Pre-feasibility Study

SULFURIC ACID MANUFACTURING UNIT

January 2023

The figures and financial projections are approximate due to fluctuations in exchange rates, energy costs, and fuel prices etc. Users are advised to focus on understanding essential elements such as production processes and capacities, space, machinery, human resources, and raw material etc. requirements. Project investment, operating costs, andrevenues can change daily. For accurate financial calculations, utilize financial calculators on SMEDA's website and consult financial experts to stay current with market conditions.

Small and Medium Enterprises Development Authority
Ministry of Industries and Production
Government of Pakistan

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2. EXECUTIVE SUMMARY

Sulfuric acid also known as hydrogen sulfate, is a highly corrosive, clear, colorless, odorless, water soluble at all concentration, strong mineral acid with the chemical formula H_2SO_4. Sulfuric acid was known to medieval European chemists as oil of vitriol or spirit of vitriol. It is a Latin word meaning 'glass', for the glassy appearance of the sulfate salts. The 8th century Alchemist Jabir ibn Hayyan, is considered to be the chemical's probable discoverer.

In the modern-day industry, sulfuric acid is an important commodity chemical. A nation's sulfuric acid production is considered to be a good indicator of its industrial strength. Sulfuric acid is manufactured in large quantities on a world scale and is used as a basic raw material used in a wide range of industrial processes and manufacturing operations. A high proportion of the manufactured sulfuric acid is used in the production of phosphate fertilizers. Other important uses include copper leaching, inorganic pigment production, petroleum refining, paper production, and industrial organic chemicals production.

Sulfuric acid is a highly reactive and very dangerous chemical. It is extremely corrosive and toxic. Exposure can occur from inhalation, ingestion, and through skin contact. Inhalation may cause irritation and/or chemical burns to the respiratory tract, nose, and throat. Chronic inhalation is known to have caused kidney and lung damage in addition to nosebleeds, erosion of the teeth, chest pain, and bronchitis. Sulfuric acid is a constituent of acid rain, being formed by atmospheric oxidation of sulfur dioxide in the presence of water can cause severe damage to environment.

In the proposed project of sulfuric acid manufacturing unit, business will produce sulfuric acid through contact process. For this, business will import sulfuric acid production plant which will be installed for doing safe and hazard-free production of the acid. The produced sulfuric acid will be sold to local wholesale industrial customers.

The site selection is very crucial for sulfuric acid production plant. The key factors involved in site selection include availability of raw materials and skilled staff, market access, community protection, transportation infrastructure, climate, government policies etc. The plant should preferably be established away from population pockets of urban or rural areas to ensure protection from plant emissions and pollution. Suitable climate for acid production is the one with low humidity levels, since plant’s performance is better in an environment with dry air.

Since sulfuric acid is largely consumed by the large industrial units, the project is suggested to be located around a large city, outside the populated areas in the special industrial zones to protect the residents against any toxic effects of chemicals. Therefore, the proposed sulfuric acid manufacturing unit, would ideally be located in or around major cities of Pakistan like Lahore, Faisalabad, Hyderabad Peshawar, Quetta, Rawalpindi, Sargodha, Sialkot, Gujranwala, Gujrat, or other cities

of Pakistan. Also, these cities are suitable due to the availability of good infrastructure, industrial setups, and skilled personnel.

The proposed sulfuric acid production plant will operate in a double shift of 12 hours in a day and night for 330 days in a year The proposed sulfuric acid production plant will be operated at 100% capacity at full scale production of 20 TPD of H_2SO_4. This will ensure that all catalytic conversion and the overall process is more efficient. Full scale plant production is carried out from the day 1 in order to get maximum performance of plant and to obtain best yield efficiency.

At maximum capacity, sulfuric acid production will be 20 tons per day for 11 months excluding one month, required for annual shut down. The annual production of sulfuric acid will be 6,600 tons which will be remain same for 10 years.

This manufacturing unit will be constructed on area of 22,500 square feet. Land will be purchased at a cost of PKR 175 million. The proposed business requires a total investment of PKR 347.32 million. This includes capital investment of PKR 341.57 million and working capital of PKR 5.75 million. The project will be established using 100% equity financing. The Net Present Value (NPV) of project is PKR 9.05 million with an Internal Rate of Return (IRR) of 26% and a Payback period of 4.24 years. Further, this project is expected to generate Gross Annual Revenues of PKR 329.4 million during 1st year, Gross Profit (GP) ratio ranging from 36% to 39% and Net Profit (NP) ratio ranging from 16% to 20% during the projection period of ten years. The proposed project will achieve its estimated breakeven point at capacity of 35% (2,309 tons) with annual breakeven revenue of PKR 115.26 million.

The proposed project may also be established using leveraged financing. At 50% financing at a cost of KIBOR+3%, the proposed business provides Net Present Value (NPV) of PKR 51.61 million, Internal Rate of Return (IRR) of 25% and Payback period of 4.21 years. Further, this project is expected to generate Net Profit (NP) ratio ranging from 10% to 20% during the projection period of ten years. The proposed project will achieve its estimated breakeven point at 35% of its total service capacity (2,341 tons), with breakeven revenue of PKR 116.81 million.

The proposed project will provide employment opportunities to 71 people, working in a double shift of 12 hours each during 330 days in a year. High return on investment and steady growth of business is expected to the entrepreneur having some prior experience or education in the related field of business. The legal business status of this project is proposed as “Sole Proprietorship” or “Partnership “concern.

3. INTRODUCTION TO SMEDA

The Small and Medium Enterprises Development Authority (SMEDA) was established in October 1998 with the objective to provide fresh impetus to the economy through development of Small and Medium Enterprises (SMEs).

With a mission "to assist in employment generation and value addition to the national income, through development of the SME sector, by helping increase the number, scale and competitiveness of SMEs", SMEDA has carried out 'sectorial research' to identify policy, access to finance, business development services, strategic initiatives and institutional collaboration and networking initiatives.

Preparation and dissemination of prefeasibility studies in key areas of investment has been a successful hallmark of SME facilitation by SMEDA.

Concurrent to the prefeasibility studies, a broad spectrum of business development services is also offered to the SMEs by SMEDA. These services include identification of experts and consultants and delivery of need-based capacity building programs of different types in addition to business guidance through help desk services.

National Business Development Program for SMEs (NBDP) is a project of SMEDA, funded through Public Sector Development Program of Government of Pakistan.

The NBDP envisages provision of handholding support / business development services to SMEs to promote business startup, improvement of efficiencies in existing SME value chains to make them globally competitive and provide conducive business environment through evidence-based policy-assistance to the Government of Pakistan. The Project is objectively designed to support SMEDA's capacity of providing an effective handholding to SMEs. The proposed program aimed at facilitating around 314,000 SME beneficiaries over a period of five years.

4. 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, marketing, finance and business management.

The purpose of this document is to facilitate potential investors in setting up a "Sulfuric Acid Manufacturing Unit" by providing a general understanding of the business with the intention of supporting them in investment decisions.

The need to come up with pre-feasibility reports for undocumented or minimally documented sectors attains greater imminence as the research that precedes such reports reveal certain thumb rules; best practices developed by existing enterprises by trial and error, and certain industrial norms that become a guiding source regarding various aspects of business setup and its successful management.

Apart from carefully studying the whole document one must consider critical aspects provided later on, which form the basis of any investment decision.

5. BRIEF DESCRIPTION OF PROJECT & PRODUCTS

Sulfuric acid or sulphuric acid, also known as hydrogen sulfate, is a highly corrosive, clear, colorless, odorless, water soluble at all concentration, strong mineral acid with the chemical formula H_2SO_4. It was known in ancient times as oil of vitriol for the glassy appearance of the sulfate salts. The discovery of sulfuric acid is credited to the 8th century alchemist Jabir ibn Haiyan. It was studied later by the 9th century physician and alchemist Ibn Zakariya al-Razi. In the 17th century, the German-Dutch chemist Johann Glauber prepared sulfuric acid by burning sulfur together with potassium nitrate (KNO3), in the presence of steam. As the potassium nitrate decomposes, it oxidizes the sulfur-to-sulfur trioxide (SO_3), which combines with water to produce sulfuric acid.

Due to its affinity[1] for water, pure anhydrous sulfuric acid does not exist in nature. Volcanic activity can result in the production of sulfuric acid and sulfuric acid aerosols (suspensions) from an eruption can persist in the atmosphere for many years. These aerosols can then reform into sulfur dioxide (SO2), a constituent of acid rain.

Sulfuric acid is classified as a mineral acid, composed of the elements sulfur, oxygen and hydrogen. Some physical and chemical properties of sulfuric acid are as follows:

Physical Properties

- Sulfuric acid is a thick, colorless liquid, with a specific gravity[2] of 1.84 at 298 Kelvin.
- The boiling point of the sulfuric acid is 611 K (338 C). A high boiling point and thickness of this chemical is due to hydrogen bonding.
- Sulfuric acid reacts with water vigorously, releasing quite a lot of heat. It is a highly exothermic reaction.

