron Powder | 110.00 | 35000.00 | 3850.00 | 1155.00 |
| 5 | Sodium Hydroxide | 270.00 | 45000.00 | 12150.00 | 3645.00 |
| 6 | Diatomite | 5.30 | 33070.00 | 175.27 | 52.58 |
| 7 | Flocculating Agent | 7.10 | 17866.00 | 126.85 | 38.06 |
| 8 | Charcoal powder | 0.59 | 26781.00 | 15.80 | 4.74 |
| 9 | Aluminium Powder | 0.61 | 228288.00 | 139.26 | 41.78 |
| 10 | Potassium Hydroxide | 5.00 | 94539.00 | 472.70 | 141.81 |
| 11 | Zinc Oxide | 6.00 | 73681.00 | 442.09 | 132.63 |
| 12 | Hydrochloric Acid (30%) | 115.00 | 4410.00 | 507.15 | 152.15 |
| 13 | Zirconium Sulphate | 23.00 | 198163.00 | 4557.75 | 1367.33 |
| 14 | Sodium Meta Aluminate | 52.00 | 16245.00 | 844.74 | 253.42 |
| 15 | Lime | 173.93 | 5000.00 | 869.65 | 260.90 |
| 16 | Coal | 2000.00 | 4000.00 | 8000.00 | 2400.00 |
| 17 | Ilmenite (Slag Plant) | 2050.00 | 12000.00 | 24600.00 | 8856.00 |
| 18 | Anthracite Coal | 350.00 | 16000.00 | 5600.00 | 2016.00 |
| 19 | Graphite Electrode | 25.00 | 165000.00 | 4125.00 | 1485.00 |
| 20 | Miscellaneous | - | - | 1200.00 | 432.00 |
| | Sub-Total | | | | 28765.00 |
| | Add: Transport Cost @5% | | | | 1438.25 |
| | **TOTAL** | | | | **30203.25** |

