Pre-feasibility Study

MANUFACTURING UNIT FOR PRIMARY BATTERIES

October 2021

"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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1. DISCLAIMER

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2. EXECUTIVE SUMMARY

A battery is a combination of two or more electrochemical cells which convert the stored chemical energy into electrical energy. A battery has two poles or posts. The positive battery post is marked with a plus sign (+) and is larger than the negative post which is marked with a minus sign (–). Each battery consists of six electrochemical cells and each cell possesses 2 volts potential difference. The overall voltage of battery is 12 volts and the capacity of battery is rated in Ampere-hours. Ampere-hours (Ah) is the product of the time that a battery can deliver a certain amount of current (in hours) times that current (in amperes), for a particular discharge period. This is one indication of the total energy a battery can store and deliver at its rated voltage.

Lead acid batteries have the oldest and most mature technology. It is a low-cost battery created by placing negative lead and positive lead oxide electrodes into sulfuric acid; used as electrolyte. Depending on the purpose of use, the number of plates in the electrodes may be increased or decreased. They are commonly used in back-up power supplies for vehicles, alarm and smaller computer systems, uninterruptible power supplies (UPS), electric scooters, electric wheelchairs, electric bicycles, marine applications, electric vehicles or micro hybrid vehicles, motorcycles, etc.

A lead acid battery is made by positive and negative plates which are manufactured by lead alloy and the nominal electric potential between these two plates is 2 volts; when these plates are immersed in dilute sulfuric acid solution. Therefore, a 12 volt lead acid battery is made up of six cells that are connected in series and are enclosed in a durable plastic casing.

There are two types of lead acid batteries. These two types are flooded acid and sealed batteries. Flooded acid batteries include wet and dry charged batteries while sealed batteries include gelled acid, and Advanced AGM (Absorbed Glass Mat) batteries.

Flooded acid batteries have removable caps on the cell tops to allow refilling up the distilled water as and when required. Sealed batteries are sealed at the top, and thus won't leak acid when tipped over or give off gas while charging under normal conditions.

Wet charged battery manufacturing process is simpler than dry charged battery. Dry charged batteries are maintenance free while wet charged batteries required regular maintenance. Dry charged batteries have high prices than those of wet charged batteries.

This “Pre-feasibility Document” provides details for setting up a “Manufacturing Unit for Primary Batteries” (hereinafter referred to as the proposed business/proposed unit). The proposed business will manufacture flooded lead acid battery which is known as wet charged lead acid battery. The proposed business may be established in large cities such as Karachi, Lahore, Peshawar, Rawalpindi, Quetta, Faisalabad, Hyderabad, Multan, etc. The reason behind this is the presence of large car manufacturing industry and presence of large number of cars in these cities.

The proposed production unit will have maximum annual capacity of producing 143,485 batteries which include 22,400 batteries of NS40 12V 30Ah (9 plates), 91,636 batteries of NS40 12V 38Ah (11 plates), 12,218 batteries of NS60 12V 45Ah (11 plates) and 17,231 batteries of NS70 12V 70Ah (13 plates).

During 1st year of operation, the proposed production unit is expected to attain 40% of its installed capacity to produce 57,393 batteries which include 8,960 batteries of NS40 12V 30Ah (9 plates), 36,654 batteries of NS40 12V 38Ah (11 plates), 4,887 batteries of NS60 12V 45Ah (11 plates) and 6,892 batteries of NS70 12V 70Ah (13 plates). The operational capacity is assumed to increase at the rate of 5% per annum to reach a maximum of 90%.

The proposed business requires a total investment of PKR 116.2 million. This includes capital investment of PKR 87.03 million and working capital of PKR 29.21 million This project is financed through 100% equity in which case the Net Present Value (NPV) is PKR 184.01 million with an Internal Rate of Return (IRR) of 39% and a payback period of 3.84 years. Further, this project is expected to generate Gross Annual Revenues of PKR 418.77 million during 1st year of operations, Gross Profit (GP) ratio ranging from 21% to 27% and Net Profit (NP) ratio ranging from 3% to 13% during the projection period of 10 years. The proposed project will achieve its estimated breakeven point at capacity of 30% (42,534 batteries) with an annual revenue of PKR 310.35 million.

The proposed project may also be established using leveraged financing. At 50% financing at a cost of KIBOR+3%, the proposed unit provides Net Present Value (NPV) of PKR 306.21 million, Internal Rate of Return (IRR) of 37% and Payback period of 4.09 years. Further, this project is expected to generate Net Profit (NP) ratio ranging from 2% to 13% during the projection period of ten years. The proposed project will achieve its estimated breakeven point at capacity of 31% (44,024 batteries) with annual revenue of PKR 321.22 million.

The proposed project will provide employment opportunities to 133 people including the owner. The legal business status of this project is proposed as “Private Limited Company”.