Chemical Properties

- Sulfuric acid is a strong dibasic acid. Also, it is diprotic and ionizes in two stages in the aqueous solution.
- This chemical is highly corrosive, reactive and is soluble in water. It has a very high oxidizing power and thus, acts as a strong oxidizing agent.
- It has very low volatility. For this reason, it plays a part in the preparation of more volatile acids from their comparing salts.
- Concentrated sulfuric acid is a very strong dehydrating agent. Thus, this chemical is used for drying many wet gases which do not react with the acid.

[1] In chemical physics and physical chemistry, chemical affinity is the electronic property by which dissimilar chemical species are capable of forming chemical compounds. Chemical affinity can also refer to the tendency of an atom or compound to combine by chemical reaction with atoms or compounds of unlike composition

[2] The specific gravity for concentrated sulfuric acid is about 1.84, or 1.84 times heavier than an equal volume of water

- It additionally expels water from natural mixes like starches.
- As it is a good oxidizing agent, it can oxidize both non-metals as well as metals. Moreover, it itself reduces to (Sulfur Dioxide) SO_2.

Applications of Sulfuric Acid

Sulfuric acid is referred as universal chemical or the king of chemicals due to its numerous applications as a raw material or processing agent. Sulfuric acid is the most commonly used chemical in the world and used in almost all industries. It is used to manufacture explosives, other acids, dyes, glue, wood preservatives. Some of its uses in industries are as follows:

Chemical Manufacturing Industry

As a highly important chemical compound, sulfuric acid is used in the manufacturing process of a number of well-known chemicals including hydrochloric acid, nitric acid, phosphoric acid, and many other industrial chemicals.

Fertilizer Manufacturing Industry

The largest amount of sulfuric acid is used to make phosphate fertilizers, calcium dihydrogen phosphate and the ammonium phosphates. It is also used to make ammonium sulfate, which is a particularly important fertilizer for sulfur-deficient soils.

Oil Refining Industry

The process of refining crude oil requires the use of an acid as a catalyst and sulfuric acid is often used for this purpose.

Metal Processing

Pickling' is a term used to describe the treatment of metals to remove impurities, rust or scale from the surface, such as in steel making. Sulfuric acid is used for this purpose. It produces results more quickly and minimizes the loss of base metal during the pickling process. It is widely used in metal processing, for example, in the manufacture of copper and zinc metals.

Manufacturing of Textile Rayon

The textile Rayon is made from cellulose fibers derived from wood. These are dissolved in a solution of Tetra Amine Copper (II) to produce a thick blue liquid which is then injected into sulfuric acid to form Rayon fibers.

Manufacturing of Lead-Acid Type Batteries

Sealed-unit lead-acid type batteries are used in the automotive industry for cars and trucks. Sulfuric acid is used in a dilute form to act as an electrolyte to allow the flow of electrons between the plates in the battery. Sulfuric acid used in this way is commonly called Battery Acid.

Manufacturing of Medicines

Chemotherapy drugs are used to treat various types of cancer. Cancer cells are more sensitive to DNA damage than normal cells so in chemotherapy treatment cancer cells are destroyed by damaging their DNA. This process is known as alkylation of DNA and a type of drug known as alkylating antineoplastic agents are used. Sulfuric acid is used in the manufacturing process of such drugs.

Hazards of Sulfuric Acid

Sulfuric acid is a highly reactive and very dangerous chemical. It is extremely corrosive and toxic. Consequences will be severe on exposure to sulfuric acid when using products containing the substance (e.g., some cleaning products, or car batteries). Workers in the industries that use or produce sulfuric acid are at risk of exposure. Some of its hazards are as follows:

Health Hazards

Sulfuric acid is a corrosive chemical and can severely burn skin and eyes. It may cause third degree burns and blindness on contact. Exposure to sulfuric acid mist can irritate the eyes, nose, throat and lungs, and at higher levels can cause a buildup of fluid in the lungs (pulmonary oedema). Asthmatics are particularly sensitive to the pulmonary irritation. Repeated exposures may cause permanent damage to the lungs and teeth.

Environmental Hazards

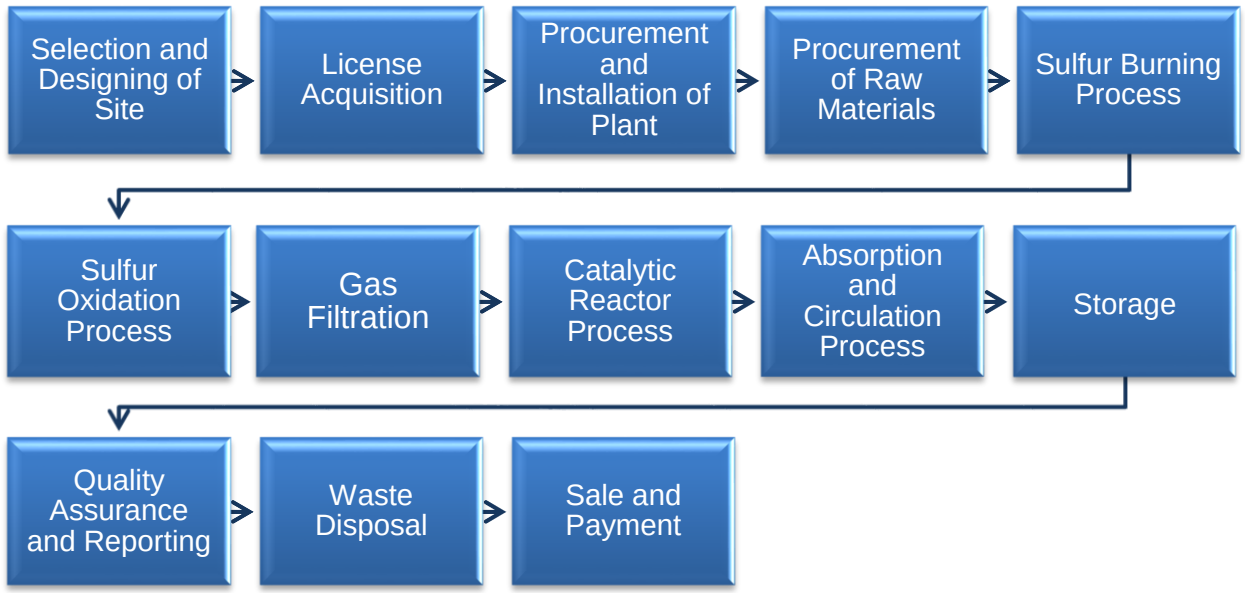
Industrial emissions of sulfuric acid can produce elevated concentrations in the atmosphere. Sulfuric acid enters the air during production, use and transporting it. In the air it reacts with other chemicals present (ammonia, magnesium, calcium) to form salts, which neutralize the acid. Sulfuric acid exists as particles or droplets which may dissolve in clouds, fog, rain, dew, or snow, resulting in very dilute acid solutions. In clouds and moist air, it will travel along the air currents until it is deposited as wet acid deposition (acid rain, acid fog, etc). Sulfuric acid is very corrosive and would badly burn any plants, birds, land animals and aquatic life.

It is assumed that 20 TPD capacity plant for production of sulfuric acid is purchased from an external supplier which also provides the services of designing, installation and training of the local staff. All the parts of plant are manufactured and installed by the supplier. In the proposed project, supplier also installs other equipment and installation necessary to continue the plant operations.

5.1. Process Flow for Sulfuric Acid Manufacturing Unit

A general process flow of a sulfuric acid manufacturing unit is shown in Figure 1.

Figure 1: Process Flow for Sulfuric Acid Manufacturing Unit



Brief description of process flow is as follows:

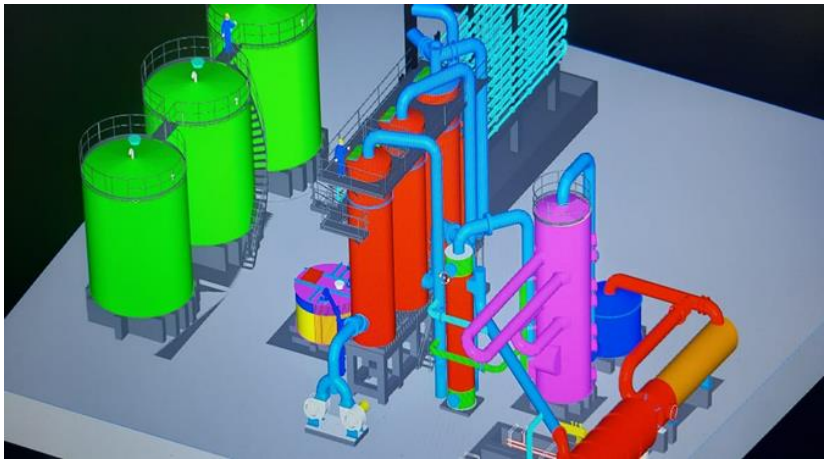
Selection and Designing of Site

The site dependency is very crucial for sulfuric acid production plant. Following key factors should be taken into consideration while selecting the appropriate site.

- The plant should be established at a location away from large population pockets so that it will not be harmful to people
- Suitable climate is also necessary for sulfuric acid production. The plants located in areas with lower humidity levels show a better performance.
- Geographically, plant must be located in area with good underground water resourcing and drainage system because of waste water discharge from the unit.
- The plant must be located in an area where business can have easy access to raw materials and market.

