

# Pre-Feasibility Study

## CHROMITE BENEFACTION PLANT



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## 1 INTRODUCTION TO SMEDA

The Small and Medium Enterprise Development Authority (SMEDA) was established with the objective to provide fresh impetus to the economy through the launch of an aggressive SME support program.<sup>1</sup>

Since its inception in October 1998, SMEDA had adopted a sectoral SME development approach. A few priority sectors were selected on the criterion of SME presence. In depth research was conducted and comprehensive development plans were formulated after identification of impediments and retardants. The all-encompassing sectoral development strategy involved recommending changes in the regulatory environment by taking into consideration other important aspects including financial aspects, niche marketing, technology up-gradation and human resource development.

SMEDA has so far successfully formulated strategies for sectors including, fruits and vegetables, marble and granite, gems and jewelry, marine fisheries, leather and footwear, textiles, surgical instruments, urban transport and dairy. Whereas the task of SME development at a broader scale still requires more coverage and enhanced reach in terms of SMEDA's areas of operation.

Along with the sectoral focus a broad spectrum of business development services is also offered to the SMEs by SMEDA. These services include identification of viable business opportunities for potential SME investors. In order to facilitate these investors, SMEDA provides business guidance through its help desk services as well as development of project specific documents. These documents consist of information required to make well-researched investment decisions. Pre-feasibility studies and business plan development are some of the services provided to enhance the capacity of individual SMEs to exploit viable business opportunities in a better way. This document is in the continuation of this effort to enable potential investors to make well-informed investment decisions.

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<sup>1</sup> For more information on services offered by SMEDA, please visit our website: [www.smeda.org.pk](http://www.smeda.org.pk)

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## PURPOSE OF THE DOCUMENT

The objective of the pre-feasibility study is primarily to facilitate potential entrepreneurs in project identification for investment. The project pre-feasibility may form the basis of an important investment decision and in order to serve this objective, the document/study covers various aspects of project concept development, start-up, and production, finance and business management.

## 2 WHAT IS CHROMITE

The mineral Chromite is an oxide of chromium, iron and magnesium, and, is the only ore of chromium. It is black or brownish black in color and has a metallic luster. The specific gravity ranges from 4.3 to 4.6. Although pure Chromite Ore has the form  $\text{FeOCr}_2\text{O}_3$  in nature, magnesium substitutes for chromium. Naturally occurring Chromite mineral is a spinel - group mineral described by the formula  $(\text{Fe, Mg})_2(\text{Cr, Al, Fe})_2\text{O}_4$ . Chromite ore rarely contains more than 50%  $\text{Cr}_2\text{O}_3$  and other minerals such as Silica ( $\text{SiO}_2$ ) are also present.

Chromium is not found as the free metal in nature. The most important ore is Chromite ( $\text{FeCr}_2\text{O}_4$ ). Chromite is used in the manufacturing of Ferro-chrome alloy, Refractory bricks and in the manufacturing of chromium based chemicals.

## 3 PROJECT PROFILE

### 3.1 Project Brief

This project is related to setting up a Chromite Beneficiation Plant to enrich the Chromite content of the ores, liberate them from unwanted rock material and other minerals and eventually separate the final product into uniform grain sizes. In other words, the purpose of beneficiation is to render the ore physically and chemically suitable for further treatment.

### 3.2 Opportunity Rationale

Pakistan is importing its entire requirements of ferroalloys, basic refractory bricks as well as Chromite chemicals. Although the Chromite reserves may not be very large but are substantial enough to support value added projects to meet the domestic requirements.

Generally high and medium grade ore is exploited and the low grade is left behind – sheer wastage of resource. This offers a reasonable opportunity for the exploitation/up gradation of low-grade ore and will go a long way towards the production of value added products – i.e. concentrates. These concentrates can either be exported at higher price or can be used to produce value added products –basic refractory bricks, ferroalloys or Chromite chemicals. Past experimentation has established beyond any doubt that the low-grade ore can be up graded economically. Moreover the refractory plants can suitably use high-grade metallurgical ore provided the silica contents be reduced to specified limits by the process of beneficiation – less than 5%. Although small to large sized Chromite beneficiation plants are installed at Karachi by the traders / exporters to upgrade the low-grade ores, which is subsequently blended with the lump ore meant for export purposes. The establishment of such plants within the mining areas will not only eliminate the cost of transportation of wastages but will also create industrial

activity in these remote areas with an added advantage of ensured availability of quality raw material. It will help in job creation for the locals and initiate economic activities in those remote areas and contribute to the economy of the country at large.

High-grade concentrates can be produced by beneficiating low-grade ores. Again the silica content of high-grade ore can be reduced to less than 4% by the process of beneficiation, making these ores suitable for utilization by refractory industry.

### 3.3 Proposed Business Legal Status

It is recommended that this project should be started as sole proprietorship or partnership as this does not involve heavy investment. Moreover, less complications and costs are involved in forming, administering and running the sole proprietorship or partnership business. The tax rates applicable for sole proprietorship are lower than private or public limited.

### 3.4 Project Capacity and Rationale

The plant would produce 15,000 tonnes of concentrates per annum. The required machinery details are given under its appropriate head.

### 3.5 Project Investment

The total cost of the project is Rs. 23.50 millions. This cost includes land, machinery, building, furniture and fixture, and raw material inventory etc. However, the cost of land varies from area to area.

### 3.6 Suitable Location

All the Chromite mining areas like Muslim-Bagh, Khanozai, Khuzdar / wadh, Chaghi, Dalbandin and Kharan etc can be the most suitable location for the installation of such a plant because of its nearness to the mining area and availability of water and power. Similarly other areas of the country where Chromite reserves are available can be suitable locations for beneficiation of ore found in those localities.

### 3.7 Key Success Factors / Practical Tips for Success

Traditionally Pakistan has been exporting Chromite to the metallurgical industry alone. The production of concentrates with low SiO<sub>2</sub> content – suitable for utilization by the refractory industry – will not only open a new export market but will also eliminate the hazard of cyclic low consumption by the metallurgical industry as well as helping the mining industry for a continuous outlet of the material albeit at higher prices. Other factors affecting the success of this business proposition will be:

- Mining of low grade ores to produce concentrates
- Abundance of cheap labor and raw material
- A close liaison with the consumers, and
- Location of the beneficiation plants close to the mining areas.

## 4 CURRENT INDUSTRY STRUCTURE

### 4.1 Chromite Producing Areas

Chromite was first discovered in 1901 in the areas between Khanozai & Muslimbagh (Hindubagh) in Zhob valley, Balochistan, and mining started in 1903. It has passed through various phases of development since then.

Balochistan is contributing great share towards the production of Chromite ore in the country. This can be confirmed by the fact that in 2008-09 Balochistan produced 42,036 tons of Chromite out of the total production of 88,779 tons for Pakistan<sup>2</sup>.

The systems are laid such that the actual production from the mines is not reported correctly. Thus during 1992-93, export of 45,955 tones of Chromite was mined against reported production of 24,484 tons. According to local mine owners & traders Chromite production from Balochistan in year 2008-2009 has exceeded 210,000 tons. The production of Chromite is dependent on the international demand. High and low cycles in the exported quantities reflects the fluctuation in demand and FOB prices. Similar discrepancies can be observed in the subsequent years as well.

During 1982, M/S Nippi Boeki Kabushiki Kaisha of Japan worked out a requirement of 50,000 tones of ferroalloy per annum at an estimated production level of 1.7 million tons of steel per annum and recommended the establishment of such a plant.