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 provide information to the potential investors about establishing a “Manufacturing Unit for Primary Batteries”. The document provides a general understanding of the business to facilitate potential investors in crucial and effective investment decisions.

The need to come up with pre-feasibility reports for undocumented or minimally documented sectors attain 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 set up and its successful management.

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

5. BRIEF DESCRIPTION OF PROJECT & PRODUCTS

A battery is a combination of two or more electrochemical cells which store chemical energy which can be converted into electrical energy. A battery has two poles or posts. The positive battery post is marked with a plus sign (+) and is larger than the negative post/pole which is marked with a minus sign (-).

A well cell battery generates power from a pair of electrodes and a liquid electrolyte solution. These are comprised of lead plates in a solution of sulfuric acid, hence referred as lead acid batteries also, and are commercially used for over 100 years. Wet cell batteries are commonly available and are cheap too. However, a constant maintenance is required to maintain the liquid electrolyte to the recommended level as insufficient electrolyte level results in reduced performance and the battery needs to be recharged. Constant care must be taken with wet cell batteries to avoid acid spills. Also, the battery vent plugs (caps) need to be tightly closed to avoid acid evaporation. Wet cell batteries, although heavier, are the most widely used. Wet charged batteries are commonly used in motor vehicles, aviation, electric utilities, energy storage and cellphone towers.

This document provides details for establishing a manufacturing unit for wet charged batteries, the proposed unit will produce wet charged batteries which are type of flooded lead acid batteries.

A lead acid battery is manufactured by using lead alloy ingots and lead oxide. It comprises of two chemically dissimilar leads based plates immersed in dilute sulphuric acid solution. The positive plates and the negative plates are made of lead alloy. The nominal electric potential between these two plates is 2 volts when these are immersed in dilute sulfuric acid. Therefore, a 12 volt lead acid battery is made up of six cells that are connected in series and are enclosed in a durable plastic casing.

There are two types of lead acid batteries; flooded acid batteries and sealed batteries. Flooded lead acid batteries include wet and dry charged batteries while sealed batteries include gelled acid and advanced AGM (Absorbed Glass Mat) batteries.

The main parts of the lead acid battery are plates, (anode and cathode plates), separators, electrolyte (sulphuric acid), case, cell connectors and terminals. The electrolyte is a sulphuric acid solution with specific gravity in the range 1.21 to 1.30 (28 to 39% by weight). As soon as the electrolytes are installed, the battery starts working. Lead acid battery has a lifespan of approximately 2 years. Batteries for automotive vehicles represent the major use of lead-acid technology; followed by industrial batteries. Low cost and ease of manufacturing of lead-acid batteries, in relation to other electrochemical couples,[1] are the two main factors that ensure a continuing demand for this battery system in the future.

A lead acid battery consists of a negative electrode made of spongy or porous lead. The lead is porous to facilitate the formation and dissolution of lead. The positive electrode consists of lead oxide. Both electrodes are immersed in an electrolytic solution of sulfuric acid and water.

Flooded acid batteries have removable caps on the cell tops to allow refilling of distilled water as and when required. Sealed batteries are sealed at the top and thus there is no chance of acid leak acid when the battery is tipped over or gives off gas while

[1] The system of active materials within a cell that provides electrical energy storage through an electrochemical reaction.

charging under normal conditions. The main difference between flooded and sealed lead acid batteries is the issue of battery maintenance; flooded batteries require maintenance while sealed batteries require no maintenance.

Flooded lead-acid batteries contain an electrolyte that is free to move around in the battery encasement. When charged, the battery acid and the lead plates store electricity. These batteries are meant to be mounted upright so that the electrolyte does not leak out of the caps on top. These batteries are used in automotive applications. There are two types of flooded lead-acid batteries: wet and dry charged batteries.

Wet charged battery manufacturing process is simpler than dry charged battery. Dry charged batteries are maintenance free while wet charged batteries required regular maintenance. Dry charged batteries have high prices than those of wet charged batteries.

In the proposed project, four products of wet charged lead acid batteries are manufactured. These products are NS40[2] 12V 30 Ah (9 Plates), NS40 12V 38Ah (11 Plates), NS60 12V 45 Ah (11 Plates) and NS70 12V 45 Ah (13 Plates). These batteries are used by automotive vehicles with engine power ranging from 1000 cc to 1800 cc. NS40 battery is generally used in Suzuki (Khyber/Cultus), Suzuki (Wagon-R), Suzuki (Alto), Hyundai (Santro Plus), Daihatsu (Cuore), Suzuki (Mehran), Suzuki (Bolan) and Suzuki (Margalla). NS60 battery is generally used in Toyota Vitz and Suzuki Swift. NS70 battery is commonly used in Honda Civic, Honda City, Suzuki Baleno, Suzuki Liana, Toyota Corolla (GLI, XLI and Grande), Toyota Yaris. One factor for selecting battery is the space; available for placing battery in the vehicles. In the proposed project, NS40 battery will be produced in largest number, since around 50% of cars produced in Pakistan use NS40 battery.