After selecting an appropriate site, next step will be the designing of plant which is carried out by the supplier of plant. The suppliers provide the site design and civil work mapping which are submitted to licensing authorities for approval and obtaining the license required for plant installation. Figure 2 shows typical sulfuric acid plant site.

Figure 2: A Typical Sulfuric Acid Plant Site



Licensing and Acquisition

After site selection and designing, licensing is obtained from the competent authority. Business needs the following three types of approvals from different government departments for setting up a sulfuric acid manufacturing unit:

Environmental Departments (Environment Compliance)

Environmental Department or Environmental protection agency (EPA) is responsible for ensuring project environmental compliance with NEQS (National Environmental Quality Standards of Pakistan). This is important for ensuring an environmental feasibility of project with respect to compliance with pollution control. A detailed Environment impacts assessments (EIA) report is submitted to EPA for getting a No-Objection-Certificate (NOC) from Environment departments.

Construction NOC (Ministry of Industries & Production)

After the EIA approval, there is a need to obtain an NOC for construction and starting the project. For that, the project design and EIA report has to be submitted with an application fee to about 100,000 (PKR) one times. A Construction NOC is granted to start the project after the inspection of design and site of the plant. The procedure is started along with the EIA application proceeding and NOC is granted in around a month.

Anti-Narcotics Department License and Approval

As sulfuric acid is a hazardous chemical material, an Anti-Narcotics Department approval is also required before selling the product in the market. Anti-Narcotic department ensures that the produced acid is not mixed with drugs or any harmful narcotics during its transportation. Ministry of Narcotics Control of Pakistan is the issuing authority.

Procurement and Installation of Production Plant

License acquisition process takes up to three months during which the business carries out activities for procurement of plant from the supplier. After completing license approval, the business imports the plant. The supplier staff will also be involved in installation of plant according to approved design of plant site. The installation of plant takes up to 6 months. Plant is installed in following steps.

- **Civil Works**

Foundations for plant equipment including absorption towers, catalytic reactor, heat exchanger, boiler and furnace are constructed before the installation of equipment.

- **Mechanical Installation of Equipment**

Supplier's engineering and technical team works with the local engineering staff to install the project. The absorption towers are placed first on their foundations, following which the reactor and circulation tank is installed. At third stage, furnace and boilers are completed and installed on the site. Finally, the filter, heat exchanger and acid coolers are installed. In the last part of installation phase, the storage tanks are installed on their foundations.

- **Pipelines and Piping Connections**

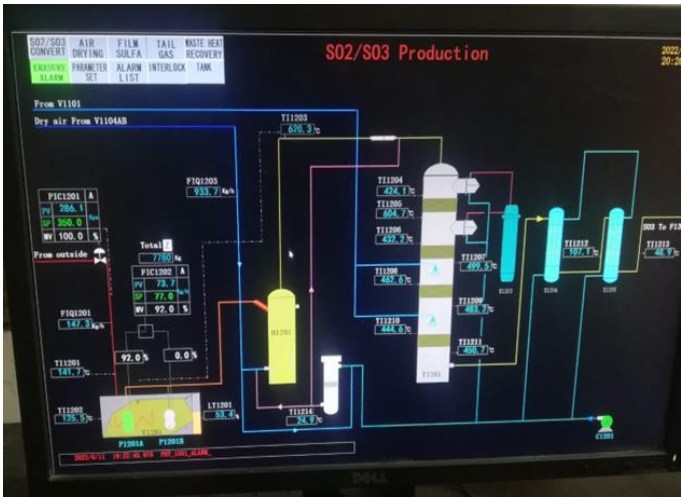
In this step, pipelines are installed as per the design and flow of process. The pipelines enable different types of fluids (liquids and gases) from flow from between different sections of the plant. They are made of Mild steel iron and having a diameter.

- **Instrumentation and Control Systems with Electrical System installation**

Complete instrumentation on all the plant equipment is required to have an effective and efficient control of the process. Control system equipment is included instruments like thermocouples, pressure meters, flowmeters, SOx[3] detectors and conductivity meter will be installed on plant. These instrumentations are connected to the centralized monitoring system in control room on a computer display. A DCS (Distributed Control system) control system is established in a control room of the plant. Process parameters including the temperatures, pressures, concentrations and flowrates are measured with the help of instruments and readings are continuously displayed on computer-based interface. This ensures a tight and efficient control and monitoring of sulfuric acid p production process. Figure 3 shows the DCS control system.

[3] Sulphur oxide gases (SOx) such as Sulphur dioxide, Sulphur monoxide

Figure 3: DCS Control System



- **Test Run and Plant Start-up**

Tests run of plant are conducted to check the plant stability and performance. The plant is brought into a continuous production after its successful test running.

The plant is to be operated for a scheduled period of 11 months before shutdown. Planned shutdown is conducted after 11 months in which all of the repairing and maintenance works are carried out. It includes the inspection, repairing and maintenance of all of plant equipment. During shutdown, the leakages of lines, pumping equipment and all motors, instruments and catalyst are checked and inspection and maintenance is carried out for restarting the plant for next production period. Usually shut down takes one month to complete all maintenance activities

Procurement of Raw Materials

In the proposed business, solid sulfur is the main raw material used for the manufacturing of sulfuric acid. It can be sourced from both local and imported sources, however, the business chooses to purchase raw sulfur from the local market. The sulfur obtained from the local market typically contains around 1% H2S (Hydrogen Sulfide) content. The transportation of sulfur is carried out using trucks, which are weighed on a truck weighing scale and then offloaded by labor. Quality analysis of the sulfur is conducted in the quality assurance lab of the plant. After the quality analysis, the sulfur is stored in an open area at the plant site. As sulfur is non-reactive to air, rain, and sun, it can be spread open without shade in the yard. However, it is important that there is no fire source nearby Sulphur yard to avoid any chance of fire accident. Business requires 7-ton raw sulfur per day to produce 20-ton sulfuric acid per day from the plant. The proposed business will maintain sulfur inventory of one week. Figure 4 shows solid sulfur.

Figure 4: Solid Sulfur

Sulfur Burning Process

Solid Sulfur is fed into pits with the help of tractors where steam is provided in steam coils to melt sulfur by steam, which is generated in waste heat boiler. Waste heat boiler shells are made of Mild steel iron and its tubes are made up of SS. It has a capacity of 2.5 Ton per hour steam generation. It also requires two pumps to supply the water into the boiler.

Steam Coils are spread across the sulfur melting pits to distribute the heat uniformly. Steam in coils transfers its heat to melt down the Sulphur at 130C. 99% of Sulphur is melted in the melting pits so that whole Sulphur is converted into liquid state before feeding into the plant furnace. The dust particles of Sulphur settle down in the form mud at the bottom of the pit.

Molten sulfur is then fed into the plant furnace by a Sulphur feed pump.

Sulfur Oxidation Process

At new startup, and after every shutdown, diesel fuel is used to heat the furnace so that the furnace inside temperature is raised to 600C. Approximately 1,000 liters of diesel fuel is burnt in the furnace after gas filtration and the heat produced by burning diesel is passed on to reactor by air blowing to raise first bed temperature to 450C.

Molten sulfur is introduced into furnace by using Sulfur feed pump where it is burned to oxidize into Sulfur Dioxide (SO_2) gas in the presence of oxygen by supplying air. The temperature of furnace is controlled by controlling the mass flow rate of sulfur. A thermocouple is inserted in the brick lining of furnace to monitor the inside temperature. Furnace is made of mild steel and has three-layer inner ceramic bricks lining for insulation. Furnace has a diameter of 7 feet and is 15 feet long which gives it a volume of around 570 cubic ft. Figure 5 shows furnace.

Figure 5: Furnace

Temperature inside the furnace is maintained in the range 830-950C. The chemical reaction taking place in the furnace is as follows:

S + O2 ----------> SO2 Δ H= - 297 KJ/mol

The reaction is exothermic and heat is generated which is recovered using waste heat boiler, which produces steam to meet the requirements at the plant. It is a fire tube type boiler for heat recovery. The temperature of SO_2 is reduced up to 400C in the boiler. Steam pressure is 130 PSI[4]Feed water of boiler is treated to meet the low TDS[5] requirement.

20% additional air is supplied into the furnace in order to carry out complete oxidation of the sulfur fed. Furnace outlet ensures that SO_2 gas is present which moves from furnace to the reactor

Gas Filtration

The SO_2 Gas is then fed into filter which is a Packed Bed Type Filter, used to remove any solid particle. Quartz stone is used as filter media spread on cast iron bed inside the filter. Almost 99% of dust is removed so that no particle matter can enter into the reactor.

Catalytic Reactor Process

After passing through filters, SO_2 enters in the converter. It is 4-stage fixed bed catalytic reactor (made of cast iron, with a height of 6 feet for each bed). It contains 4 catalyst beds for maximum conversion of Sulfur Dioxide (SO_2) into Sulfur Trioxide (SO_3) (97%-99%). Catalytic reactor shell is made of MS with a height of 24 feet and diameter of 6 feet. Vanadium Pentoxide (V_2O_5) catalyst is used in this process. V_2O_5 increases the rate of the overall chemical reaction by oxidizing the SO_2 to SO_3 and

[4]Pounds per square inch or PSI is an imperial unit of pressure. Using the imperial units of pounds and square inches, it is a measure of force per unit area

[5] TDS stands for total dissolved solids, and represents the total concentration of dissolved substances in water.

being re-oxidized itself by the oxygen in the gas stream. Initially, 20 drums (92kg/drum) of V_2O_5 will be used in catalytic reactor to start the production (service life of catalyst is 7 years). Figure 6 shows vanadium pentoxide V_2O5 catalyst.