| TABLE 8 :: ANNUAL COST OF PRODUCTION AND SALES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | YEARS | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **A.** | **VARIABLE COST** | | | | | | | | | | |
| | Raw Materials | 21142.28 | 24162.60 | 27182.93 | 30203.25 | 30203.25 | 30203.25 | 30203.25 | 30203.25 | 30203.25 | 30203.25 |
| | Power (Titanium Dioxide) | 1212.75 | 1386.00 | 1559.25 | 1559.25 | 1559.25 | 1559.25 | 1559.25 | 1559.25 | 1559.25 | 1559.25 |
| | Power (Titanium Slag Plant) | 5100.48 | 5829.12 | 6557.76 | 6557.76 | 6557.76 | 6557.76 | 6557.76 | 6557.76 | 6557.76 | 6557.76 |
| | Water (Titanium Dioxide) | 682.50 | 780.00 | 877.50 | 877.50 | 877.50 | 877.50 | 877.50 | 877.50 | 877.50 | 877.50 |
| | Water (Titanium Slag Plant) | 100.80 | 115.20 | 129.60 | 129.60 | 129.60 | 129.60 | 129.60 | 129.60 | 129.60 | 129.60 |
| | Packing Materials | 172.20 | 196.80 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 |
| | Sub-total | 28411.01 | 32469.72 | 36528.44 | 39548.76 | 39548.76 | 39548.76 | 39548.76 | 39548.76 | 39548.76 | 39548.76 |
| | Contingency @ 5% | 1420.55 | 1623.49 | 1826.42 | 1977.44 | 1977.44 | 1977.44 | 1977.44 | 1977.44 | 1977.44 | 1977.44 |
| | **TOTAL 'A'** | **29831.56** | **34093.21** | **38354.86** | **41526.20** | **41526.20** | **41526.20** | **41526.20** | **41526.20** | **41526.20** | **41526.20** |
| **B.** | **FIXED COST** | | | | | | | | | | |
| **1** | **Salaries & Wages** | | | | | | | | | | |
| | Manager, Executives, Head of Divisions | 144.00 | 151.20 | 158.76 | 166.70 | 175.04 | 183.79 | 192.98 | 202.63 | 212.76 | 223.40 |
| | Dy. Managers, Engineers, Supervisors | 648.00 | 680.40 | 714.42 | 750.14 | 787.65 | 827.03 | 868.38 | 911.80 | 957.39 | 1005.26 |
| | Skilled Workers | 910.80 | 956.34 | 1004.16 | 1054.37 | 1107.09 | 1162.44 | 1220.56 | 1281.59 | 1345.67 | 1412.95 |
| | Unskilled workers | 648.00 | 680.40 | 714.42 | 750.14 | 787.65 | 827.03 | 868.38 | 911.80 | 957.39 | 1005.26 |
| | Sub-Total (1) | 2350.80 | 2409.57 | 2469.81 | 2531.56 | 2594.85 | 2659.72 | 2726.21 | 2794.37 | 2864.23 | 2935.84 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2** | **Other Factory Expenses** | | | | | | | | | | |
| | **a) Repair & Maintenance :** | | | | | | | | | | |
| | i) on Building, Civil & Structural Works @ 1% | 101.04 | 101.04 | 101.04 | 101.04 | 101.04 | 101.04 | 101.04 | 101.04 | 101.04 | 101.04 |
| | ii) on Plant and Machinery including & miscelaneous fixed assets @ 4% | 1723.92 | 1723.92 | 1723.92 | 1723.92 | 1723.92 | 1723.92 | 1723.92 | 1723.92 | 1723.92 | 1723.92 |
| | Sub-total (a) | 1824.96 | 1824.96 | 1824.96 | 1824.96 | 1824.96 | 1824.96 | 1824.96 | 1824.96 | 1824.96 | 1824.96 |
| | b) Insurance @0.5% on Buildings, Plant & Machinery, Misc. Fixed Assets and Pollution& environment Control Equipments | 290.86 | 290.86 | 290.86 | 290.86 | 290.86 | 290.86 | 290.86 | 290.86 | 290.86 | 290.86 |
| | c) Production Overheads | 1057.91 | 1084.36 | 1111.47 | 1139.26 | 1167.74 | 1196.93 | 1226.85 | 1257.52 | 1288.96 | 1321.18 |
| | Sub-total (2) | 3173.73 | 3200.18 | 3227.29 | 3255.08 | 3283.56 | 3312.75 | 3342.67 | 3373.34 | 3404.78 | 3437.00 |
| **3** | Administrative & Sales Expenses | | | | | | | | | | |
| | a) Administrative Overheads* | 2762.27 | 2831.33 | 2902.11 | 2974.66 | 3049.03 | 3125.26 | 3203.39 | 3283.47 | 3365.56 | 3449.70 |
| | b) Selling & Distribution Overheads* | 2071.70 | 2123.49 | 2176.58 | 2230.99 | 2286.76 | 2343.93 | 2402.53 | 2462.59 | 2524.15 | 2587.25 |
| | Sub-total (3) | 4833.97 | 4954.82 | 5078.69 | 5205.65 | 5335.79 | 5469.19 | 5605.92 | 5746.06 | 5889.71 | 6036.95 |
| | Sub-total (1 thru 3) | 10358.50 | 10564.57 | 10775.79 | 10992.29 | 11214.20 | 11441.66 | 11674.80 | 11913.77 | 12158.72 | 12409.79 |
| | Contingency @ 5% | 517.93 | 528.23 | 538.79 | 549.61 | 560.71 | 572.08 | 583.74 | 595.69 | 607.94 | 620.49 |
| | **TOTAL ' B'** | **10876.43** | **11092.80** | **11314.58** | **11541.90** | **11774.91** | **12013.74** | **12258.54** | **12509.46** | **12766.66** | **13030.28** |
| | **TOTAL COST (A+B)** | **40707.99** | **45186.01** | **49669.44** | **53068.10** | **53301.11** | **53539.94** | **53784.74** | **54035.66** | **54292.86** | **54556.48** |
| | | * Salary and wages are assumed to increase by 5 per cent every year | | | | | | | | | |