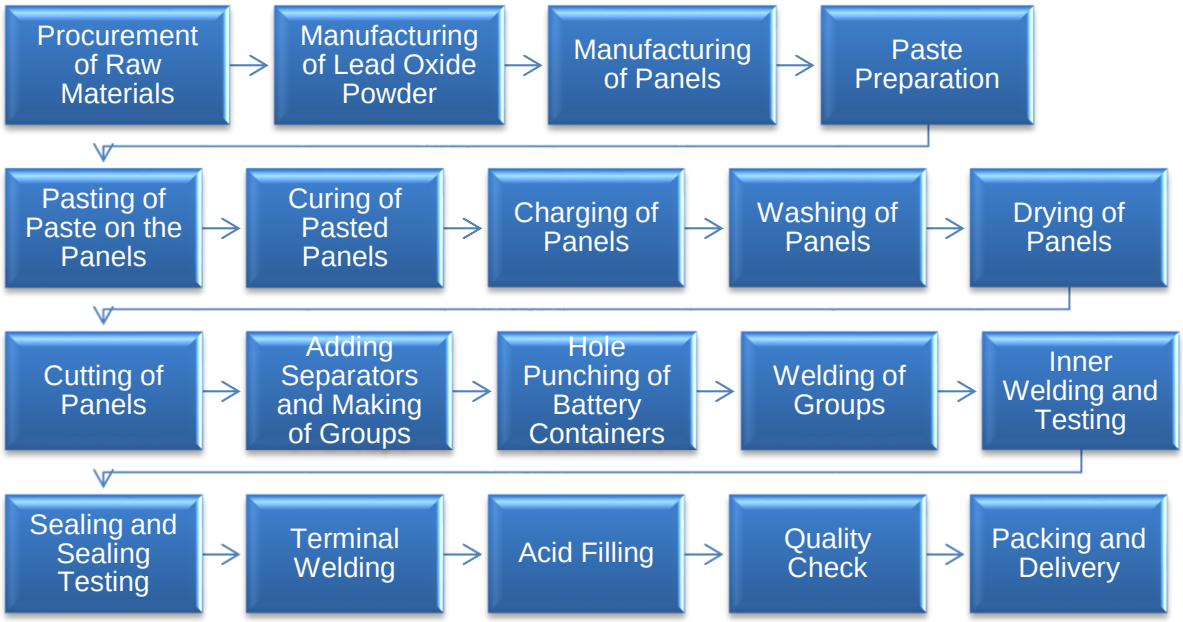
As per Pakistan Automotive Manufacturers Association (PAMA), during the year 2020-2021, 18,714 Suzuki Cultus, 12,280 Suzuki Wagon-R, 8,864 Suzuki Bolan and 35,994 Suzuki Alto were produced which are 50% of the total cars produced in this tax year.

5.1. Process Flow of Manufacturing Unit for Primary Batteries

Lead acid batteries are manufactured carefully, using complex machinery, equipment and processes in an automated controlled environment. The manufacturing processes can be divided into several stages; including lead oxide and grid production process, pasting and curing, charge-discharge process, formation, assembly process, filling, inspection and dispatch. Complete manufacturing process flow of wet lead acid batteries is shown in Figure 1.

[2] Nippon Series/Size

Figure 1: Overall Process Flow of Manufacturing of Primary Batteries



Brief description of process flow is provided below:

Procurement of Raw Materials

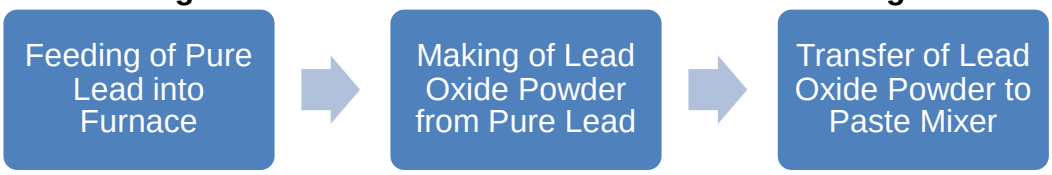
For manufacturing of lead acid battery, most of the raw materials are procured from the local market while some raw materials are imported. The imported raw materials include pure lead and lead alloy. Pure lead is used to manufacture lead oxide powder and lead alloy is used for manufacturing of panels. Sulphuric acid, to be used in charging phase, is procured locally. Some other smaller raw materials are used for making paste, which are treated as a proprietary information by the local manufacturers. These raw materials are procured from trusted suppliers having a good reputation in term of quality standards. Figure 2 shows lead ingots.

Figure 2: Lead Ingots

Manufacturing of Lead Oxide Powder

Process flow of manufacturing Lead Oxide powder is shown in Figure 3.