### 4.2 Pakistan's Chromite Trade Scenario

In the absence of value added projects in the region, bulk of the ore mined is being exported. The estimated production of Chromite Ore from Pakistan in the year 2007-08 is 41520 tons. Revenue receipts are estimated to be Rs. 4.3 million in FY 2007-08.<sup>3</sup>

Table No. 4-1 below shows, the list of importing markets for Chromium Ore & Products exported by Pakistan in FY 2010.<sup>4</sup>

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<sup>2</sup> <http://www.statpak.gov.pk/fbs/sites/default/files/other/yearbook2010/ENERGY%20%20&%20MINING/7-3.pdf>

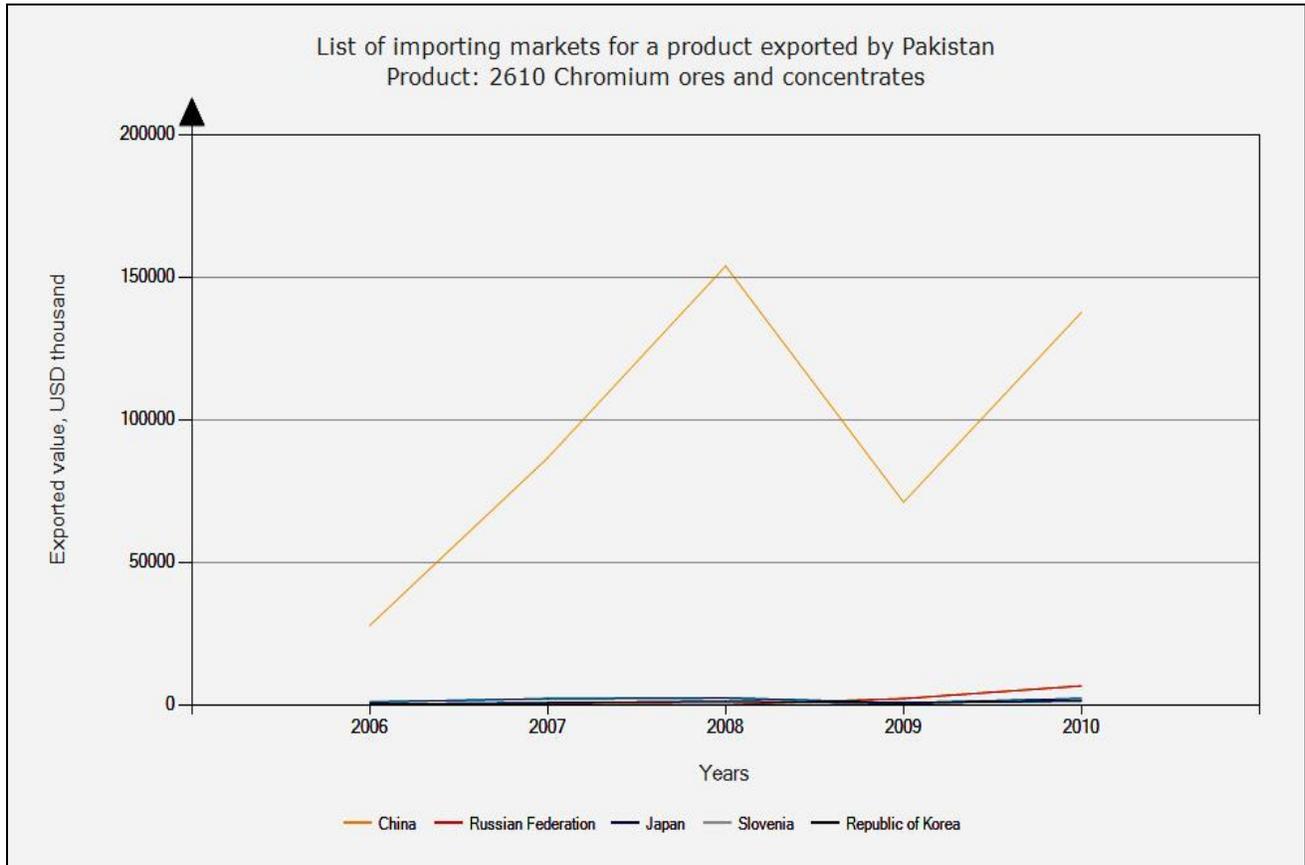
<sup>3</sup> Mineral Statistics of Pakistan (2004-2009)

<sup>4</sup> [http://www.trademap.org/tradestat/Country\\_SelProductCountry\\_TS.aspx](http://www.trademap.org/tradestat/Country_SelProductCountry_TS.aspx)

Table 4-1 List of Importing Markets for a product exported by Pakistan

<b>List of importing markets for a product exported by Pakistan</b>					
Product : 2610 Chromium ores and concentrates					
Sources : ITC calculations based on COMTRADE statistics.					
Unit : US Dollar thousand					
Importers	Exported value in 2006	Exported value in 2007	Exported value in 2008	Exported value in 2009	Exported value in 2010
World	30923	91400	160583	75523	150857
China	27831	86606	153902	71062	137626
Russian Federation	0	296	0	2159	6610
Japan	975	2141	2388	704	2215
Slovenia	48	166	0	377	1687
Republic of Korea	268	729	1240	604	1347
Netherlands	0	0	0	13	745
Spain	152	231	413	166	482
Australia	17	75	86	63	76
Chinese Taipei	161	83	310	248	69
Brunei Darussalam	113	0	0	0	0
Chile	0	22	0	0	0
Croatia	32	0	0	0	0
Czech Republic	24	0	0	0	0
Germany	513	539	2124	127	0
Ireland	35	0	0	0	0
Italy	131	0	0	0	0
Mexico	0	20	0	0	0
Peru	0	0	25	0	0
Poland	172	69	0	0	0
Romania	25	12	68	0	0
Slovakia	400	413	0	0	0
Viet Nam	23	0	0	0	0
Thailand	0	0	26	0	0
United Kingdom	1	0	0	0	0

Fig: 4-1 list of importing markets for a product exported by Pakistan



Pakistan is importing its entire requirements of ferroalloys, basic refractory bricks as well as Chromite chemicals. Although the Chromite reserves may not be very large but are substantial enough to support value added projects to meet the domestic requirements.

### 4.3 China’s Imports of Chromite Ore<sup>5</sup>

Due to an increase in demand of stainless steel in china and lack of availability of Chromite ore, imports of Chromite ore increased rapidly in China especially over the last five years. As shown in the table below the imports of Chrome Ore increased from 2.82 MMTPA in 2005 to 6.76 MMTPA in 2009.

<sup>5</sup> [http://ideasfirst.in/Admin/Downloads/Reports/1720868194\\_Chrome-Ferrochrome% 20-% 20Final% 20-% 2031Mar20101.pdf](http://ideasfirst.in/Admin/Downloads/Reports/1720868194_Chrome-Ferrochrome%20-%20Final%20-%202031Mar20101.pdf)

Table 4-2 China's Import of Chrome Ore

China's Import of Chrome Ore					
Country	2005	2006	2007	2008	2009
India	0.98	1.34	0.98	0.55	0.41
South Africa	0.33	0.87	1.96	2.60	2.90
Turkey	0.62	0.74	1.08	1.18	1.29
Australia	0.20	0.22	0.22	0.07	0.14
Kazakhstan	0.07	0.11	0.20	0.20	0.17
Oman	0.05	0.07	0.34	0.81	0.69
Pakistan	0.15	0.20	0.30	0.38	0.30
Others	0.42	0.52	0.79	1.05	0.86
Total	2.82	4.07	5.87	6.58	6.76

Source: ENRC, Tex Report

India was a major exporter to China in 2005 and 2006, but because of the increase in the export tax on Chrome Ore by the government this demand of China was drawn out of the country. During 2007 to 2009, South Africa and Turkey have been increasingly catering to the Chrome Ore demand of China, with South Africa supplying almost 42.89% of the total import of Chrome Ore by China in 2009.