| TABLE 9 :: STATEMENT OF FIXED ASSETS AND DEPRECIATION UNDER STRAIGHT LINE METHOD AS PER COMPANIES ACT 1956 | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | (Rs.Lacs) |
| **Sl. No.** | **Items** | **Cost** | **Items 6, 7, 9 & 11 allocated** | **After allocation total cost** | **Depreciation Rate** | **Amount** |
| 1 | Land and Land Development | 1783.00 | 0.00 | 1783.00 | 0.00% | 0.00 |
| 2 | Building, Civil & Structural Works | 10104.00 | 2532.03 | 12636.03 | 3.34% | 422.04 |
| 3 | Plant and Machinery | 35728.00 | 8953.22 | 44681.22 | 5.28% | 2359.17 |
| 4 | Miscellaneous Fixed Assets | 7370.00 | 1846.91 | 9216.91 | 5.28% | 486.65 |
| 5 | Pollution & Environment Control Equipments | 4970.00 | 1244.88 | 6214.88 | 5.28% | 328.15 |
| 6 | Process Know-how & Engineering Charges | 2161.00 | -2161.00 | 0.00 | 0.00% | 0.00 |
| 7 | Pre-operative Expenses | 2915.00 | -2915.00 | 0.00 | 0.00% | 0.00 |
| 8 | Sub-Total (1 to 7) | 65031.00 | | 65031.00 | | |
| 9 | Contingency @ 5% | 3251.55 | -3251.55 | 0.00 | 0.00% | 0.00 |
| 10 | Sub-Total (8 & 9) | 68282.55 | | 68282.55 | | |
| 11 | Interest during Construction | 6249.49 | -6249.49 | 0.00 | 0.00% | 0.00 |
| | **TOTAL** | **74532.04** | | **74532.04** | | **3596.01** |

| TABLE 10 :: PROJECTED PROFITABILITY STATEMENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | (Rs. Lacs) |
| **Particulars** | **OPERATING YEARS** | | | | | | | | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| Raw Materials | 21142.28 | 24162.60 | 27182.93 | 30203.25 | 30203.25 | 30203.25 | 30203.25 | 30203.25 | 30203.25 | 30203.25 |
| Power | 6313.23 | 7215.12 | 8117.01 | 8117.01 | 8117.01 | 8117.01 | 8117.01 | 8117.01 | 8117.01 | 8117.01 |
| Water | 783.30 | 895.20 | 1007.10 | 1007.10 | 1007.10 | 1007.10 | 1007.10 | 1007.10 | 1007.10 | 1007.10 |
| Packing Materials | 172.20 | 196.80 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 | 221.40 |
| Salaries and Wages | 2350.80 | 2409.57 | 2469.81 | 2531.56 | 2594.85 | 2659.72 | 2726.21 | 2794.37 | 2864.23 | 2935.84 |
| Other Factory Expenses | 3173.73 | 3200.18 | 3227.29 | 3255.08 | 3283.56 | 3312.75 | 3342.67 | 3373.34 | 3404.78 | 3437.00 |
| Administrative & Sales Expenses | 4833.97 | 4954.82 | 5078.69 | 5205.65 | 5335.79 | 5469.19 | 5605.92 | 5746.06 | 5889.71 | 6036.95 |
| Sub-Total | 38769.51 | 43034.29 | 47304.23 | 50541.05 | 50762.96 | 50990.42 | 51223.56 | 51462.53 | 51707.48 | 51958.55 |
| Contingency @ 5% | 1938.48 | 2151.71 | 2365.21 | 2527.05 | 2538.15 | 2549.52 | 2561.18 | 2573.13 | 2585.37 | 2597.93 |
| TOTAL COSTS | 40707.99 | 45186.00 | 49669.44 | 53068.10 | 53301.11 | 53539.94 | 53784.74 | 54035.66 | 54292.85 | 54556.48 |
| Stock Variation | 3409.90 | 398.29 | 398.61 | 300.70 | 14.34 | 14.70 | 15.06 | 15.44 | 15.83 | 16.22 |
| **COST OF PRODUCTION** | **37298.09** | **44787.71** | **49270.83** | **52767.40** | **53286.77** | **53525.24** | **53769.68** | **54020.22** | **54277.02** | **54540.26** |
| **REVENUE** | **52372.74** | **64616.02** | **72777.74** | **73458.00** | **73458.00** | **73458.00** | **73458.00** | **73458.00** | **73458.00** | **73458.00** |
| Profit before Interest, Depreciation and Tax | 15074.65 | 19828.31 | 23506.91 | 20690.60 | 20171.23 | 19932.76 | 19688.32 | 19437.78 | 19180.98 | 18917.74 |
| Interest : | | | | | | | | | | |
| On Term Loans @ 14% p.a. | 7260.08 | 6050.07 | 4840.05 | 3630.04 | 2420.03 | 1210.01 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| On WC Loans @ 14% p.a. | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 |
| Sub-total : | 8270.71 | 7060.70 | 5850.68 | 4640.67 | 3430.66 | 2220.64 | 1010.63 | 1010.63 | 1010.63 | 1010.63 |
| Profit before Tax & Depreciation | 6803.94 | 12767.61 | 17656.23 | 16049.93 | 16740.57 | 17712.12 | 18677.69 | 18427.15 | 18170.35 | 17907.11 |
| Depreciation | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 |
| Profit before Tax | 3207.93 | 9171.60 | 14060.22 | 12453.92 | 13144.56 | 14116.11 | 15081.68 | 14831.14 | 14574.34 | 14311.10 |
| Tax | 672.40 | 1922.41 | 2947.09 | 2610.40 | 2755.17 | 2958.81 | 3161.20 | 3108.68 | 3054.85 | 2999.68 |
| Net Profit/(-)Loss | 2535.53 | 7249.19 | 11113.13 | 9843.52 | 10389.39 | 11157.30 | 11920.48 | 11722.46 | 11519.49 | 11311.42 |
| Dividend | 0.00 | 0.00 | 3913.96 | 5218.61 | 5218.61 | 7827.91 | 7827.91 | 7827.91 | 7827.91 | 7827.91 |
| Dividend Distribution Tax @16.995% | 0.00 | 0.00 | 665.18 | 886.90 | 886.90 | 1330.35 | 1330.35 | 1330.35 | 1330.35 | 1330.35 |
| Retained Earnings | 2535.53 | 7249.19 | 6533.99 | 3738.01 | 4283.88 | 1999.04 | 2762.22 | 2564.20 | 2361.23 | 2153.16 |
| Add back : Depreciation | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 |
| **Net Cash Accrual** | **6131.54** | **10845.20** | **10130.00** | **7334.02** | **7879.89** | **5595.05** | **6358.23** | **6160.21** | **5957.24** | **5749.17** |