Figure 3: Flow Chart of Lead Oxide Manufacturing



Lead is fed into furnace of lead oxide mill where lead is converted to lead oxide by grinding and oxidation process. Heat is generated by electric power and the temperature of oxide is increased in the range 115-135 C. Lead oxide ball mill temperature is controlled with flow of air and water spraying system. The fine powder of lead oxide remaining in the air stream are drawn out of the lead oxide ball Mill and conveyed into the Paste Mixer Machine.

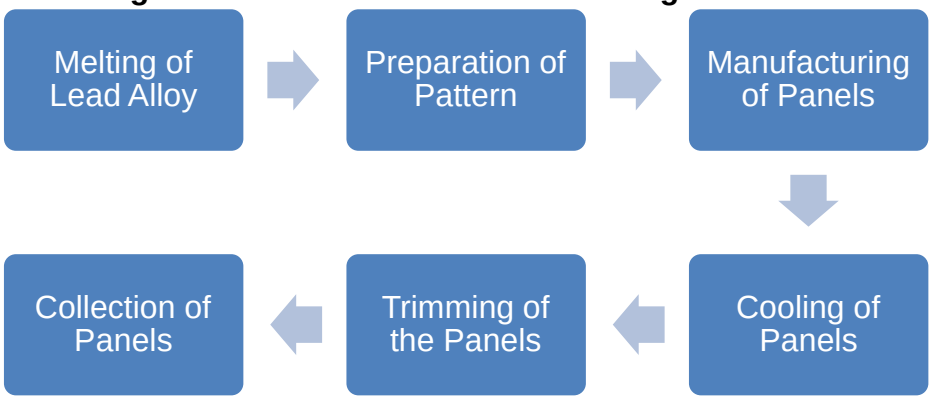
The exact ratio of input of pure lead used for producing lead oxide powder is determined by the technical teams at the time of setting up the battery production facility. An average value has been obtained from the primary market research for determining the lead cost for manufacturing batteries. This percentage is used in this prefeasibility study for calculating the lead cost per battery. In the proposed project, lead oxide mill, having a capacity of 5 ton per 24 hours, is used with an electricity consumption of 20 KW. Figure 4 shows lead oxide mill.

Figure 4: Lead Oxide Mill

Manufacturing of Panels

Process flow of manufacturing of panels is shown in Figure 5.

Figure 5: Flow Chart of Manufacturing of Panels



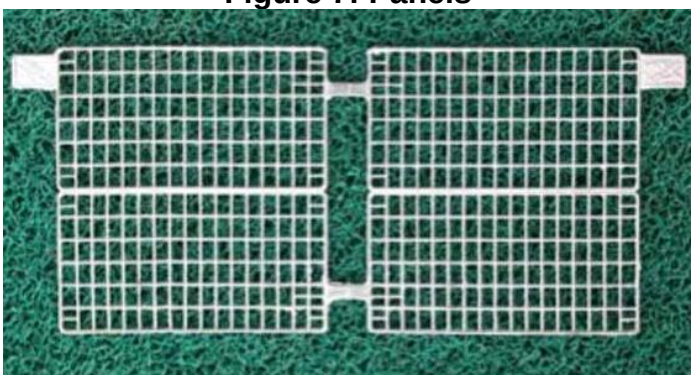
Casting and stamping methods are generally used for making battery grids/panels. In the proposed project, casting method is used. Gravity casting machine is used to manufacture panels (panels are also called grids) of positive and negative plates (2 combined plates). The lead alloy slabs are melted in the melting pot and the molten lead is poured into the patterns of battery grids.

The gravity casting machine used for the proposed unit can produce 20 panels per minute and consumes 17 KW of electricity. The lead alloy ingots are added in the furnace of gravity casting machine to melt them. The molten lead is added into customized mold of gravity casting machine to manufacture the panels as per the required design input to the machine through control panel.

After manufacturing, the panels pass through the cooling system of the gravity casting machine. The cooled panels are received at the outlet of the machine. In the proposed project, positive plates panel of 90 grams and 136 grams and negative plates panel of 75 grams and 120 grams are manufactured. For NS40 and NS60 batteries, positive plates of 90 grams and negative plates of 75 grams are used. However, for NS70 battery, positive plates of 136 grams and negative plates of 120 grams are used. After cooling, these grids are passed to trimming machine where rough edges and casting gates are trimmed. Figure 6 shows gravity casting machine and Figure 7 shows panels.

Figure 6: Gravity Casting Machine

Figure 7: Panels



Paste Preparation

Process flow of paste manufacturing is shown in Figure 8.