#### 4.4 Tax Regime – To Curb Chrome Ore Export<sup>6</sup>

Stainless steel production reached record levels in china and India in the year 2008. Following this Chromite ore and ferrochrome price reached record levels that led to governments and businesses looking for ways to reduce prices and costs. Tariffs were scrutinized and changed in some places; however, in countries where Chromite ore, ferrochrome, and stainless steel were produced and consumed, there were conflicting pressures. Chromite ore producers wanted to export more ore, while ferrochromium producers wanted to limit Chromite ore exports to secure their source of ore. As a result, ferrochromium producers promoted Chromite ore export taxes and quotas that Chromite ore producers sought to reduce. Stainless steel producers promoted reduced import duties on ferrochromium, while promoting increased import duties on stainless steel mill products.

The Government of Kazakhstan, South Africa and India has imposed export tax on chrome ore and plan to increase the same to curb the export of chrome ore without much value addition.

<sup>6</sup> USGS, <http://www.usgs.gov/>

Thus imposition of tax; higher on exports and lower on imports by various countries, will protect the interest of the local producers and increase the cost of exports generating revenues for various countries.

#### 4.5 China to dominate Stainless Steel Industry

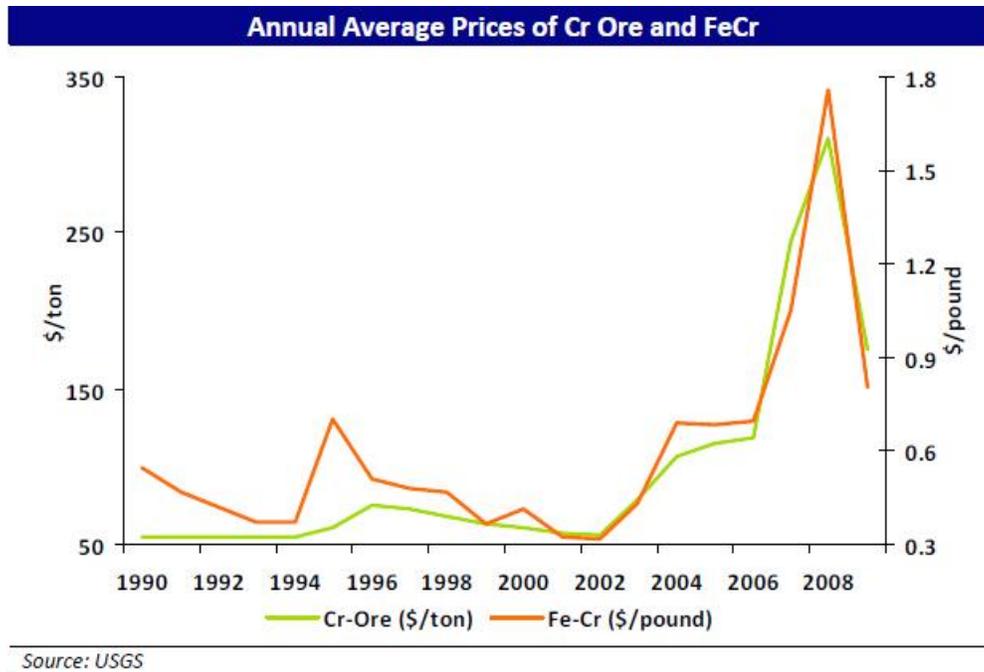
China produced 11 MMTPA of stainless steel in 2009, up 30% from 2008. By 2015, Chinese melt capacity is expected to reach 21.7 MMTPA which is 50% higher than 14.5 MMTPA achieved in 2009. Conservatively, Chinese melt production could rise between 16 to 18 MMTPA by 2015 (+5 to +7 MMTPA compared to 2009). With this capacity, theoretically China would be producing 55% of the world’s stainless steel.

To meet the forecast numbers, China needs to import heavily. Almost 4.5 to 9 MMTPA of chrome ore or 1.5 to 2.5 MMTPA of ferrochrome needs to import by China every year. This is because its resources are not enough to cater to such a huge demand of raw material required to produce stainless steel.

Thus, China’s growing consumption of stainless steel will definitely drive the demand for chrome ore and ferrochrome.

#### 4.6 Pricing Plays a Significant Role <sup>7</sup>

Fig: 4-2 Annual Average Prices of Chrome Ore and Ferrochrome

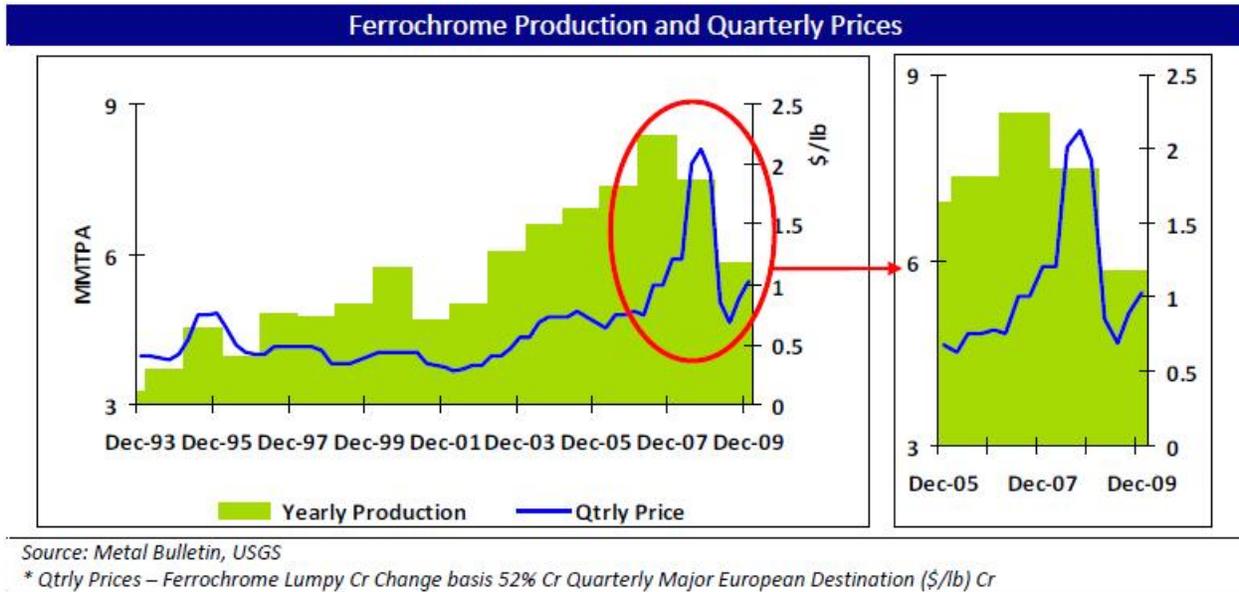


<sup>7</sup> Ideas 1<sup>st</sup> (Report)– Ferrochrome –March 2010



Chrome ore is not openly traded. Purchase contracts are confidential in nature, however historically it is observed that the chrome ore prices move in tandem with ferrochrome prices. Lately, South African miners have started supplying Run-of-mine (ROM) material without beneficiation and this has created a new market.