| TABLE 11 :: Depreciation for Tax Computation Under Written Down Value Method | | | | | |
|---|---|---|---|---|---|
| | | | | | (Rs.Lacs) |
| | Rate | Building & Civil Works | Rate | Plant & machinery | Total |
| Value | | 12636.03 | | 60113.01 | |
| Depreciation Year 1 | 10.00% | 1263.60 | 35.00% | 21039.55 | **22303.15** |
| Balance | | 11372.43 | | 39073.46 | |
| Depreciation Year 2 | 10.00% | 1137.24 | 15.00% | 5861.02 | **6998.26** |
| Balance | | 10235.19 | | 33212.44 | |
| Depreciation Year 3 | 10.00% | 1023.52 | 15.00% | 4981.87 | **6005.39** |
| Balance | | 9211.67 | | 28230.57 | |
| Depreciation Year 4 | 10.00% | 921.17 | 15.00% | 4234.59 | **5155.76** |
| Balance | | 8290.50 | | 23995.98 | |
| Depreciation Year 5 | 10.00% | 829.05 | 15.00% | 3599.40 | **4428.45** |
| Balance | | 7461.45 | | 20396.58 | |
| Depreciation Year 6 | 10.00% | 746.15 | 15.00% | 3059.49 | **3805.64** |
| Balance | | 6715.30 | | 17337.09 | |
| Depreciation Year 7 | 10.00% | 671.53 | 15.00% | 2600.56 | **3272.09** |
| Balance | | 6043.77 | | 14736.53 | |
| Depreciation Year 8 | 10.00% | 604.38 | 15.00% | 2210.48 | **2814.86** |
| Balance | | 5439.39 | | 12526.05 | |
| Depreciation Year 9 | 10.00% | 543.94 | 15.00% | 1878.91 | **2422.85** |
| Balance | | 4895.45 | | 10647.14 | |
| Depreciation Year 10 | 10.00% | 489.55 | 15.00% | 1597.07 | **2086.62** |
| Balance | | 4405.90 | | 9050.07 | |