Figure 6: Vanadium Pentoxide (V_2O_5) Catalyst

It is an exothermic reaction. Almost all of SO_2 gas is converted into SO_3 gas which is oxidized in presence of catalyst V_2O_5.

$$SO_2 + ½\ O_2 \text{ --------> } SO_3 \qquad \Delta H = -100\ KJ/mol$$

Major portion of surplus air from furnace is consumed during the oxidation of SO_2 gas for SO_3 production.

The SO_3 gas is then formed, passes through heat exchanger (ΔT= 250-300C) where heat of reaction is rejected before feeding SO gas into absorption tower. Heat exchangers shells and tubes are made of MS and cast iron respectively. Shells have the length of 15 feet and diameter of 5 feet while the number of tubes is 150. Figure 7 shows catalytic reactor.

Figure 7: Catalytic Reactor

Absorption and Circulation Process

The SO_3 is brought in contact with concentrated sulfuric acid which is showered from top of tower by using showering pump, with SO_3 entering from bottom of absorption tower (counter flow for good absorption). SO_3 is absorbed in concentrated acid to form oleum which is further diluted to form 98% Sulfuric Acid in circulation tanks which have shells made of MS, with inner lining of acid proof ceramics bricks.

$SO_3 + H_2SO_4$ ----------> $H_2S_2O_7$ (oleum) Δ H= - 130 KJ/mol

$H_2O + H_2S_2O_7$ ----------> $2H_2SO_4$

Almost 99% of SO_3 gas is absorbed in the absorption towers which is converted into acid. In circulation tank, 5 tons of sulfuric acid are purchased from the market to start the plant production process. This has to be done after every annual shutdown. The quantity of water (1.5-0.5%) is added by using watering pump is automatically adjusted through digital flow meter in the circulation tank for Oleum to sulfuric Acid conversion. Liquid acid flows through the pipes by using circulation pumps. Figure 8 shows absorption tower.

Figure 8: Absorption Tower

Storage

The sulfuric acid coming out of absorption tower is cooled down by using acid cooler before storing in three storage tanks. The storage tanks are made of MS and each storage tank has a storage capacity of 300 MT. business will maintain the finished good inventory of one week.

Quality Assurance and Reporting

An on-site quality assurance lab will be established for raw materials and the final product Sulfuric Acid. It has advanced lab testing equipment and works under the supervision of an experienced chemist.

For any detailed laboratory analysis, outside laboratories, such as PCSIR may be used. The quality reports also have to be submitted to government authorities for inspection and analysis and for production licensing and sales and on-site reports will be monitored and kept in record.

Quality testing of materials and product is conducted daily on shift basis, with regular reporting to the production department.

Legal Reporting to government authorities including environment department, ministry of industries, and narcotics is done in accordance with their requirements. Chamber of Commerce and Industries and Federal Board of Revenue will also check the record of production and sales.

Waste Disposal

The waste produced during the production process is of 3 types: solid, liquid and gas. The treatment of waste is as:

- For liquid waste treatments, waste water treatment plant has to be installed at the plant site to mitigate the liquid waste disposals.
- For preventing SOx gases to escape, a wet scrubbing [6] unit is sued. It has highly basic solution stored in its tank (Caustic Soda, Soda Ash) which neutralizes the acidic gases
- Sulfur mud is the main solid waste which is 10% of daily raw sulfur input. Sulfur mud collected and sold in the market to earn revenue.

Sale and Payment

Sulfuric acid is sold to industrial consumers in standard filling of 30 Tons. Customers send their tankers and business fills them and dispatch. Alternately, the business hires tankers for delivery to the customer's site. All the delivery expense are borne by the customer. Business follows the 15-day credit policy.

[6] In wet scrubbing processes, liquid or solid particles are removed from a gas stream by transferring them to a liquid. The liquid most commonly used is water.

5.2. Installed and Operational Capacities

The proposed sulfuric acid production plant will operate in a double shift of 12 hours in a day and night for 330 days in a year The proposed sulfuric acid production plant will be operated at 100% capacity at full scale production of 20 TPD of H_2SO_4. This will ensure that all catalytic conversion and the overall process is more efficient. Full scale plant production is carried out from the day 1 in order to get maximum performance of plant and to obtain best yield efficiency.

At maximum capacity, sulfuric acid production will be 20 tons per day for 11 months excluding one month, required for annual shut down. The annual production of sulfuric acid will be 6,600 tons which will be remain same for 10 years.

The annual working days and installed and operational capacity of the business will be shown in Table 1 and Table 2.

Table 1: Annual Working Days

Years	Production Shutdown Months in a Year	Production Months in a Year	Annual Working Days
Year 1	1	11	330

Table 2: Installed and Operational Capacity of Sulfuric Acid Production Plant

Years	Production Capacity of Plant per Day (Tons)	Annual Production Capacity of Plant (Tons)
Year 1	20	6,600

6. CRITICAL FACTORS

Before making the decision to invest in sulfuric acid manufacturing unit, one should carefully analyze the associated risk factors. The important considerations in this regard include:

- Carefully selected location of sulfuric acid manufacturing unit to protect the population and environment from toxic effects.
- Sound technical knowhow and basic knowledge of the business
- Availability of specialized workforce
- Selection of appropriate machinery and technology
- Rigorous supervision of the production process at every level
- Quality products and customer satisfaction
- Accurate control of different quality parameters and precautionary measures.
- Careful handling and storage

7. GEOGRAPHICAL POTENTIAL FOR INVESTMENT

The site dependency is very crucial for sulfuric acid production plant. The key factors involved in site selection include availability of raw materials and skilled staff, market access, community protection, transportation infrastructure, dry climate, government policies, etc. The plant should be established away from main population pockets to prevent people from getting affected by the plant's emissions and pollution. Suitable climate is the one where which has low humidity levels. The plant's performance is better in dry climate.

Since sulfuric acid is largely consumed by the large industrial units, the project is suggested to be located around a large city, outside the populated areas, in an industrial zone to protect the residents against the toxic effects of chemicals. Therefore, the proposed sulfuric acid manufacturing unit, may be located in or around major cities of Pakistan like Lahore, Faisalabad, Peshawar, Quetta, Sargodha, Sialkot, Gujranwala, Gujrat, Hyderabad and other cities of Pakistan. Also, these cities are suitable due to the availability of good infrastructure, industrial setups, and skilled personnel.

8. POTENTIAL TARGET MARKETS/CUSTOMERS

Sulfuric acid is a very important industrial chemical that is used in production of large number of products for variety of applications.

Chemicals manufacturing industry plays important role in growth of agriculture and manufacturing industry. The chemical products showed the growth of 15.2 percent in

FY2021-22 against 14.5 percent same period last year. Sulfuric acid, hydrochloric acid, soda ash, and toilet soaps are the major contributors to overall growth of chemicals.

Pakistan is mostly self-sufficient in the production of inorganic chemicals such as sulfuric acid, with the surplus exported as well. Currently, 15-20 sulfuric acid plants are operational in Pakistan which are fulfilling country's need of sulfuric acid. Some important manufacturers are Musa Chemicals, Atta Chemicals, Attock Chemicals, Exide Pakistan, Fazal Chemicals and Ittehad Chemicals. The international trade of sulfuric acid is carried out under the HS code 280700. Export[7] value of sulfuric acid for the Pakistan during the year of 2021, 2018 and 2017 was US$0.11 million, US$0.13 million and US$0.53 million respectively

Sulfuric acid is one of the largest volume industrial chemicals produced in the world with a market size that was valued at over $10 billion in 2020. Its global demand is projected to rise at an annual rate of about 2 percent per year. Around 180 million ton of sulfuric acid are produced annually across the globe. The global sulfuric acid market size is expected to reach USD 18.2 Billion in 2030 and register a revenue CAGR of 11.7% during the forecast period. China, USA, Germany, Morocco, Canada and Netherlands are the major players in global market. Rising demand for sulfuric acid in downstream chemicals and industrial applications, and increasing application in agriculture sector in production of processed phosphate fertilizers are key factors, driving revenue growth of the global sulfuric acid market.

[7] https://comtrade.un.org/data

9. PROJECT COST SUMMARY

A detailed financial model has been developed to analyze the commercial viability of sulfuric acid manufacturing unit. Various assumptions relevant to revenue and costs along with the results of the analysis are outlined in this section.

The projected Income Statement, Cash Flow Statement and Balance Sheet are attached as annexures of this document.

All the figures in this financial model have been calculated after carefully considering the relevant assumptions and target market.

9.1. Initial Project Cost

Table 3 provides fixed and working capital requirements for establishment of sulfuric acid manufacturing unit.