Figure 8: Flow Chart for Paste Manufacturing

It is the most important process in battery manufacturing which directly affects the quality and life of battery. During the paste mixing process, lead oxide powder (made in lead oxide mill), water, acid, and other chemicals are blended in a mixer to form a thick paste. The paste-mixing machine is fully automatic and PLC[3] controlled. This machine has a capacity of mixing 2,500 kg per hour and requires an electricity power of 45 KW. The machine comprises of different parts; including paste tank, mixing system and cooling system. Paste tank is a closed cylindrical steel tank. In the upper part of this tank, there are inspection doors and hose for cooling air inlet and outlet, the pipes for the inlet of acid and water. There are two discharging doors on sides of tank which are used to dump the final prepared paste in the cone feeder. The rotating paddles of mixing system produce a mixing action of the various components (lead oxide, acid, water and additives/expanders) to obtain a uniform and easily pasting paste. In the mixing cycle, cooling is essential because the temperature rises due to the exothermic nature of the reaction. The temperature is controlled by using two cooling systems to ensure a good quality of paste. The maximum temperature limit for pasting cycle is 60 C while final paste or dumping paste temperature should be less than 50 C. High temperature causes hardening in paste earlier than it is used. Figure 9 shows paste mixer machine.

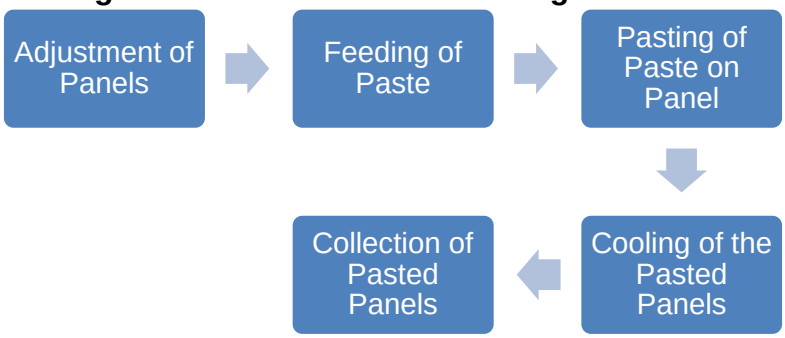
Figure 9: Paste Mixer Machine

[3] A Programmable Logic Controller, PLC, is used for automation of typical industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, light fixtures, etc.

Pasting of Paste on the Panels

Process flow of pasting of paste on panels is shown in Figure 10.

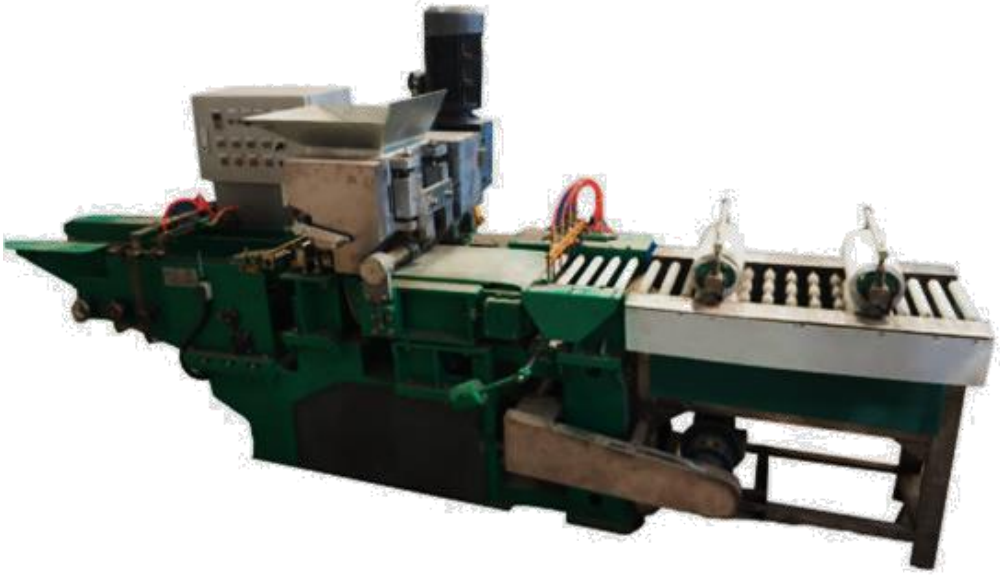
Figure 10: Flow Chart for Pasting of Panels



Double side pasting machine has capacity of pasting over 80 panels per minute with an electricity consumption of 15.5 KW. The machine consists of panel feeding system, hopper and pasting belt. Panels are placed manually on the two parallel conveyor chains. The gap between two chains is adjusted according to panel width. Two vacuum suction feeders pick panels from inlet automatically and place these on the feeding conveyor, which feeds panels directly into hopper, through feeder roller. Hopper is the main part/component of pasting machine. The paste is dropped into hopper form cone feeder and by combined action of rotating paddles and roller, paste is applied on upper part of panels continuously while a couple of motorized rollers are fitted in the central zone to ensure the paste application in the lower part of the panels. Pasting belt is operated by a separate motor and gear transmission system. Pasting belt is used to have better result in pasting. After pasting, the pasted panels are set into the racks and are left in open area for drying before going to curing chamber.