Fig: 4-3 Ferrochrome Production and Quarterly Prices



#### 4.7 Value Chain

There is a tremendous amount of value addition during the process of conversion of chrome ore to ferrochrome and thus almost all major producers across the globe have captive sourcing of chrome ore except Chinese manufacturers.

Due to the current circumstances prevailing in South Africa, the benefits availed by South African producers since a long period are getting passed over to Chinese producers of ferrochrome.



Between 1992 to 2006, steel production grew at an annual average of around 3.5% while stainless steel production grew by over 5% during the same period.

With the revival of steel industry in the developed as well as emerging nations it is estimated that the steel industry will grow by 11% in 2010 and at a CAGR of 5% to 6% over 2010 to 2014. Based on this analysis, we anticipate that the stainless steel production will grow by 14% in 2010 and at a CAGR of 8 to 8.5% between 2010 to 2014.

The demand scenario is depicted in the table below:

Table: 4-3 Stainless Steel, Ferrochrome & Chromite Estimates

<b>Stainless Steel, Ferrochrome &amp; Chrome Ore Estimates</b>				
<b>Year</b>	<b>Stainless Steel</b>		<b>Ferrochrome</b>	<b>Chrome ore</b>
	<b>Growth (%)</b>	<b>Production MMTPA</b>	<b>Global Demand MMTPA</b>	<b>MMTPA</b>
2000	-	19.35	5.72	14.71
2001	- 1.0 %	19.19	4.68	12.14
2002	1.8 %	20.69	5.03	14.25
2003	10.4 %	22.84	6.07	15.51
2004	7.5 %	24.57	6.59	17.78
2005	- 1.0 %	24.32	6.91	18.87
2006	16.6 %	28.36	7.34	19.00
2007	- 1.8 %	27.84	8.37	21.49
2008	- 6.8 %	25.93	7.46	24.40
2009	-5.2 %	24.60	5.83	22.95
<b>2010E</b>	<b>14.0 %</b>	<b>28.04</b>	<b>7.24</b>	<b>26.14</b>
<b>2011E</b>	<b>7.0 %</b>	<b>30.00</b>	<b>7.77</b>	<b>28.05</b>
<b>2012E</b>	<b>7.0 %</b>	<b>32.10</b>	<b>8.29</b>	<b>29.94</b>
<b>2013E</b>	<b>7.0 %</b>	<b>34.34</b>	<b>8.87</b>	<b>32.06</b>
<b>2014E</b>	<b>7.0 %</b>	<b>36.74</b>	<b>9.48</b>	<b>34.23</b>

*Source: Ideas 1<sup>st</sup> Estimates, USGS, ISSF, ICDA Chromium, Metal Bulletin.*

Chrome ore and ferrochrome industry which has been struggling for some time now needs to overcome the concerns discussed in the course of the report to meet the increasing appetite of the stainless steel industry.

However it seems difficult to address these concerns in the short term and the present situation is expected to continue for a few more years. This implies a demand supply shortfall with increasing chrome ore and ferrochrome prices.

#### 4.8 Advantages of the Beneficiation Plant at the Mining Site

Currently the ore is transported and upgraded in the mini beneficiation plants established in Karachi. This means the impurities in the ore are also transported to Karachi, thus increasing the transportation costs. Having a plant in Balochistan, near to the mines, would mean that the impurities get treated at the source and only the end product is transported. This will give savings to the plant/mine owner in the form of low transportation costs.

The plant will upgrade the low grade Chromite and thus will provide a uniform standard of high grade material. With the value addition activity being carried out in Balochistan, the stakeholders

in the value chain will be getting higher returns for their input. This will improve the cash inflow in this sector, thus increasing the importance of the sector. Once this is achieved, the stakeholders will start improving the current uneconomical practices being carried out in the industry ensuring continued supply of Chromite to local & international markets.

## 5 MARKET INFORMATION

### 5.1 Industrial uses of Chromite

The utilization of Chromite ores in three main industrial groups in terms of percentages is provided below:

- Metallurgical – About 65 % to 70 % of the entire production is used by this sector alone.
- Chemical – this sector utilizes about 15 % to 20 % of the ore produced.
- Refractory – about 10 % to 15 % of ore is consumed by this sector.

#### 5.1.1 Metallurgical

Chromium is used in metallurgical industry to produce stainless steel and other special steels. Addition of small or moderate amount of chromium, with or without other alloying agents improves the hardness, tenacity, ductility, and the corrosion and oxidation resistance of this metal. Ferrochrome containing about 70 % - 75 % chromium is added to produce ferro alloys.

The ferrochrome industry utilizes Chromite ore containing at least 40 %  $\text{Cr}_2\text{O}_3$  and normally having a Cr:Fe ratio of about 3:1. The ore should be hard, lumpy with minimum quantity of fines. However, with the development of a new process (agglomeration of the ores and the AOD-argon-oxygen decarburization process for the production of stainless steel), an increasing amount of friable ores and fines as well as ores having very low Cr:Fe ratio – down to 1.6:1 – can now be used for metallurgical purposes.

Chromium is a constituent of a variety of alloy steels, cast iron, and, non-ferrous alloys, chromium's function in these products is to enhance their mechanical properties or to impart special properties of electrical or abrasive resistance.

#### 5.1.2 Chemical

Chromium pigments represent the largest use of chromium in the chemical industry. Sodium dichromate – the primary base material for manufacture of chromium chemicals – is used to manufacture chrome green, chrome oxide green, chrome yellow, molybdenum orange and zinc chromate pigments. These pigments are used in paints, ink and roofing granules, the familiar chromium plating used in automobile trim, appliances and other consumer goods is derived from chemicals. Other uses that take advantage of special properties of these chemicals are in leather tanning, metal treatment – corrosion, inhibitor – drilling mud's, textile, dyes, catalysts and wood and water treatment.

Chromite ores for chemical uses (in the form of concentrates and fines) should contain at least 45 %  $\text{Cr}_2\text{O}_3$ , not more than 25 % FeO and 8 %  $\text{SiO}_2$ , and a low MgO and S-content.

### 5.1.3 Refractory

Due to its high melting point, its (nearly) chemical neutrality, and its resistance against acids and bases at high temperatures, chromite is used in the production of refractories, particularly production of refractory bricks. The major application of chromite refractories is in iron and steel processing, non-ferrous alloy refining, glass making and cement processing.

Chromite ores containing 30 % - 46 % Cr<sub>2</sub>O<sub>3</sub> (and a preferable combine content of Cr<sub>2</sub>O<sub>3</sub> and Al<sub>2</sub>O<sub>3</sub> in the range of 57 % to 63 %), with 15 – 20 % MgO, a low silica content of up to 5 % SiO<sub>2</sub>, and a low iron oxide content of about 15 % are used.

A new field for Chromite consumption is in the (steel) foundry industry as a molding medium, especially where a large scale and close tolerance have to be met. The grain size should be between 0.1 mm to 0.2 mm. Common specifications for such Chromite sands are as follows:

Cr <sub>2</sub> O <sub>3</sub>	44 % to 47 %
Fe <sub>2</sub> O <sub>3</sub>	18 % to 26 %
SiO <sub>2</sub>	about 1.5 %
CaO	0.1 % to 0.5 %
MgO	10 %

## 5.2 Market Overview & Observations

Demand for chrome ore has been expanding by some 5% annually over past decade while chrome ore output was marginally lower at an average of 4.6 % per annum. Thus new chrome ore resource needs to be explored.