Table 3: Initial Project Cost estimates

Particulars	Cost (PKR)	Reference
Land	175,000,000	9.1.1
Building Infrastructure	19,200,000	9.1.1
Production Plant Infrastructure	20,250,000	9.1.1
Sulfuric Acid Production Plant	99,000,000	9.1.2
Vanadium Pentaoxide Catalyst (V2O5)	7,000,000	9.1.3
Office equipment	5,021,500	9.1.4
Tools & Equipment	4,948,000	9.1.5
Furniture & fixtures	1,805,000	9.1.6
Office vehicles	3,527,060	9.1.7
Pre-operating costs	5,238,324	9.1.8
Legal, Licensing, and Training costs	580,000	9.1.9
Total Capital Cost - (A)	**341,569,883**	
Equipment spare part inventory	825,000	
Raw material inventory	1,925,000	
Cash	3,000,000	
Total	**5,750,000**	
Total Project Cost - (A+B)	**347,319,883**	

9.1.1. Land and Infrastructure Cost

Business will purchase land and construct building and other infrastructure. The plant needs electricity to run from the usage of small bulb to big heat exchangers, compressors, pumps, etc. The usage of electricity is inevitable and in case of sudden shortage production quantity as well as quality will suffer in order to avoid that a generator 400KVA is necessary which can supply power throughout the production unit. The proposed project requires electricity load of around 326 KW for which an industrial electricity connection will be required. Land requirement, land cost, building infrastructure cost and sulfuric acid production plant infrastructure cost are shown in Table 4,
Table **5**, Table 6 and Table 7 respectively.

Table 4: Land Requirement

Production Area	Number	Length	Width	Area (Sq. Ft.)
Admin Block & Offices	1	60	50	3,000
Control Room	1	20	20	400
Mechanical Workshop	1	15	20	300
Electrical Workshop	1	15	20	300
Quality Assurance Lab	1	15	20	300
Production Plant Area	1	135	100	13,500
Sulfur Raw Material Yard	1	50	50	2,500
Store Room	1	25	25	625
Parking & Acid Filing Area	1	43	25	1,075
Kitchen	1	10	10	100
Washrooms	10	8	5	400
Total				**22,500**

Table 5: Land Purchase Cost

Cost Item	Area (Sq. Ft.)	Area in Kanal	Cost Per Kanal (PKR)	Total Cost (PKR)
Land	22,500	5	35,000,000	175,000,000
Total				**175,000,000**

Table 6: Building Infrastructure Cost

Production Area	Area (Sq. Ft.)	Cost Per Sq.ft (PKR)	Total Cost (PKR)
Admin Block & Offices	3,000	3,000	9,000,000
Control Room	400	3,000	1,200,000
Mechanical Workshop	300	2,000	600,000
Electrical Workshop	300	2,000	600,000
Chemical Laboratory	300	3,000	900,000
Sulfur Raw Material Yard	2,500	1,000	2,500,000
Store Room	625	2,000	1,250,000
Parking & Filing Area	1,075	2,000	2,150,000
Kitchen	100	2,000	200,000
Washrooms	400	2,000	800,000
Total	**9,000**		**19,200,000**

Table 7: Production Plant Infrastructure Cost

Production Area	Area (Sq. Ft.)	Cost/Sq.ft (PKR)	Total Cost (PKR)
Production Plant Infrastructure	13,500	1,500	20,250,000
Total	**13,500**		**20,250,000**

9.1.2. Sulfuric Acid Production Plant

Table 8 provides details of sulfuric acid production plant for the proposed project.

Table 8: Sulfuric Acid Production Plant

Cost Item	Number of Items	Unit Cost (PKR)	Total Cost (PKR)
Sulfuric Acid Production Plant (20TPD)	1	90,000,000	90,000,000
Project Designing Cost			2,000,000
Training & Installation Cost			7,000,000

Total			**99,000,000**

9.1.3. Vanadium Pentoxide Catalyst

Table 9 shows details of vanadium pentoxide catalyst required for sulfuric acid production.

Table 9: Vanadium Pentoxide Catalyst (V2O5)

Particulars	Quantity Required For Initial Start-up of Plant (Drum)	Price per Drum (PKR)	Total Cost (PKR)
Vanadium Pentaoxide Catalyst (92 Kg/Drum)	20	350,000	7,000,000
Total			**7,000,000**

9.1.4. Office Equipment

Table 10 shows details of equipment cost required for the sulfuric acid production.

Table 10: Office Equipment Cost Details

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Air Conditioners	10	105,000	1,050,000
Laptop	14	150,000	2,100,000
Desktop Computer	8	75,000	600,000
Printer	9	51,500	463,500
Water Dispenser	6	20,000	120,000
Security System (6 Cams , 2 MP)	30	2,500	75,000
DVR	5	14,000	70,000
LED/LCD TV	3	36,000	108,000
WI-FI/ Internet Connection	5	3,500	17,500
Ceiling Fan	25	8,000	200,000
Exhaust Fan	25	4,500	112,500
Bracket Fan	10	10,500	105,000
Total			**5,021,500**

9.1.5. Tools and Equipment

Table 11 shows Tools and Equipment required for sulfuric acid production.

Table 11: Tools and Equipment's

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Mechanical Department			
Welding Plant	2	15,000	30,000
Gas Cutters	5	4,000	20,000
Mechanical Tools Kit	5	6,000	30,000
Electrical Department			
Generator (400KVA)	1	4,500,000	4,500,000
Electrical Tools Kit	5	6,000	30,000
Electrical Digital Multimeter	5	900	4,500
Instruments			
Digital Thermocouple Thermometer	10	4,000	40,000
Thermocouple	10	1,500	15,000
Digital Flow Meter	10	2,000	20,000
Pressure Gauges	10	1,000	10,000
Lab Equipments			
Weight Balance	5	700	3,500
Dryers	5	3,000	15,000
Ovens	2	15,000	30,000
Baume Meter	5	3,000	15,000
Thermometer	5	500	2,500
Digital Multi Meter	5	900	4,500
Conductivity Meter	4	7,000	28,000
Truck Weighing Machine-20ton	1	150,000	150,000
Total			**4,948,000**

9.1.6. Furniture and Fixtures

Table 12 provides details of furniture and fixtures.

Table 12: Furniture & Fixtures Cost Details

Cost Item	Number of Items	Unit Cost (PKR)	Total Cost (PKR)
Executive Table	1	60,000	60,000
Executive Chair	1	30,000	30,000
Staff Chairs	40	14,000	560,000
Staff Table	21	30,000	630,000
Visitor Chairs	15	20,000	300,000
Sofa Set	5	45,000	225,000
Total			**1,805,000**

9.1.7. Vehicles

Table 13 provides details of the vehicles required along with their cost for the proposed project.

Table 13: Office Vehicle Cost Details

Cost Item	Number of Vehicles	Unit Cost (PKR)	Registration Fee Plus Number Plate Charges	Total (PKR)
Motorcycle	2	111,500	13,000	236,000
Tractor with Front Loader	1	1,800,000	74,530	1,874,530
Suzuki Ravi Pickup	1	1,400,000	16,530	1,416,530
Total Cost (PKR)				**3,527,060**

9.1.8. Pre-Operating Costs

Table 14 provides details of estimated pre-operating costs.

Table 14: Pre-Operating Cost Details

Costs Item	Hiring Months Beforein Year 0	Unit Cost (per month) (PKR)	Cost (PKR)
Production Department			
General Manager	1	150,000	150,000
Production Manager - Chemical Engineer	1	120,000	120,000

Production Supervisor	1	90,000	90,000
Boiler Engineer	1	70,000	70,000
Mechanical Department			
Manager - Mechanical Engineer	1	100,000	100,000
Mechanical Foreman	1	70,000	70,000
Electrical Department			
Manager - Electrical Engineer	1	100,000	100,000
Associate - Electrical Engineer	1	45,000	45,000
System Control Room			
Manager - Computer System Control	1	80,000	80,000
Labortaory			
Chemist	1	80,000	80,000
Associate Chemist	1	50,000	50,000
Safety			
Supervisor	1	70,000	70,000
Sulfur Feeding & Filing			
Tractor Driver	1	30,000	30,000
HR			
Procurement Manager	1	70,000	70,000
Sales Manager	1	100,000	100,000
Security Guard	1	25,000	25,000
Office Boy	1	25,000	25,000
Sweeper	1	25,000	25,000
Utility expenses			3,938,324
Total Cost (PKR)			**5,238,324**

9.1.9. Legal, Licensing, and Training costs

Table 15 shows legal, licensing, and training costs required for sulfuric acid production

Table 15: Legal, Licensing, and Training costs

Particular	Total One Time Cost (PKR)
Enviroment Protection Authority (EPA) Cost	70,000

Project Consultant Cost	200,000
Enviromental Consultant Cost	150,000
Construction NOC Cost	100,000
Anti Narcotics Approval Cost	60,000
Total Cost	**580,000**

9.2. Breakeven Analysis

Table 16 shows calculation of break-even analysis.

Table 16: Breakeven Analysis

Particulars	Amount First Year (PKR)	Profitability Ratio
Sales (PKR) – A	329,400,000	100%
Variable Cost (PKR) – B	213,334,504	65%
Contribution (PKR) (A-B) = C	116,065,496	35%
Fixed Cost (PKR) – D	40,613,732	12%
Contribution Margin	35%	
Breakeven Analysis		
Breakeven Revenue (PKR)		115,263,912
Break-Even (Tons)		2,309
Breakeven Capacity		35%

9.3. Revenue Generation

Table 17 provides details regarding revenue generation from the sulfuric acid and sulfuric mud respectively during the first year of its operations.