Figure 11 shows double sided pasting machine.

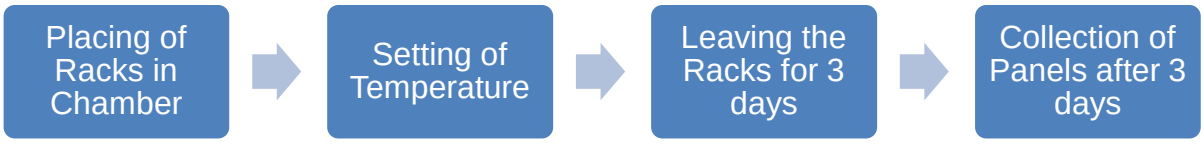
Figure 11: Double Sided Pasting Machine



Curing of Pasted Panels

Process flow of curing the pasted panels is shown in Figure 12.

Figure 12: Flow Chart for Curing of Panels



The pasted panels, set in racks, are sent into the curing chamber for curing process. The curing chamber provides an environment of controlled temperature and humidity conditions for dry curing of panels. Nowadays, the curing process is conducted in special chambers with controlled temperature, humidity and duration of both the curing and the drying phase. The process, including drying, can be completed in about 3 days. For the curing process, the panels are suspended individually on racks with a small separation between each other. In the proposed project, panel curing and drying chamber having a capacity of maintaining 3 racks of panels per day and each rack contains of 3,200 panels. Panel curing and drying chamber having an electricity power of 90KW is required for curing process. The temperature is maintained in the range 40-45 C and humidity at 80% for curing process. Figure 13 shows curing chamber and racks.

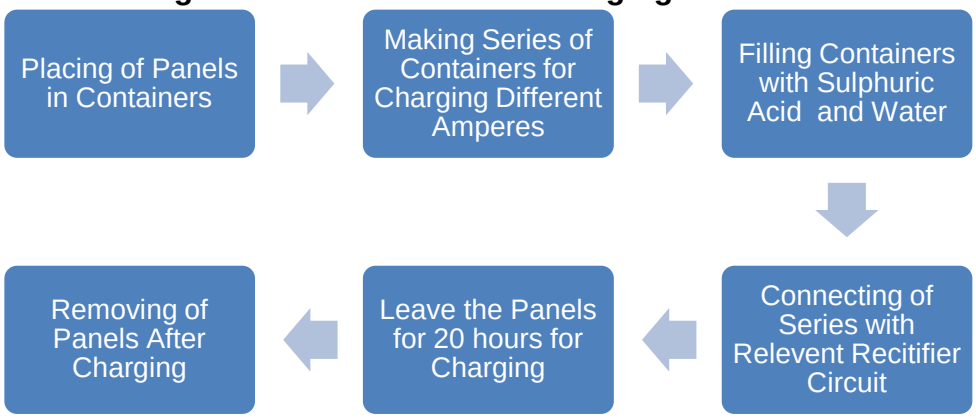
Figure 13: Racks and Curing Chamber

	
Panel Curing and Drying Chamber	**Racks**

Charging of Panels

Process flow of charging of panels is shown in Figure 14.

Figure 14: Flow Chart for Charging of Panels



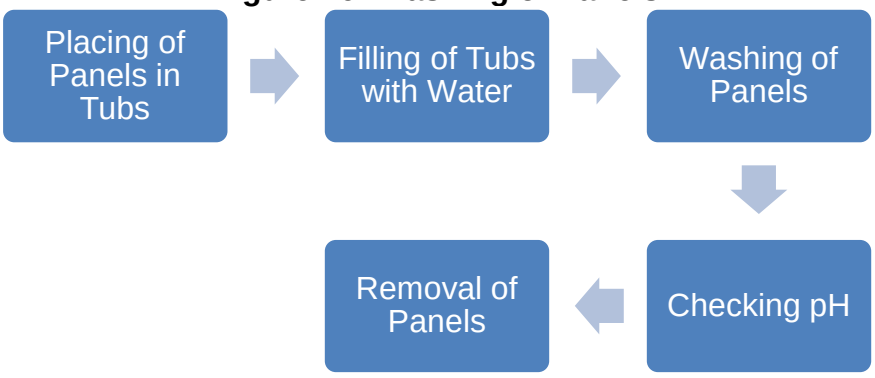
After curing, the panels needs to be charged. In this phase, panels are placed in a set of positive and negative sequence in a battery container and the container is filled with water and sulphuric acid (sulphuric acid 5 % and water 95%). The battery containers are connected through a series of connections with the panel of the rectifier. For the proposed project, rectifier having 4 circuits are used. Charging time and voltage is programed in the rectifier as per the ampere's requirement of each panel. This charging process takes 20 hours. Figure 15 shows rectifier.