- Depletion of chrome ore grades will drive exploration of mines attracting cross border investments.
- Backward integration is required to overcome the shortage of power throughout the industrial chain of chrome ore, ferrochrome and stain less steel.
- South Africa is caught in a tight spot because of shortage of power, which is compelling it to increase ROM chrome ore exports instead of beneficiated chrome ore and ferrochrome.
- Toughened export tax regime in South Africa, China and India to increase chrome ore and ferrochrome prices.
- Kazakhstan holds a strong position as compared to the countries as it has cash rich ferrochrome producers who have vertically integrated plants though it holds only 5% of world chrome ore resources.
- Geopolitical situation:
  - X Producers: South Africa, Kazakhstan and India
  - X Consumers: China, Europe, U.S and Asia

- Non availability of low ash low phosphorus coking coal prices is likely to create some strain for China and India.
- Need for process innovation to directly manufacture stainless steel from chrome ore / liquid chrome.
- Dynamics of ferrochrome will mainly depend on stainless steel trend which will mainly be driven by growing dominance of China's stainless steel industry.
- Avenue for Mergers and Acquisition leading to further consolidation of the business helping players to gain influence globally.
- Augmentation of power supply in South Africa might change the dynamics of chrome and ferrochrome industry post 2012.
- Substitute for Chromium – None.

## CONCLUSION

Chromium market is highly consolidated and is represented by a few miners and producers in South Africa and Kazakhstan. This makes it possible to cut down supply whenever there is a reduction in stainless steel production to curb the downfall in prices. The chrome ore and ferrochrome industry is struggling hard to meet the demand emanating from the stainless steel producers particularly from China.

Considering the various triggers and concerns as discussed in the report, it seems that shortage of chrome ore and ferrochrome may last for many years; probably till 2013 and the industry will be subject to wild price fluctuations. Overcoming the concerns will bring new dimensions and way forth for the chrome ore and ferrochrome producers and will also keep a balance in the demand supply situation.

Ferrochrome companies who have already integrated backwards into chrome ore mines and power plants have an edge to “Outperform” for a long period keeping the existing scenario in view.<sup>8</sup>

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<sup>8</sup> Ideas 1<sup>st</sup> (Report)– Ferrochrome –March 2010

## 6 PRODUCTION PROCESS

The methods and the machinery used in the process of beneficiation of chrome ore for high-grade basic refractory raw material are the following.

### 6.1 Crushing

Crushing of lumpy Chrome ore requires Jaw Crushers, Drum Roller Crushers and Hammer Crushers.

#### 6.1.1 Jaw Crusher

The size and specifications are as Jaws width = 14", length = 18" and the displacement must be less than half inch. Motor required for power is about fifteen kilowatts, with a speed of 950 rpm.

#### 6.1.2 Roller Crusher

The diameter of drum must be of 24" and the length of the drum should be of 18". Two motors of ten kilowatts are required with a gear transmission and the speed of about 35-rpm.

#### 6.1.3 Hammer Crusher:

The hammer crusher of a normal size is required with a minimum speed, so that a maximum quantity of coarse size could be achieved. The power that is required for a normal size hammer crusher is 25 kilowatts with a speed of 950 rpm.

### 6.2 Sizing

Vibrating screens are required for sizing both on the initial stage and for the final material. The size of screens could be from 8' to 10' in length and about two and a half feet in width. The power required for vibrating screens is 3 to 5 kilowatts. The sheets of ready-made screens of the required size could be attached with this machine. The minimum size of about 80 meshes could be separated in this type of vibrating screen.

### 6.3 Conveyor Belt

Conveyor belts are required on the feeding and discharge of each machine. Motors required for the conveyor belts should be about 2 kilowatts with a gear transmission of the speed of about 60-rpm.

### 6.4 Spiral Mixing Machine

Prior to sending the crushed ore directly to the shaking tables, the ore is dropped through spiral tracks of the machine in order to properly blend the crushed ore with water and clear a major part of unwanted material in the first stage. This will enable the ore to get rid of its impurities and in the second phase when sent to the shaking table this will require less time to separate, up-grade & washed Chromite ore with standardized superior quality end product. Usually very fine grinded ore (powdered form) is being washed & upgraded via spirals.

### 6.5 Shaking Tables

If a mixture containing mineral particles of different specific gravitates is agitated in water and then allowed to settle, the heavy particles will sink more rapidly to the bottom layer. Taking

advantage of this phenomenon in its simplest form, the dirt can be washed away to leave the gold sediment in the pan. When a water/solid mixture flows over the surface of the Table the dense particles sink in advance as of the lighter particles. The jiggling action of the Table causes the heavy concentrates to progress towards the end of the table, whilst the lighter particles or 'tailings' are washed over the lower edge. The table part of the machine, often referred to as the deck, is normally manufactured from best quality timbers with a 15-mm marine ply surface, and steel reinforcing where necessary for extra strength. The surface of the Timber deck has a covering of the material, which acts both as a wearing surface and a waterproof barrier to protect the timber beneath.

The capacity of full size Concentrating table varies according to the duty. On coarse feeds, up to one ton (1000 KGs.) per hour of solid can be obtained and even double of the mentioned quantity when the table is used for roughing work. On more difficult ores, and especially with slims the capacity may be as low as 5 cwt. (250 KGs. Per hour).

### 6.6 Roller Dryer

The ore concentrates from the table are wet and it needs to be dried before the end use. For the drying purpose a rotary dryer is used.

Rotary dryer is a cylinder, made up of MS. sheet of at least half inch thick. The length of dryer should be 20 feet and its diameter will be about two and a half feet. The main body of the dryer is based on four small wheels or rollers, tapering towards the discharge end. Material is fed from the upper side. The dryer could be rotated with the help of a gear or chain and sprocket, driven by a motor.

Dryer could be gas fired or fired with furnace oil. The burners are placed at the discharge end with an air blower, firing upwards to the feeding end. The capacity of the dryer should be two tons per hour.

In Practical, currently the Chromite ore is dried naturally by spreading the ore on concrete floor under the sun in open air. The concrete floor prevents mixture of soil, gravels or other impurities in the beneficiated Chromium ore.

### 6.7 Raw Material Requirement

The basic raw material required is the Chromite Ore. Balochistan contributes high share in the overall production of Chromite in the country. The Chromite reserves are located in the areas of Muslim Bagh, Khanozai, Dalbandin, Kharan and Wad. Chromite ore reserves are also available in Khyber Pakhtunkhwa province.