Table 17: Revenue

Products	Quantity Sold (Ton)	Price Per Ton (PKR)	Total Revenue (PKR)
Sulfuric Acid	6,450	50,000	322,500,000
Sulfuric Mud	230	30,000	6,900,000
Total			**329,400,000**

9.4. Variable Cost Estimate

Variable costs of the project have been provided in Table 18.

Table 18: Variable Cost Estimate

Description of Costs	Amount (PKR)
Raw Material Cost – Sulphur	92,400,000
Diesel Cost	230,000
Concentrated Sulfuric Acid	250,000
Consumable Cost	2,061,000
Generator Fuel Cost	30,360,000
Direct Electricity Cost	41,931,904
Direct Labor	32,520,000
Plant Maintenance Cost	9,900,000
Communications expense (phone, mail, internet, etc.)	1,132,800
Office vehicles running expense	1,416,000
Office expenses (stationery, entertainment etc.)	1,132,800
Total Variable Cost (PKR)	**213,334,504**

Table 19: Raw Material Cost - Sulphur

Raw Material	Usage per Day (Ton)	Annual Consumption (Ton)	Price per Ton(PKR)	Total Cost (PKR)
Sulphur	7	2,310	40,000	92,400,000
Total				**92,400,000**

Table 20: Annual Diesel Cost

Particulars	Diesel Required for Heating the Furnace (Liters)	Price per Liter (PKR)	Total Cost (PKR)
Diesel Cost	1,000	230	230,000
Total			**230,000**

Table 21: Concentrated Sulfuric Acid (One Time Cost)

Particulars	Quantity Required For Initial Start-up of Plant (Ton)	Price per Ton (PKR)	Total Cost (PKR)
Concentrated Sulfuric Acid	5	50,000	250,000
Total			**250,000**

Table 22: Consumables

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Mechanical Department			
Welding Rods (50 Pcs)	10	1,000	10,000
Oxygen Cylinder (40 Kg)	50	12,000	600,000
LPG Cylinder (40 Kg)	50	15,000	750,000
Electrical Department			
Cables of Different Ranges			380,000
Fuse, Switches & Breakers			190,000
Safety Equipments			
Helmets	25	600	15,000
Gloves	25	300	7,500
Gogals	25	300	7,500
Gas Masks	150	30	4,500
Safety Shoes	25	1,500	37,500
Air Mufers	25	600	15,000
Closed Uniforms	25	800	20,000
Civil Works			
Sholve	5	700	3,500
Level	5	300	1,500
Hammer	5	800	4,000
Small Trolly	5	3,000	15,000
Total			**2,061,000**

Table 23: Cables of Different Ranges

Cost Item	Average Feet Required for Plant	Unit Cost Per Meter (PKR)	Total Cost (PKR)
3 Volt	500	40	20,000
12 Volt	1,000	60	60,000
220 Volt	1,500	100	150,000
440 Volt	1,000	150	150,000
Total			**380,000**

Table 24: Direct Labor

Personnel	Number of Personnel	Salary per Head (PKR)	Annual Salaries (PKR)
Production Departement			
General Manager	1	150,000	1,800,000
Production Manager - Chemical Engineer	2	120,000	2,880,000
Production Supervisor	2	90,000	2,160,000
Boiler Engineer	2	70,000	1,680,000
Plant Operators	4	60,000	2,880,000
Boiler Operator	4	50,000	2,400,000
Production Staff - Technician	2	35,000	840,000
Mechanical Department			
Manager - Mechanical Engineer	2	100,000	2,400,000
Mechanical Foreman	2	70,000	1,680,000
Electrical Department			
Manager - Electrical Engineer	2	100,000	2,400,000
Associate - Electrical Engineer	2	45,000	1,080,000
System Control Room			
Manager - Computer System Control	2	80,000	1,920,000
System Operator	2	50,000	1,200,000
Labortaory			
Chemist	2	80,000	1,920,000

Associate Chemist	2	50,000	1,200,000
Safety			
Supervisor	2	70,000	1,680,000
Sulfur Feeding & Filing			
Tractor Driver	2	30,000	720,000
SulfurAcid - Filling Staff	4	35,000	1,680,000
Total			**32,520,000**

Table 25: Generator Cost

Machine	Diesel Consumption per Liter/Hour	Generator Usage Hours per Day	Total Diesel Consumption Liter/Day	Diesel Price per Liter	Total Diesel Consumption Liter/Day (PKR)	Total Diesel Consumption Liter/Year (PKR)
400kva Generator	80	5	400	230	92,000	30,360,000

Table 26: Variable Cost Assumption

Description of Costs	Rational
Machinery Maintenance Cost	10% of Cost of Machinery
Office vehicles running and maintenance expense	10% of Management staff expense
Commuication expense	8% of Management staff expense
Office expenses (stationery, entertainment, etc.)	8% of Management staff expense

9.5. Fixed Cost Estimate

Table 27 shows the estimated fixed cost of the project.

Table 27: Fixed Cost Estimate

Description of Costs	Amount (PKR)
Management Staff	14,160,000
Administration benefits expense	2,334,000
Indirect Electricity Cost	5,327,983
Promotional expense	3,294,000
Amortization of Legal, Licensing, and Training costs	116,000
Depreciation expense	13,016,484
Amortization of pre-operating costs	1,047,577
Bad debt expense	1,317,600
Total Fixed Cost	**40,613,732**

Table 28: Management Staff

Personnel	Number of Personnel	Salary per Head (PKR)	Annual Salaries (PKR)
Mechanical Department			
Associate - Mechanical Engineer	2	45,000	1,080,000
Mechanical Staff - Technician	2	35,000	840,000
Electrical Department			
Electrical Staff – Technician	2	35,000	840,000
Labortaory			
Lab Staff	2	35,000	840,000

Safety			
Associate	2	35,000	840,000
HR			
Account Manager	1	90,000	1,080,000
Account Officer	1	50,000	600,000
Procurement Manager	1	70,000	840,000
Admin and HR Manager	1	70,000	840,000
Admin and HR Officer	1	40,000	480,000
Procurement Officer	1	40,000	480,000
Sales Manager	1	100,000	1,200,000
Sales Officer	1	50,000	600,000
Security Guard	6	25,000	1,800,000
Office Boy	2	25,000	600,000
Sweeper	4	25,000	1,200,000
Total			**14,160,000**

Table 29: Fixed Cost Assumptions

Description of Costs	Rational
Promotional expense	1% of revenue
Administration benefits expense	5% of administration expense
Bad debt expense	0.4% of revenue
Depreciation	
Building infrastructure	10% of cost
Production Plant Infrastructure	6.5% of cost
Sulfuric Acid Production Plant	6.5% of cost
Tool & equipment	15% of cost
Office equipment, Furniture & Fixture, Office vehicles	15% of cost

9.6. Financial Feasibility Analysis

The financial feasibility analysis provides the information regarding projected Internal Rate of Return (IRR), Net Present Value (NPV) and Payback period of the study, which is shown in Table 30.

Table 30: Financial Feasibility Analysis

Description	Project
IRR	26%
NPV (PKR)	9,046,552
Payback Period (years)	4.24
Projection Years	10
Discount rate used for NPV	25%

9.7. Financial Feasibility Analysis with 50% Debt

The financial feasibility analysis provides the information regarding projected IRR, NPV and payback period of the study on the basis of Debt: Equity Model (50:50), which is shown in Table 31.

Table 31: Financial Feasibility Analysis with 50% Debt

Description	Project
IRR	25%
NPV (PKR)	51,611,625
Payback Period (years)	4.21
Projection Years	10
Discount rate used for NPV	22%

9.8. Human Resource Requirement

The proposed services shall require the workforce as provided in Table 32.

Table 32: Human Resource

Personnel	Number of Personnel	Salary per Head (PKR)	Annual Salaries (PKR)
Production Departement			
General Manager	1	150,000	1,800,000
Production Manager - Chemical Engineer	2	120,000	2,880,000

Production Supervisor	2	90,000	2,160,000
Boiler Engineer	2	70,000	1,680,000
Plant Operators	4	60,000	2,880,000
Boiler Operator	4	50,000	2,400,000
Production Staff - Technician	2	35,000	840,000
Mechanical Department			-
Manager - Mechanical Engineer	2	100,000	2,400,000
Mechanical Foreman	2	70,000	1,680,000
Associate - Mechanical Engineer	2	45,000	1,080,000
Mechanical Staff - Technician	2	35,000	840,000
Electrical Department			-
Manager - Electrical Engineer	2	100,000	2,400,000
Associate - Electrical Engineer	2	45,000	1,080,000
Electrical Staff - Technician	2	35,000	840,000
System Control Room			-
Manager - Computer System Control	2	80,000	1,920,000
System Operator	2	50,000	1,200,000
Labortaory			-
Chemist	2	80,000	1,920,000
Associate Chemist	2	50,000	1,200,000
Lab Staff	2	35,000	840,000
Safety			-
Supervisor	2	70,000	1,680,000
Associate	2	35,000	840,000
Sulfur Feeding & Filing			-
Tractor Driver	2	30,000	720,000
SulfurAcid - Filling Staff	4	35,000	1,680,000
HR			-
Account Manager	1	90,000	1,080,000
Account Officer	1	50,000	600,000
Procurement Manager	1	70,000	840,000
Admin and HR Manager	1	70,000	840,000

Admin and HR Officer	1	40,000	480,000
Procurement Officer	1	40,000	480,000
Sales Manager	1	100,000	1,200,000
Sales Officer	1	50,000	600,000
Security Guard	6	25,000	1,800,000
Office Boy	2	25,000	600,000
Sweeper	4	25,000	1,200,000
Total	**70**		**46,680,000**

10. CONTACT DETAILS

The contact details of all the major suppliers of machinery & equipment and raw material are given in Table 33.