Figure 15: Rectifier

Washing of Panels

Process flow of washing of panels is shown in Figure 16.

Figure 16: Washing of Panels



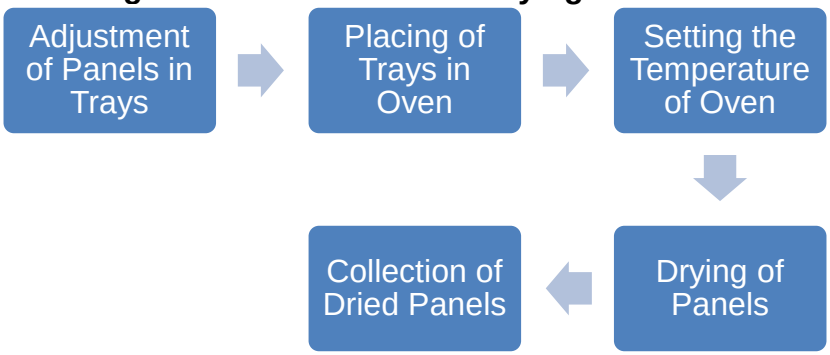
Washing of positive and negative panels starts by filling the stainless-steel trolley tubs with water. The positive and negative panels are dipped in water and are placed in the tub for 15 to 20 minutes until the pH of water reaches 4 to 5. Portable Digital pH meter or pH paper is used to check for acidic condition of water in stainless steel trolley tubs. After washing, the next step is drying. Figure 17 shows stainless steel trolley tubs.

Figure 17: Stainless Steel Trolley Tubs

Drying of Panels

Process flow of drying of panels is shown in Figure 18.

Figure 18: Flow Chart for Drying of Panels



In this step, the washed panels are placed for drying in trays which are then loaded in the inert gas oven using electric portable gantry crane. For the proposed project, inert gas oven having 4 trays (each tray have a capacity of 3,000 panels) with drying time of 3 hours, is used. This oven is gas operated with a gas consumption of 8 kg per hour and electricity consumption of 28 KW. The electric portable gantry crane has an electricity consumption of 2 KW. The electricity is used to operate air compressor system in the oven while gas is used for to generate heat for drying of panels. The process of drying has to done entirely in an oxygen-free environment so that there is no oxidation on the plates during drying process. The lead content in the dried plates is very high which gives the wet charged battery better performance. Figure 19 shows inert gas oven and electric portable gantry crane.

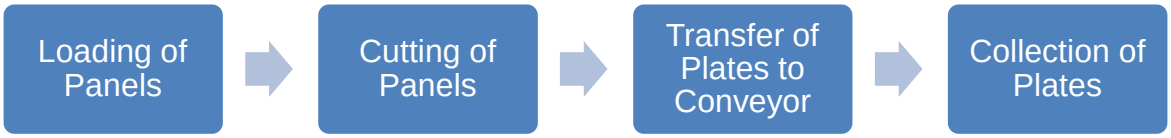
Figure 19: Inert Gas Oven and Electric Portable Gantry Crane

	
Inert Gas Oven	**Electric Portable Gantry Crane**

Cutting of Panels

Process flow of cutting of panels is shown in Figure 20.

Figure 20: Flow Chart for Cutting of Panels



Panels are loaded into the cutting machine by hanging them vertically by the sides of these panels onto a two-chain conveyor. This loading conveyor transfers panels to a feeding mechanism that transfers these panels individually from a vertical to a horizontal position. Panels are fed to horizontal chain conveyor. This conveyor consists of two outside chains with confining lugs and two center chains with lugs that support the center trailing panel edge during parting. The outside conveyor chains converge slightly as panels travel through the machine to allow panel feeding and give positive location for parting. Rotary wire brushes clean the top and bottom of panel

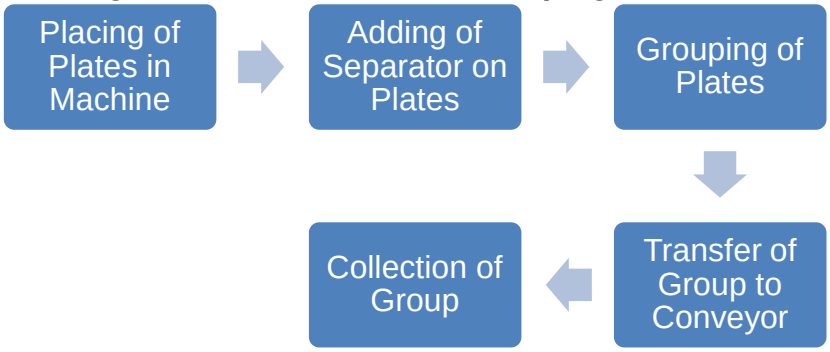
sides. The panel sides are supported by the flat metal anvil[4] and the top surface is brushed first. Panel sides are trimmed and panels are parted by knives cutter and transferred to the next step. After parting, the plates are transferred onto conveyor which are manually collected. In this project, the suggested cutting and lug brushing machine has a capacity of 80 pieces per minute with an electricity consumption of 8 KW. Figure 21 shows cutting and lug brushing machine.