**NOTE:**

**Depreciation for Plant & Machinery in the First year includes normal depreciation of 15% plus additional depreciation of 20%.**

| TABLE 12 :: TAX COMPUTATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | (Rs. Lacs) |
| | OPERATING YEARS | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Profit before Depreciation | 6803.94 | 12767.61 | 17656.23 | 16049.93 | 16740.57 | 17712.12 | 18677.69 | 18427.15 | 18170.35 | 17907.11 |
| Less : Current Depreciation | 6803.94 | 6998.26 | 6005.39 | 5155.76 | 4428.45 | 3805.64 | 3272.09 | 2814.86 | 2422.85 | 2086.62 |
| Balance | 0.00 | 5769.35 | 11650.84 | 10894.17 | 12312.12 | 13906.48 | 15405.60 | 15612.29 | 15747.50 | 15820.49 |
| Less : Unabsorbed Depreciation | 0.00 | 5769.35 | 9729.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Balance | 0.00 | 0.00 | 1920.98 | 10894.17 | 12312.12 | 13906.48 | 15405.60 | 15612.29 | 15747.50 | 15820.49 |
| Taxable Income | 0.00 | 0.00 | 1920.98 | 10894.17 | 12312.12 | 13906.48 | 15405.60 | 15612.29 | 15747.50 | 15820.49 |
| A -Tax Exempted for 10 years | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| B - Tax computation as per MAT@ 20.9605% | 672.40 | 1922.41 | 2947.09 | 2610.40 | 2755.17 | 2958.81 | 3161.20 | 3108.68 | 3054.85 | 2999.68 |
| Tax to be paid either A or B whichever is more | 672.40 | 1922.41 | 2947.09 | 2610.40 | 2755.17 | 2958.81 | 3161.20 | 3108.68 | 3054.85 | 2999.68 |