## 7 MACHINERY & EQUIPMENT REQUIREMENT

The main equipments required for running the Chromite beneficiation plant are listed in the table 8-1 below:

Table 7-1 Machinery Requirement Details

Description	Qty	Cost/Unit	Total Amount (Rs.)
Jaw Crusher (Length 18", Width 14", Displacement<1/2", RPM 950)	1	845,000	845,000
Roller Crusher (Length 18", Dia 24", RPM 35)	1	397,500	397,500
Hammer crusher (RPM 950)	1	845,000	845,000
Sieve Vibrator (Length 8-10', Width 2 <sup>1/2'</sup> )	3	256,500	769,500
Table separators (15 mm marine ply)	4	481,000	1,924,000
Spiral machines (4-spirals)	1	910,000	910,000
Conveyors (200 Rft)	1 set	4200/rft	840,000
Hopper Assy. (for tables)	1	192,000	192,000
Installation cost			300,000
Transformer (120 KVA complete with installation)	1	1,500,000	1,500,000
Electric cables, switches & Misc. Eqpt.		675,000	675,000
Misc. Contingency			459,900
<b>Total</b>			<b>9,657,900</b>

Table 7-2 Office Equipment Details

Office Equipment Details	Qty	Cost/Unit	Total Cost
Computer	2	50,000	100,000
Computer Printer	1	20,000	20,000
Telephone sets	2	1500	3,000
Fax Machine	1	35,000	35,000
Copier	1	150,000	150,000
<b>Total Equipment Cost</b>			<b>308,000</b>

Table 7-3 Furniture &amp; Fixture Details

Description	Total Cost
Furniture and Carpeting	200,000
Electric Wiring and Lighting	100,000
Misc	60,000
<b>Total</b>	<b>360,000</b>

## 7.1 Technology and Processes

### 7.1.1 Technology / Process Options

The machinery used for the Chromite Beneficiation Plant is local made. It includes jaw crusher, roller crusher, hammer crusher, sieve vibrator, table separator etc.

### 7.1.2 Merits & demerits of a particular technology

The local machinery is readily available in the market at a very reasonable price. One of the benefits of using locally manufactured machinery is the availability of spare parts and it is also easier to find operators to operate these machines.

## 8 HUMAN RESOURCE REQUIREMENT

The manpower required for operating the Chromite Beneficiation Plant is as follows:

Table 8-1 Human Resource Requirement Details

Positions	No.	Salary/Month	Total Monthly Salary	Total Salary/Year
Manager	1	50,000	50,000	600,000
Machine operators	4	25,000	100,000	1,200,000
Labor	16	7,000	112,000	1,344,000
Assistant / Peon	1	7,000	7,000	84,000
Watch Man	2	7,000	14,000	168,000
Acc./Admin. In charge	1	30,000	30,000	360,000
Supervisor	1	25,000	25,000	300,000
<b>Total</b>	<b>26</b>		<b>338,000</b>	<b>4,056,000</b>

## 9 LAND & BUILDING REQUIREMENT

### 9.1 Land Requirement

Two acres of land will be required to install various facilities of the project. The total cost of land would be Rs. 2,100,000. However, the cost of land would vary from location to location.

### 9.2 Covered Area Requirement

The covered area detail for the proposed project and construction cost detail is given in table below:

Table 9-1 Covered Area Requirement Details

Description	Sq .ft	Rs/Sq. ft	Total Cost (Rs.)
Office Area	300	1300	390,000
Sheds	500	1000	500,000
Flooring	900	700	630,000
Water Tanks	300	800	240,000
Total Building Cost			1,760,000

### 9.3 Recommended Mode

It is recommended that land should be acquired for the project, as it would be difficult to setup such a project at a rented place due to high machinery & installation cost.

### 9.4 Proposed Project Location

All the areas where Chromite Ore is being mined can be suitable locations for such like plants and where required utilities are available. Additionally the said project can be started in an Industrial Area where Raw Material is easily available. The proposed location of this Pre-feasibility is recommended to be Muslim-Bagh & Khanozai being the most suitable location for the installation of such a plant because of its nearness to the mining area and availability of water and electricity. Similarly Dalbandin, Kharan & Wad could also be suitable locations for beneficiation of ore found in these localities.

### 9.5 Production Capacity

The Plant would have the capacity to process around 15,000 tons of Chromite Ore per annum, however it is assumed that in first year of its operation the plant will process around 10,500 Tons of Chromite Ore at the rate of 70% capacity utilization. This production is based on single shift bases.

### 9.6 Utilities and Infrastructure Requirement

Basic utilities like electricity and water are required for operations. Proximity of the plant to the metalled road if possible is also proposed.

## 10 PROJECT ECONOMICS

### 10.1 Project Cost

Capital Investment	Rs. in actual
Land	2,100,000
Building/Infrastructure	1,760,000
Machinery & equipment	9,657,900
Furniture & fixtures	360,000
Office equipment	308,000
Pre-operating costs	788,000
<b>Total Capital Costs</b>	<b>14,973,900</b>
Working Capital	Rs. in actual
Equipment spare part inventory	419,271
Raw material inventory	7,127,604
Upfront insurance payment	482,895
Cash	500,000
<b>Total Working Capital</b>	<b>8,529,770</b>
<b>Total Investment</b>	<b>23,503,670</b>

### 10.2 Cost of Goods Sold

Cost of goods sold 1	8,000
Cost of goods sold 2	500
Cost of goods sold growth rate	5.0%
Operating costs 2 (Transportation)	1,000

### 10.3 Project Returns

Description	Equity	Project
IRR	32%	24%
MIRR	24%	18%
Payback Period (yrs)	4.42	4.94
NPV	5,800,413	9,737,257

### 10.4 Project Financing

Description	Percentage	Amount in Rs
Debt Financing	39%	9,206,272
Equity Financing	61%	14,297,398
<b>Total</b>		<b>23,503,670</b>

## 11 FINANCIAL ANALYSIS

### 11.1 Project Cost

#### Statement Summaries

SMEDA

#### Initial Investment

Capital Investment	Rs. in actuals
Land	2,100,000
Building/Infrastructure	1,760,000
Machinery & equipment	9,657,900
Furniture & fixtures	360,000
Office vehicles	-
Office equipment	308,000
Pre-operating costs	788,000
Training costs	-
<b>Total Capital Costs</b>	<b>14,973,900</b>

Working Capital	Rs. in actuals
Equipment spare part inventory	419,271
Raw material inventory	7,127,604
Upfront land lease rental	-
Upfront building rent	-
Upfront machinery & equipment lease rental *	-
Upfront office equipment lease rental *	-
Upfront office vehicles lease rental *	-
Upfront insurance payment	482,895
Cash	500,000
<b>Total Working Capital</b>	<b>8,529,770</b>

<b>Total Investment</b>	<b>23,503,670</b>
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Initial Financing	Rs. in actuals
Debt	9,206,272
Equity	14,297,398
Lease	-
Export re-finance facility	-