Table 33: Contact Details

Name of Supplier	Product	Contact	Website/Email
Desmet Ballestra	H2SO4 Production Plant	+ 39 02 50831	mail@ballestra.com https://www.ballestra.com/detergents-surfactants/your-dsc-contacts
Elessent Clean Technologies	H2SO4 Production Plant	(+971) 524403255	https://elessentct.com/contact/
R.C. Costello & Assoc., Inc.	H2SO4 Production Plant	(310) 792-5870	https://rccostello.com/process_design_chemicals.html?gclid=CjwKCAiAleOeBhBdEiwAfgmXf_WHiBwshResG6mlo6ytVH15raZOdFqrthNOw-iCFnS20Jjp-jQYqRoCscIQAvD_BwE
ISHTAR company	Raw Material	(+971) 524403255	https://ishtarcompany.com/granular-sulfur/
OGDCL, Petroleum Refineries	Raw Material	+92 51 9209811-8	https://ogdcl.com/operations/production
International Petro-chemical (pvt) Ltd. Etc	Raw Material	+92-42-35888531-36	https://www.ipchem.com/

11. USEFUL LINKS

Table 34: Useful Links

Name of Organization	E-mail Address
Small and Medium Enterprises Development Authority (SMEDA)	www.smeda.org.pk
National Business Development Program (NBDP)	www.nbdp.org.pk
Government of Pakistan	www.pakistan.gov.pk
Government of Punjab	www.punjab.gov.pk
Government of Sindh	sindh.gov.pk/
Government of Balochistan	balochistan.gov.pk/
Government of Khyber Pakhtunkhwa	kp.gov.pk/
Government of Gilgit Baltistan	gilgitbaltistan.gov.pk/
Government of Azad Jammu & Kashmir	ajk.gov.pk/
Trade Development Authority of Pakistan	www.tdap.gov.pk
Securities and Exchange Commission of Pakistan	www.secp.gov.pk
State Bank of Pakistan	www.sbp.gov.pk
Federal Board of Revenue	www.fbr.gov.pk
Federation of Pakistan Chambers of Commerce and Industry (FPCCI)	www.fpcci.com.pk
Pakistan Stock Exchange (PSX)	www.psx.com.pk
Pakistan Standards and Quality Control Authority (PSQCA)	http://www.psqca.com.pk
Punjab Small Industries Corporation	https://www.psic.gop.pk/
Sindh Small Industries Corporation	https://ssic.gos.pk/
Government of KPK	https://small_industries_de.kp.gov.pk/
Government of Balochistan Industries and Commerce	https://balochistan.gov.pk/departments-download/industries-and-commerce/
Pakistan Environmental Protection Agency	https://environment.gov.pk/
Ministry of Industries & Production (MoI&P)	https://moip.gov.pk/
Ministry of Narcotics Control	https://narcon.gov.pk/index
Ministry of Commerce	https://www.commerce.gov.pk/

12. ANNEXURES

12.1. Income Statement

Calculations

Income Statement **SMEDA**

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sulphuric Acid	322,500,000	363,220,000	399,784,147	440,029,084	484,325,345	533,080,763	586,744,227	645,809,812	710,821,333	782,377,348
Sulphur Mud	6,900,000	7,594,600	8,359,123	9,200,608	10,126,803	11,146,234	12,268,288	13,503,296	14,862,628	16,358,799
Revenue	**329,400,000**	**370,814,600**	**408,143,270**	**449,229,692**	**494,452,148**	**544,226,997**	**599,012,515**	**659,313,108**	**725,683,961**	**798,736,147**
Cost of sales										
Raw Material Cost - Sulphur	92,400,000	101,701,600	111,939,561	123,208,144	135,611,097	149,262,614	164,288,384	180,826,747	199,029,973	219,065,657
Diesel Cost	230,000	253,153	278,637	306,687	337,560	371,541	408,943	450,110	495,421	545,293
Concentrated Sulfuric Acid	250,000	275,167	302,867	333,355	366,913	403,849	444,503	489,250	538,501	592,710
Consumable Cost	2,061,000	2,268,474	2,496,834	2,748,182	3,024,832	3,329,332	3,664,484	4,033,376	4,439,402	4,886,302
Generator Fuel Cost	30,360,000	33,416,240	36,780,141	40,482,676	44,557,932	49,043,430	53,980,469	59,414,503	65,395,563	71,978,716
Direct Electricity Cost	41,931,904	45,721,150	49,852,818	54,357,851	59,269,989	64,626,020	70,466,058	76,833,841	83,777,059	91,347,713
Direct Labor	32,520,000	35,674,440	39,134,861	42,930,942	47,095,244	51,663,482	56,674,840	62,172,299	68,203,012	74,818,705
Plant Maintenance Cost	9,900,000	10,896,600	11,993,524	13,200,873	14,529,760	15,992,423	17,602,327	19,374,294	21,324,640	23,471,320
Total cost of sales	209,652,904	230,206,824	252,779,244	277,568,709	304,793,327	334,692,691	367,530,008	403,594,421	443,203,572	486,706,417
Gross Profit	119,747,096	140,607,776	155,364,026	171,660,983	189,658,821	209,534,306	231,482,507	255,718,688	282,480,389	312,029,730
General administration & selling expenses										
Management Staff	14,160,000	15,533,520	17,040,271	18,693,178	20,506,416	22,495,538	24,677,606	27,071,333	29,697,253	32,577,886
Administration benefits expense	2,334,000	2,560,398	2,808,757	3,081,206	3,380,083	3,707,951	4,067,622	4,462,182	4,895,013	5,369,830
Indirect Electricity Cost	5,327,983	5,809,455	6,334,436	6,906,858	7,531,008	8,211,560	8,953,611	9,762,719	10,644,943	11,606,891
Communications expense (phone, mail, internet, etc.)	1,132,800	1,242,682	1,363,222	1,495,454	1,640,513	1,799,643	1,974,208	2,165,707	2,375,780	2,606,231
Office vehicles running and maintenance expense	1,416,000	388,212	427,292	470,306	517,650	569,760	627,116	690,245	759,730	836,210
Office expenses (stationery, entertainment etc.)	1,132,800	1,242,682	1,363,222	1,495,454	1,640,513	1,799,643	1,974,208	2,165,707	2,375,780	2,606,231
Promotional expense	3,294,000	3,708,146	4,081,433	4,492,297	4,944,521	5,442,270	5,990,125	6,593,131	7,256,840	7,987,361
Amortization of Legal, Licensing, and Training costs	116,000	116,000	116,000	116,000	116,000	-	-	-	-	-
Depreciation expense	13,016,484	12,930,928	12,850,933	12,776,137	12,706,204	12,640,816	11,464,600	15,321,727	15,268,279	15,218,305
Amortization of pre-operating costs	1,047,665	1,047,665	1,047,665	1,047,665	1,047,665	-	-	-	-	-
Bad debt expense	1,317,600	1,483,258	1,632,573	1,796,919	1,977,809	2,176,908	2,396,050	2,637,252	2,902,736	3,194,945
Subtotal	44,295,332	46,062,945	49,065,802	52,371,473	56,008,381	58,844,089	62,125,146	70,870,003	76,176,354	82,003,889
Operating Income	75,451,765	94,544,831	106,298,224	119,289,510	133,650,440	150,690,218	169,357,361	184,848,685	206,304,036	230,025,841
Gain / (loss) on sale of office equipment	-	-	-	-	-	-	1,255,375	-	-	
Gain / (loss) on sale of office vehicles	-	-	-	-	-	-	881,765	-	-	
Earnings Before Interest & Taxes	75,451,765	94,544,831	106,298,224	119,289,510	133,650,440	150,690,218	171,494,501	184,848,685	206,304,036	230,025,841
Interest expense on long term debt (Project Loan)	-	-	-	-	-	-	-	-	-	-
Interest expense on long term debt (Working Capital Loan)	-	-	-	-	-	-	-	-	-	-
Subtotal	-	-	-	-	-	-	-	-	-	-
Earnings Before Tax	75,451,765	94,544,831	106,298,224	119,289,510	133,650,440	150,690,218	171,494,501	184,848,685	206,304,036	230,025,841
Tax	21,566,823	27,772,070	31,591,923	35,814,091	40,481,393	46,019,321	52,780,713	57,120,823	64,093,812	71,803,398
NET PROFIT/(LOSS) AFTER TAX	**53,884,941**	**66,772,761**	**74,706,301**	**83,475,419**	**93,169,047**	**104,670,897**	**118,713,788**	**127,727,862**	**142,210,224**	**158,222,443**