| TABLE 13 :: LOAN REPAYMENT SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | (Rs.Lacs) |
| **Year** | **Principal** | **Interest 14% p.a.** | **Total** | **Repayment Principal** | **Repayment Interest** | **Balance** |
| Construction Period | 51857.74 | 6249.49 | 58107.23 | 0.00 | 6249.49 | 51857.74 |
| 1 | 51857.74 | 7260.08 | 59117.82 | 8642.96 | 7260.08 | 43214.78 |
| 2 | 43214.78 | 6050.07 | 49264.85 | 8642.96 | 6050.07 | 34571.82 |
| 3 | 34571.82 | 4840.05 | 39411.87 | 8642.96 | 4840.05 | 25928.86 |
| 4 | 25928.86 | 3630.04 | 29558.90 | 8642.96 | 3630.04 | 17285.90 |
| 5 | 17285.90 | 2420.03 | 19705.93 | 8642.96 | 2420.03 | 8642.94 |
| 6 | 8642.94 | 1210.01 | 9852.95 | 8642.93 | 1210.01 | 0.01 |
| 7 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| TABLE 14 :: PROJECTED CASH FLOW STATEMENT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction Period | OPERATING YEARS | | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **A.** | **SOURCES** | | | | | | | | | | | |
| i) | Increase in Share Capital | 26093.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ii) | Increase in Long Term Loan | 51857.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| iii) | Increase in Working Capital Loan | 0.00 | 7218.78 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| iv) | Profit before Tax with Interest added back | 0.00 | 11478.64 | 16232.30 | 19910.90 | 17094.59 | 16575.22 | 16336.75 | 16092.31 | 15841.77 | 15584.97 | 15321.73 |
| v) | Depreciation | 0.00 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 | 3596.01 |
| | **TOTAL (A)** | **77950.78** | **22293.43** | **19828.31** | **23506.91** | **20690.60** | **20171.23** | **19932.76** | **19688.32** | **19437.78** | **19180.98** | **18917.74** |
| **B.** | **APPLICATIONS** | | | | | | | | | | | |
| i) | Increase in Capital Expenditure | 68282.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ii) | Increase/(Decrease) in Working Capital | 0.00 | 9625.04 | 1682.95 | 1343.15 | 359.20 | 16.38 | 16.99 | 17.64 | 18.34 | 19.09 | 19.89 |
| iii) | Interest | | | | | | | | | | | |
| | On Term Loan @ 14% | 6249.49 | 7260.08 | 6050.07 | 4840.05 | 3630.04 | 2420.03 | 1210.01 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | On Working Capital Loan @ 14% p.a | 0.00 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 | 1010.63 |
| | Sub-Total | 6249.49 | 8270.71 | 7060.70 | 5850.68 | 4640.67 | 3430.66 | 2220.64 | 1010.63 | 1010.63 | 1010.63 | 1010.63 |
| iv) | Tax | 0.00 | 672.40 | 1922.41 | 2947.09 | 2610.40 | 2755.17 | 2958.81 | 3161.20 | 3108.68 | 3054.85 | 2999.68 |
| v) | Dividend | 0.00 | 0.00 | 0.00 | 3913.96 | 5218.61 | 5218.61 | 7827.91 | 7827.91 | 7827.91 | 7827.91 | 7827.91 |
| vi) | Dividend Distribution Tax @16.995% | 0.00 | 0.00 | 0.00 | 665.18 | 886.90 | 886.90 | 1330.35 | 1330.35 | 1330.35 | 1330.35 | 1330.35 |
| vii) | Repayment of Term Loan | 0.00 | 8642.96 | 8642.96 | 8642.96 | 8642.96 | 8642.96 | 8642.93 | 0.01 | 0.00 | 0.00 | 0.00 |
| viii) | Repayment of Working Capital Loan | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **TOTAL (B)** | **74532.04** | **27211.11** | **19309.02** | **23363.02** | **22358.74** | **20950.68** | **22997.63** | **13347.74** | **13295.91** | **13242.83** | **13188.46** |
| | Opening Balance | 0.00 | 3418.74 | -1498.94 | -979.65 | -835.76 | -2503.90 | -3283.35 | -6348.22 | -7.64 | 6134.23 | 12072.38 |
| | Surplus/Deficit During the Year (A-B) | 3418.74 | -4917.68 | 519.29 | 143.89 | -1668.14 | -779.45 | -3064.87 | 6340.58 | 6141.87 | 5938.15 | 5729.28 |
| | **Closing Balance** | **3418.74** | **-1498.94** | **-979.65** | **-835.76** | **-2503.90** | **-3283.35** | **-6348.22** | **-7.64** | **6134.23** | **12072.38** | **17801.66** |

| TABLE 15 :: PROJECTED BALANCE SHEET | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | (Rs. Lacs) |
| | OPERATING YEARS | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Share Capital | 26093.04 | 26093.04 | 26093.04 | 26093.04 | 26093.04 | 26093.04 | 26093.04 | 26093.04 | 26093.04 | 26093.04 |
| Add : Reserves & Surplus | 2535.53 | 9784.72 | 16318.71 | 20056.72 | 24340.60 | 26339.64 | 29101.86 | 31666.06 | 34027.29 | 36180.45 |
| Shareholder's Fund | 28628.57 | 35877.76 | 42411.75 | 46149.76 | 50433.64 | 52432.68 | 55194.90 | 57759.10 | 60120.33 | 62273.49 |
| Add : Term Loan | 43214.78 | 34571.82 | 25928.86 | 17285.90 | 8642.94 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Capital Fund | 71843.35 | 70449.58 | 68340.61 | 63435.66 | 59076.58 | 52432.69 | 55194.90 | 57759.10 | 60120.33 | 62273.49 |
| Less : Net Fixed Assets | 70936.03 | 67340.02 | 63744.01 | 60148.00 | 56551.99 | 52955.98 | 49359.97 | 45763.96 | 42167.95 | 38571.94 |
| **Net Current Assets** | **907.32** | **3109.56** | **4596.60** | **3287.66** | **2524.59** | **-523.29** | **5834.93** | **11995.14** | **17952.38** | **23701.55** |
| A) Current Assets | | | | | | | | | | |
| i) Working Capital | 9625.04 | 11307.99 | 12651.14 | 13010.34 | 13026.72 | 13043.71 | 13061.35 | 13079.69 | 13098.78 | 13118.67 |
| ii) Cash & Bank Balance | -1498.94 | -979.65 | -835.76 | -2503.90 | -3283.35 | -6348.22 | -7.64 | 6134.23 | 12072.38 | 17801.66 |
| (as per Cash Flow Statement) | | | | | | | | | | |
| TOTAL A : | 8126.10 | 10328.34 | 11815.38 | 10506.44 | 9743.37 | 6695.49 | 13053.71 | 19213.92 | 25171.16 | 30920.33 |
| B) Current Liabilities | | | | | | | | | | |
| i) Working Capital Loan | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 |
| TOTAL B : | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 | 7218.78 |
| **Net Current Assets (A-B)** | **907.32** | **3109.56** | **4596.60** | **3287.66** | **2524.59** | **-523.29** | **5834.93** | **11995.14** | **17952.38** | **23701.55** |