\* Provisioning for the first year installments

## 11.2 Projected Income Statement

Statement Summaries										SMEDA
Income Statement										
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Rs. in actuals Year 10
Revenue	110,687,500	137,878,125	162,963,281	171,907,313	180,502,678	189,527,812	199,004,203	208,954,413	219,402,133	230,372,240
Cost of goods sold	99,426,125	123,550,260	145,766,985	153,918,699	161,778,233	170,043,832	178,736,845	187,879,774	197,496,338	207,611,535
Gross Profit	11,261,375	14,327,865	17,196,297	17,988,613	18,724,445	19,483,980	20,267,358	21,074,638	21,905,796	22,760,705
General administration & selling expenses										
Administration expense	1,248,360	1,348,229	1,456,087	1,572,574	1,698,380	1,834,250	1,980,990	2,139,470	2,310,627	2,495,477
Rental expense	-	-	-	-	-	-	-	-	-	-
Utilities expense	260,000	266,000	272,600	1,125,650	1,125,650	1,125,650	1,125,650	1,125,650	1,125,650	1,125,650
Travelling & Comm. expense (phone, fax, etc.)	42,420	45,814	49,479	53,437	57,712	62,329	67,315	72,700	78,516	84,798
Office vehicles running expense	-	-	-	-	-	-	-	-	-	-
Office expenses (stationary, etc.)	12,120	13,090	14,137	15,268	16,489	17,808	19,233	20,772	22,433	24,228
Promotional expense	-	-	-	-	-	-	-	-	-	-
Insurance expense	482,895	434,606	386,316	338,027	289,737	241,448	193,158	144,869	96,579	48,290
Professional fees (legal, audit, etc.)	110,688	137,878	162,963	171,907	180,503	189,528	199,004	208,954	219,402	230,372
Depreciation expense	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590
Amortization expense	157,600	157,600	157,600	157,600	157,600	-	-	-	-	-
Property tax expense	-	-	-	-	-	-	-	-	-	-
Miscellaneous expense	110,688	137,878	162,963	171,907	180,503	189,528	199,004	208,954	219,402	230,372
Subtotal	3,527,360	3,643,684	3,764,735	4,708,960	4,809,163	4,763,131	4,886,945	5,023,959	5,175,200	5,341,777
Operating Income	7,734,015	10,684,181	13,431,562	13,279,653	13,915,281	14,720,850	15,380,413	16,050,679	16,730,596	17,418,928
Other income	17,500	-	191,618	396,631	849,004	1,390,665	2,003,190	2,656,951	3,352,845	4,058,543
Gain / (loss) on sale of assets	-	-	-	-	-	-	-	-	-	-
Earnings Before Interest & Taxes	7,751,515	10,684,181	13,623,180	13,676,284	14,764,286	16,111,514	17,383,602	18,707,630	20,083,441	21,477,471
Interest expense	1,257,422	860,627	421,927	278,004	146,870	-	-	-	-	-
Earnings Before Tax	6,494,093	9,823,555	13,201,252	13,398,280	14,617,416	16,111,514	17,383,602	18,707,630	20,083,441	21,477,471
Tax	2,597,637	3,929,422	5,202,247	5,358,414	5,846,966	6,444,606	6,953,441	7,483,052	8,033,376	8,566,957
NET PROFIT/(LOSS) AFTER TAX	3,896,456	5,894,133	7,999,005	8,039,866	8,770,449	9,666,909	10,430,161	11,224,578	12,050,065	12,910,514
Balance brought forward		3,896,456	9,790,589	12,260,993	25,826,318	29,071,308	44,263,676	49,168,378	65,918,415	72,443,021
Total profit available for appropriation	3,896,456	9,790,589	17,789,594	20,300,859	34,596,767	38,738,217	54,693,837	60,392,956	77,968,480	85,353,535
Owner's withdrawals	-	-	-	-	-	-	-	-	-	25,606,060
Balance carried forward	3,896,456	9,790,589	17,789,594	20,300,859	34,596,767	38,738,217	54,693,837	60,392,956	77,968,480	59,747,474

## 11.3 Projected Balance Sheet

Statement Summaries											SMEDA
Balance Sheet											Rs. in actuals
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
<b>Assets</b>											
<b>Current assets</b>											
Cash & Bank	500,000	-	-	-	11,382,979	12,874,289	26,858,986	30,375,000	45,537,885	50,257,696	63,984,158
Accounts receivable	-	9,097,603	10,215,026	12,363,345	13,761,805	14,482,602	15,206,732	15,967,069	16,765,423	17,603,694	18,483,878
Finished goods inventory	-	4,322,875	5,174,880	6,101,874	6,413,279	6,740,760	7,085,160	7,447,369	7,828,324	8,229,014	8,650,481
Equipment spare part inventory	419,271	548,379	680,557	753,804	831,069	916,253	1,010,169	1,113,712	1,227,867	1,353,723	-
Raw material inventory	7,127,604	9,322,441	11,569,467	12,814,665	14,128,168	15,576,305	17,172,876	18,933,096	20,873,738	23,013,296	-
Pre-paid annual land lease	-	-	-	-	-	-	-	-	-	-	-
Pre-paid building rent	-	-	-	-	-	-	-	-	-	-	-
Pre-paid lease interest	-	-	-	-	-	-	-	-	-	-	-
Pre-paid insurance	482,895	434,606	386,316	338,027	289,737	241,448	193,158	144,869	96,579	48,290	-
<b>Total Current Assets</b>	<b>8,529,770</b>	<b>23,725,904</b>	<b>28,026,246</b>	<b>32,371,714</b>	<b>46,807,037</b>	<b>50,831,657</b>	<b>67,527,081</b>	<b>73,981,114</b>	<b>92,329,816</b>	<b>100,505,713</b>	<b>91,118,517</b>
<b>Fixed assets</b>											
Land	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000
Building/Infrastructure	1,760,000	1,672,000	1,584,000	1,496,000	1,408,000	1,320,000	1,232,000	1,144,000	1,056,000	968,000	880,000
Machinery & equipment	9,657,900	8,692,110	7,726,320	6,760,530	5,794,740	4,828,950	3,863,160	2,897,370	1,931,580	965,790	-
Furniture & fixtures	360,000	342,000	324,000	306,000	288,000	270,000	252,000	234,000	216,000	198,000	180,000
Office vehicles	-	-	-	-	-	-	-	-	-	-	-
Office equipment	308,000	277,200	246,400	215,600	184,800	154,000	123,200	92,400	61,600	30,800	-
<b>Total Fixed Assets</b>	<b>14,185,900</b>	<b>13,083,310</b>	<b>11,980,720</b>	<b>10,878,130</b>	<b>9,775,540</b>	<b>8,672,950</b>	<b>7,570,360</b>	<b>6,467,770</b>	<b>5,365,180</b>	<b>4,262,590</b>	<b>3,160,000</b>
<b>Intangible assets</b>											
Pre-operation costs	788,000	630,400	472,800	315,200	157,600	-	-	-	-	-	-
Legal, licensing, & training costs	-	-	-	-	-	-	-	-	-	-	-
<b>Total Intangible Assets</b>	<b>788,000</b>	<b>630,400</b>	<b>472,800</b>	<b>315,200</b>	<b>157,600</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>TOTAL ASSETS</b>	<b>23,503,670</b>	<b>37,439,614</b>	<b>40,479,766</b>	<b>43,565,044</b>	<b>56,740,177</b>	<b>59,504,607</b>	<b>75,097,441</b>	<b>80,448,884</b>	<b>97,694,996</b>	<b>104,768,303</b>	<b>94,278,517</b>
<b>Liabilities &amp; Shareholders' Equity</b>											
<b>Current liabilities</b>											
Accounts payable	-	8,668,321	10,793,966	12,682,971	13,432,162	14,168,321	14,947,903	15,773,759	16,648,951	17,576,768	16,352,699
Export re-finance facility	-	-	-	-	-	-	-	-	-	-	-
Short term debt	-	4,475,094	359,430	53,798	-	-	-	-	-	-	-
Other liabilities	-	-	-	-	-	-	-	-	-	-	-
<b>Total Current Liabilities</b>	<b>-</b>	<b>13,143,415</b>	<b>11,153,396</b>	<b>12,736,770</b>	<b>13,432,162</b>	<b>14,168,321</b>	<b>14,947,903</b>	<b>15,773,759</b>	<b>16,648,951</b>	<b>17,576,768</b>	<b>16,352,699</b>
<b>Other liabilities</b>											
Lease payable	-	-	-	-	-	-	-	-	-	-	-
Deferred tax	-	1,938,780	1,945,980	1,953,180	1,960,380	1,967,580	1,588,464	1,209,348	830,232	451,116	72,000
Long term debt	9,206,272	4,163,565	3,292,404	2,316,703	1,223,919	-	-	-	-	-	-
<b>Total Long Term Liabilities</b>	<b>9,206,272</b>	<b>6,102,345</b>	<b>5,238,384</b>	<b>4,269,883</b>	<b>3,184,299</b>	<b>1,967,580</b>	<b>1,588,464</b>	<b>1,209,348</b>	<b>830,232</b>	<b>451,116</b>	<b>72,000</b>
<b>Shareholders' equity</b>											
Paid-up capital	14,297,398	14,297,398	14,297,398	14,297,398	14,297,398	14,297,398	14,297,398	14,297,398	14,297,398	14,297,398	14,297,398
Retained earnings	-	3,896,456	9,790,589	17,789,594	20,300,859	34,596,767	38,738,217	54,693,837	60,392,956	77,968,480	59,747,474
<b>Total Equity</b>	<b>14,297,398</b>	<b>18,193,854</b>	<b>24,087,987</b>	<b>32,086,992</b>	<b>34,598,257</b>	<b>48,894,165</b>	<b>53,035,615</b>	<b>68,991,235</b>	<b>74,690,354</b>	<b>92,265,878</b>	<b>74,044,872</b>
<b>TOTAL CAPITAL AND LIABILITIH</b>	<b>23,503,670</b>	<b>37,439,614</b>	<b>40,479,766</b>	<b>49,093,645</b>	<b>51,214,718</b>	<b>65,030,066</b>	<b>69,571,982</b>	<b>85,974,343</b>	<b>92,169,537</b>	<b>110,293,762</b>	<b>90,469,572</b>