12.2. Balance Sheet

Calculations **SMEDA**

Balance Sheet

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Assets											
Current assets											
Cash & Bank	3,000,000	36,611,331	68,906,260	95,267,163	118,737,018	141,030,829	162,258,263	248,663,315	388,447,750	542,124,224	678,046,073
Accounts receivable	-	14,972,727	16,855,209	18,551,967	20,419,531	22,475,098	24,737,591	27,227,842	29,968,778	32,985,635	36,306,188
Equipment spare part inventory	825,000	994,920	1,199,838	1,446,961	1,744,982	2,104,385	2,537,812	3,060,510	3,690,864	4,451,048	-
Raw material inventory	1,925,000	2,332,074	2,825,231	3,422,675	4,146,458	5,023,297	6,085,559	7,372,455	8,931,487	10,820,203	-
Finished goods inventory		4,764,839	5,231,973	5,744,983	6,308,380	6,927,121	7,606,652	8,352,955	9,172,600	10,072,808	11,061,509
Total Current Assets	5,750,000	59,675,891	95,018,511	124,433,748	151,356,370	177,560,730	203,225,878	294,677,076	440,211,479	600,453,918	725,413,771
Fixed assets											
Land	175,000,000	175,000,000	175,000,000	175,000,000	175,000,000	175,000,000	175,000,000	175,000,000	175,000,000	175,000,000	175,000,000
Building Infrastructure	19,200,000	17,280,000	15,360,000	13,440,000	11,520,000	9,600,000	7,680,000	5,760,000	3,840,000	1,920,000	47,872,458
Production Plant Infrastructure	20,250,000	18,933,750	17,703,056	16,552,358	15,476,454	14,470,485	13,529,903	12,650,460	11,828,180	11,059,348	10,340,490
Sulphuric Acid Production Plant	99,000,000	92,565,000	86,130,000	79,695,000	73,260,000	66,825,000	60,390,000	53,955,000	47,520,000	41,085,000	34,650,000
Vanadium Pentaoxide Catalyst (V2O5)	7,000,000	5,950,000	4,900,000	3,850,000	2,800,000	1,750,000	700,000	13,269,275	11,278,884	9,288,492	7,298,101
Furniture & fixtures	1,805,000	1,534,250	1,263,500	992,750	722,000	451,250	180,500	3,421,577	2,908,341	2,395,104	1,881,867
Office vehicles	3,527,060	2,998,001	2,468,942	1,939,883	1,410,824	881,765	352,706	5,373,837	4,567,761	3,761,686	2,955,610
Office equipment	5,021,500	4,268,275	3,515,050	2,761,825	2,008,600	1,255,375	502,150	9,518,809	8,090,988	6,663,166	5,235,345
Tools & Equipment	4,948,000	4,205,800	3,463,600	2,721,400	1,979,200	1,237,000	494,800	9,379,482	7,972,559	6,565,637	5,158,715
Total Fixed Assets	335,751,560	322,735,076	309,804,148	296,953,215	284,177,078	271,470,874	258,830,059	288,328,438	273,006,712	257,738,433	290,392,586
Intangible assets											
Pre-operation costs	5,238,324	4,190,659	3,142,994	2,095,330	1,047,665	-	-	-	-	-	-
Legal, licensing, & training costs	580,000	464,000	348,000	232,000	116,000	-	-	-	-	-	1,446,147
Total Intangible Assets	5,818,324	4,654,659	3,490,994	2,327,330	1,163,665	-	-	-	-	-	1,446,147
TOTAL ASSETS	**347,319,883**	**387,065,626**	**408,313,653**	**423,714,293**	**436,697,112**	**449,031,605**	**462,055,937**	**583,005,515**	**713,218,191**	**858,192,351**	**1,017,252,504**
Liabilities & Shareholders' Equity											
Current liabilities											
Accounts payable		12,803,272	14,136,154	15,612,451	17,248,540	19,062,853	21,076,171	23,311,961	25,796,775	28,560,711	29,398,422
Total Current Liabilities	-	12,803,272	14,136,154	15,612,451	17,248,540	19,062,853	21,076,171	23,311,961	25,796,775	28,560,711	29,398,422
Other liabilities											
Long term debt (Project Loan)	-	-	-	-	-	-	-	-	-	-	-
Long term debt (Working Capital Loan)	-	-	-	-	-	-	-	-	-	-	-
Total Long Term Liabilities	-	-	-	-	-	-	-	-	-	-	-
Shareholders' equity											
Paid-up capital	347,319,883	347,319,883	347,319,883	347,319,883	347,319,883	347,319,883	347,319,883	347,319,883	347,319,883	347,319,883	347,319,883
Retained earnings		26,942,471	46,857,616	60,781,958	72,128,689	82,648,868	93,659,882	212,373,670	340,101,533	482,311,757	640,534,199
Total Equity	347,319,883	374,262,354	394,177,499	408,101,842	419,448,572	429,968,751	440,979,766	559,693,554	687,421,416	829,631,640	987,854,083
TOTAL CAPITAL AND LIABILITIES	**347,319,883**	**387,065,626**	**408,313,653**	**423,714,293**	**436,697,112**	**449,031,605**	**462,055,937**	**583,005,515**	**713,218,191**	**858,192,351**	**1,017,252,504**

12.3. Cash Flow Statements

Calculations **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
Operating activities											
Net profit		53,884,941	66,772,761	74,706,301	83,475,419	93,169,047	104,670,897	118,713,788	127,727,862	142,210,224	158,222,443
Add: depreciation expense		13,016,484	12,930,928	12,850,933	12,776,137	12,706,204	12,640,816	11,464,600	15,321,727	15,268,279	15,218,305
amortization of pre-operating costs		1,047,665	1,047,665	1,047,665	1,047,665	1,047,665	-	-	-	-	-
amortization of License Cost		116,000	116,000	116,000	116,000	116,000	-	-	-	-	-
Accounts receivable		(14,972,727)	(1,882,482)	(1,696,758)	(1,867,565)	(2,055,566)	(2,262,493)	(2,490,251)	(2,740,936)	(3,016,857)	(3,320,554)
Finished goods inventory		(4,764,839)	(467,135)	(513,010)	(563,397)	(618,741)	(679,531)	(746,303)	(819,646)	(900,208)	(988,701)
Equipment inventory	(825,000)	(169,920)	(204,918)	(247,123)	(298,021)	(359,403)	(433,427)	(522,697)	(630,354)	(760,184)	4,451,048
Raw Material Iventory	(1,925,000)	(407,074)	(493,157)	(597,443)	(723,783)	(876,839)	(1,062,262)	(1,286,896)	(1,559,032)	(1,888,716)	10,820,203
Accounts payable		12,803,272	1,332,882	1,476,297	1,636,089	1,814,313	2,013,317	2,235,790	2,484,814	2,763,936	837,711
Cash provided by operations	(2,750,000)	60,553,802	79,152,544	87,142,862	95,598,544	104,942,678	114,887,316	127,368,031	139,784,436	153,676,474	185,240,454
Financing activities											
Project Loan - principal repayment		-	-	-	-	-	-	-	-	-	-
Working Capital Loan - principal repayment		-	-	-	-	-	-	-	-	-	-
Additions to Project Loan	-	-	-	-	-	-	-	-	-	-	-
Additions to Working Capital Loan	-	-	-	-	-	-	-	-	-	-	-
Issuance of shares	347,319,883	-	-	-	-	-	-	-	-	-	-
Cash provided by / (used for) financing activities	347,319,883	-	-	-	-	-	-	-	-	-	-
Investing activities											
Capital expenditure	(341,569,883)	-	-	-	-	-	-	(40,962,979)	-	-	(49,318,605)
Cash (used for) / provided by investing activities	(341,569,883)	-	-	-	-	-	-	(40,962,979)	-	-	(49,318,605)
NET CASH	3,000,000	60,553,802	79,152,544	87,142,862	95,598,544	104,942,678	114,887,316	86,405,052	139,784,436	153,676,474	135,921,849

13. KEY ASSUMPTIONS

13.1. Operating Cost Assumptions

Table 35: Operating Cost Assumptions

Description	Details
Operating costs growth rate	10.1%
Electricity growth rate	9.0%
Water price growth rate	9.0%
Gas price growth rate	9.0%
Wage growth rate	9.7%
Office equipment price growth rate	9.6%
Office vehicles price growth rate	6.2%

13.2. Revenue Assumptions

Table 36: Revenue Assumptions

Description	Details
Sale price growth rate	10.1%
Maximum operational capacity	100%

13.3. Financial Assumptions

Table 37: Financial Assumptions

Description	Details
Project life (Years)	10
Debt: Equity	0:100
Discount Rate	25%

13.4. Debt Related Assumptions

Table 38: Debt Related Assumption

Description of Cost	Details
Project Life (Years)	10
Debt: Equity	50:50
Discount Rate	22%

Debt Grace Period	1 Years
Interest Rate (KIBOR+3%)	19%

13.5. Cash Flow Assumptions

Table 39: Cash Flow Assumptions

Description	Details
Accounts receivable cycle (in days)	15
Accounts payable cycle (in days)	40

Small and Medium Enterprises Development Authority

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