| TABLE 16 :: WORKING CAPITAL REQUIREMENT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | (Rs. Lacs) |
| **Sl** | **ITEMS** | **Y E A R S** | | | | | | | | | |
| **No** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 1 | Raw Materials | 1824.61 | 2085.27 | 2345.93 | 2345.93 | 2345.93 | 2345.93 | 2345.93 | 2345.93 | 2345.93 | 2345.93 |
| 3 | Water | 11.27 | 12.88 | 14.49 | 16.30 | 18.34 | 20.63 | 23.21 | 26.11 | 29.37 | 33.04 |
| 4 | Packing Materials | 14.86 | 16.98 | 19.11 | 19.11 | 19.11 | 19.11 | 19.11 | 19.11 | 19.11 | 19.11 |
| 5 | Work in Progress | 242.83 | 277.53 | 312.22 | 338.28 | 338.28 | 338.28 | 338.28 | 338.28 | 338.28 | 338.28 |
| 6 | Finished Goods | 3167.07 | 3530.66 | 3894.58 | 4169.22 | 4183.56 | 4198.26 | 4213.32 | 4228.76 | 4244.59 | 4260.81 |
| 7 | Sundry Debtors | 4364.40 | 5384.67 | 6064.81 | 6121.50 | 6121.50 | 6121.50 | 6121.50 | 6121.50 | 6121.50 | 6121.50 |
| | **TOTAL** | **9625.04** | **11307.99** | **12651.14** | **13010.34** | **13026.72** | **13043.71** | **13061.35** | **13079.69** | **13098.78** | **13118.67** |
| | Increase/(Decrease) | 9625.04 | 1682.95 | 1343.15 | 359.20 | 16.38 | 16.99 | 17.64 | 18.34 | 19.09 | 19.89 |
| | Stock Variation | 3409.90 | 398.29 | 398.61 | 300.70 | 14.34 | 14.70 | 15.06 | 15.44 | 15.83 | 16.22 |

| TABLE 17 :: BREAK-EVEN ANALYSIS (At 100% Capacity Utilisation) | | |
|---|---|---|
| **Sl. No.** | **Items** | **Amount (Rs. Lacs)** |
| A | **VARIABLE COSTS** | |
| 1 | Raw Materials | 33559.17 |
| 2 | Power | 9018.90 |
| 4 | Water | 1119.00 |
| 5 | Packing Materials | 246.00 |
| | Sub-total (1 thru 5) | 43943.07 |
| | Contingency @ 5% | 2197.15 |
| | **TOTAL VARIABLE COST (A)** | **46140.22** |
| B | **REVENUE** | **81620.00** |
| C | **CONTRIBUTION** | **35479.78** |
| D | **FIXED COST** | |
| 1 | Salaries & Wages* | 2633.70 |
| 2 | Other Factory Expenses* | 3301.04 |
| 3 | Administrative & Sales Expenses* | 5415.68 |
| 4 | Sub-Total | 11350.42 |
| 5 | Contingency @ 5% | 567.52 |
| | Sub-total | 11917.94 |
| 6 | Interest ** | 5919.43 |
| 7 | Depreciation | 3596.01 |
| | **TOTAL FIXED COST (D)** | **21433.38** |
| | **BREAK-EVEN SALES** | **49306.75** |
| | **BREAK-EVEN POINT** | **60.41%** |
| | **CASH BREAK-EVEN SALES** | **41034.25** |
| | **CASH BREAK-EVEN POINT** | **50.27%** |
| | * Average over 10 years | |
| | ** Average over 5 years | |