Note: Total assets value will differ from project cost due to first installment of leases paid at the start of year 0

## 11.4 Projected Cash Flow Statement

Statement Summaries											SMEDA
Cash Flow Statement											
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	Rs. in actuals										
<b>Operating activities</b>											
Net profit	-	3,896,456	5,894,133	7,999,005	8,039,866	8,770,449	9,666,909	10,430,161	11,224,578	12,050,065	12,910,514
Add: depreciation expense	-	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590	1,102,590
amortization expense	-	157,600	157,600	157,600	157,600	157,600	-	-	-	-	-
Deferred income tax	-	1,938,780	7,200	7,200	7,200	7,200	(379,116)	(379,116)	(379,116)	(379,116)	(379,116)
Accounts receivable	-	(9,097,603)	(1,117,423)	(2,148,320)	(1,398,460)	(720,797)	(724,130)	(760,337)	(798,353)	(838,271)	(880,185)
Finished good inventory	-	(4,322,875)	(852,005)	(926,994)	(311,405)	(327,481)	(344,400)	(362,209)	(380,955)	(400,690)	(421,467)
Equipment inventory	(419,271)	(129,108)	(132,178)	(73,247)	(77,265)	(85,185)	(93,916)	(103,542)	(114,155)	(125,856)	1,353,723
Raw material inventory	(7,127,604)	(2,194,837)	(2,247,026)	(1,245,198)	(1,313,503)	(1,448,137)	(1,596,571)	(1,760,220)	(1,940,642)	(2,139,558)	23,013,296
Pre-paid building rent	-	-	-	-	-	-	-	-	-	-	-
Pre-paid lease interest	-	-	-	-	-	-	-	-	-	-	-
Advance insurance premium	(482,895)	48,290	48,290	48,290	48,290	48,290	48,290	48,290	48,290	48,290	48,290
Accounts payable	-	8,668,321	2,125,645	1,889,005	749,191	736,158	779,583	825,856	875,191	927,817	(1,224,069)
Other liabilities	-	-	-	-	-	-	-	-	-	-	-
<b>Cash provided by operations</b>	<b>(8,029,770)</b>	<b>67,613</b>	<b>4,986,826</b>	<b>6,809,932</b>	<b>7,004,103</b>	<b>8,240,688</b>	<b>8,459,237</b>	<b>9,041,473</b>	<b>9,637,426</b>	<b>10,245,270</b>	<b>35,523,577</b>
<b>Financing activities</b>											
Change in long term debt	9,206,272	(5,042,707)	(871,161)	(975,700)	(1,092,784)	(1,223,919)	-	-	-	-	-
Change in short term debt	-	4,475,094	(4,115,665)	(305,631)	(53,798)	-	-	-	-	-	-
Change in export re-finance facility	-	-	-	-	-	-	-	-	-	-	-
Add: land lease expense	-	-	-	-	-	-	-	-	-	-	-
Land lease payment	-	-	-	-	-	-	-	-	-	-	-
Change in lease financing	-	-	-	-	-	-	-	-	-	-	-
Issuance of shares	14,297,398	-	-	-	-	-	-	-	-	-	-
Purchase of (treasury) shares	-	-	-	-	-	-	-	-	-	-	-
<b>Cash provided by / (used for) financing</b>	<b>23,503,670</b>	<b>(567,613)</b>	<b>(4,986,826)</b>	<b>(1,281,331)</b>	<b>(1,146,583)</b>	<b>(1,223,919)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Investing activities</b>											
Capital expenditure	(14,973,900)	-	-	-	-	-	-	-	-	-	-
Acquisitions	-	-	-	-	-	-	-	-	-	-	-
<b>Cash (used for) / provided by investing</b>	<b>(14,973,900)</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>NET CASH</b>	<b>500,000</b>	<b>(500,000)</b>	<b>-</b>	<b>5,528,601</b>	<b>5,857,520</b>	<b>7,016,769</b>	<b>8,459,237</b>	<b>9,041,473</b>	<b>9,637,426</b>	<b>10,245,270</b>	<b>35,523,577</b>
Cash balance brought forward		500,000	-	-	(53,798)	11,436,778	12,820,491	26,912,784	30,321,202	45,591,684	50,203,898
Cash available for appropriation	500,000	(0)	-	5,528,601	5,803,722	18,453,547	21,279,728	35,954,258	39,958,628	55,836,954	85,727,475
Owner's withdrawals	-	-	-	-	-	-	-	-	-	-	25,606,060
Cash carried forward	500,000	-	-	5,528,601	5,803,722	18,453,547	21,279,728	35,954,258	39,958,628	55,836,954	60,121,414

## 12 KEY ASSUMPTIONS

Table 13.1 Production related Assumptions

Production capacity	(tonns per year) 15,000
Sale price per unit in year 1	11,000
Sale price growth rate	5%
Production capacity utilization	70%
Production capacity utilization growth rate	10%
Maximum capacity utilization	90%

Table 13.2 Cash flow Assumptions

Raw Material Inventory Cycle (In Days)	30
Machine Spare parts Inventory Cycle (In Days)	15
Accounts Receivables Cycle (In Days)	30
Accounts Payable Cycle (In Days)	30
Initial Cash in Bank (Rupees)	500,000

Table 13.3 Expense Assumptions

Communication Expense (% of Admin. Exp.)	1.5%
Pre-Operational Expense (Rupees)	788,000
Wages Growth Rate	8%
Electricity Tariff Growth Rate	8%
Office Equipment Price Growth Rate	5%

Table 13.4 Depreciation Expense Assumptions

Building Depreciation Rate	5%
Plant & Machinery Depreciation Rate	10%
Furniture & Fixtures Depreciation Rate	5%

Table 13.5 Financing Assumptions

Debt	39%
Equity	61%
Return on Equity	25%
WACC (Weighted Average Cost of Capital)	18%
Tax Rate	40%