| TABLE 18 :: | | | |
|---|---|---|---|
| INTERNAL RATE OF RETURN | | | |
| | | | (Rs. Lacs) |
| Year | Outflow | Inflow | Net Inflow |
| 0 | -74532.04 | 0.00 | -74532.04 |
| 1 | 0.00 | 15074.65 | 15074.65 |
| 2 | 0.00 | 19828.31 | 19828.31 |
| 3 | 0.00 | 23506.91 | 23506.91 |
| 4 | 0.00 | 20690.60 | 20690.60 |
| 5 | 0.00 | 20171.23 | 20171.23 |
| 6 | 0.00 | 19932.76 | 19932.76 |
| 7 | 0.00 | 19688.32 | 19688.32 |
| 8 | 0.00 | 19437.78 | 19437.78 |
| 9 | 0.00 | 19180.98 | 19180.98 |
| 10 | 0.00 | 18917.74 | 18917.74 |
| | IRR = | | 22.64% |
| Inflows = Profit before Interest, Depreciation and Tax | | | |

| TABLE 19 :: | | | | |
|---|---|---|---|---|
| PAY-BACK PERIOD | | | | |
| | | | | (Rs. Lacs) |
| Year | Profit before Tax | Depreciation | Total | Cumulative Total |
| 1 | 3207.93 | 3596.01 | 6803.94 | 6803.94 |
| 2 | 9171.60 | 3596.01 | 12767.61 | 19571.55 |
| 3 | 14060.22 | 3596.01 | 17656.23 | 37227.78 |
| 4 | 12453.92 | 3596.01 | 16049.93 | 53277.71 |
| 5 | 13144.56 | 3596.01 | 16740.57 | 70018.28 |
| 6 | 14116.11 | 3596.01 | 17712.12 | 87730.40 |

| TABLE 20 ::: | | |
|---|---|---|
| DEBT SERVICE COVERAGE RATIO | | |
| | | OVERALL |
| Profit After Tax | (Rs. Lacs) | 98761.91 |
| Depreciation | (Rs. Lacs) | 35960.10 |
| Interest | (Rs. Lacs) | 35516.58 |
| Loan Repayment | (Rs. Lacs) | 43214.78 |
| | | |
| **Debt-Service Coverage Ratio :** | | **2.16** |

**TABLE 21 :: SENSITIVITY ANALYSIS ON IRR**

**(Rs.Lacs)**

| Year | At 10% increase in Capital Outlays Net Inflow | At 5% fall in Revenue Net Inflow | At 10% fall in Revenue Net Inflow | At 10% increase in Capital Outlays & 10% fall in Revenue Net Inflow |
|---|---|---|---|---|
| 0 | -81985.24 | -74532.04 | -74532.04 | -81985.24 |
| 1 | 15074.65 | 12456.01 | 9837.38 | 9837.38 |
| 2 | 19828.31 | 16597.51 | 13366.71 | 13366.71 |
| 3 | 23506.91 | 19868.02 | 16229.14 | 16229.14 |
| 4 | 20690.60 | 17017.70 | 13344.80 | 13344.80 |
| 5 | 20171.23 | 16481.34 | 12825.43 | 12825.43 |
| 6 | 19932.76 | 16259.86 | 12586.96 | 12586.96 |
| 7 | 19688.32 | 16015.42 | 12342.52 | 12342.52 |
| 8 | 19437.78 | 15764.88 | 12091.98 | 12091.98 |
| 9 | 19180.98 | 15508.08 | 11835.18 | 11835.18 |
| 10 | 18917.74 | 15244.84 | 11571.94 | 11571.94 |
| | | | | |
| **IRR** | **19.82%** | **17.13%** | **11.02%** | **8.80%** |
| | | | | |

**Inflow = Profit before interest, tax and depreciation**