Figure 21: Cutting and Lug Brushing Machine

Adding Separators and Making of Plates Group

Process flow of making plates groups is shown in Figure 22.

Figure 22: Flow Chart for Grouping of Plates



After cutting, the separators are added and groups are made using plate envelope and stacking machine having a capacity of 80 plates per minute with electricity consumption of 8 KW. This machine has two parts; first part is uncoiling device and the second part consists of two plate loaders. The uncoiling device has a spindle for polyethylene (PE) separator, according to the equipment's configuration. The separator's driving system acts through two vacuum belts, which ensures movement synchronization during the cutting stage. The operator places the plate stacks in a vertical position on the two loading stations. The uninterrupted movement of the

[4] A heavy iron block with a flat top and concave sides, on which metal can be hammered and shaped.

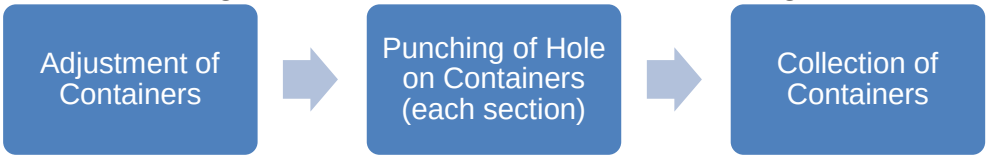
vacuum device from the pick-up area to the main chain ensures proper preservation of the plate integrity. Three independently motorized chains allow very accurate control of plate alignment. The pre-folding shuttle guides the plates into the rotary crimping unit, where two disks seal the envelope mechanically. The plates are first stacked in a 2-plate group (one enveloped and one non-enveloped), then a 4-disc wheel assembles these small stacks into the final element, according to the required settings. The passage of the plates from the wheel to the main chain is performed without extraction devices, to avoid any marks and damages on the separator. According to the equipment's configuration, the groups of positive and negative plates are conveyed out of the machine either in a horizontal or vertical position. The group of positive and negative plates are collected manually by the labor and transferred to the cast on strap machine. Figure 23 shows plate envelope and stacking machine.

Figure 23: Plate Envelope and Stacking Machine

Hole Punching of Battery Containers

Process flow of hole punching of battery containers is shown in Figure 24.

Figure 24: Flow Chart for Hole Punching



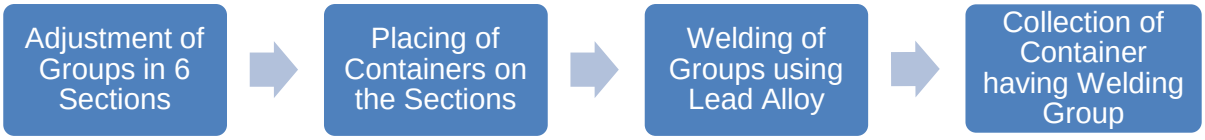
In this step, the battery container is inserted into the punch mold of the hole punching machine which punches holes automatically in the battery containers. The hole punching machine has a capacity of punching 4 containers per minute with an electricity consumption of 2 KW. Figure 25 shows hole punching machine.

Figure 25: Hole Punching Machine

Welding of Groups (Cast on Strap) (COS)

Process flow of welding of groups is shown in Figure 26.

Figure 26: Flow Chart for COS Process



The collected group of positive and negative plates are welded to the punched containers with lead accessories using cast on strap (COS) machine; having a capacity of 100 batteries per 8 hours and an electricity power of 3 KW. The key part of COS is a rotary table with four working positions. Rotation is performed by a brushless motor which grants an accurate positioning. An automatic system loads the groups of positive and negative plates into the rack by twelve rotating air-operated grippers by picking them up from the loading conveyor. The system is equipped with a plate and lug alignment device which includes a vibrating table suitable for PE separators. Three motorized brushes perform lug brushing, lug deoxidizing and drop removal tasks. The lead melting pot is electrically heated and specially designed with two sections to allow the pump to work with a fixed head. The mold is designed to cast 6 groups simultaneously, according to the dimensions. Its cooling system manages 6 independent circuits, one for each post and one for each half mold. Each circuit is equipped with dedicated thermal probes.[5] The unit for the automatic unloading of the welded groups is provided with twelve rotating air-operated grippers to pick up the output from the COS machine and place it inside the battery container. The unit performs the group boxing into the battery container in two steps: first, it inserts the

[5] A probe can be defined as a type of sensor which is used to measure temperature.

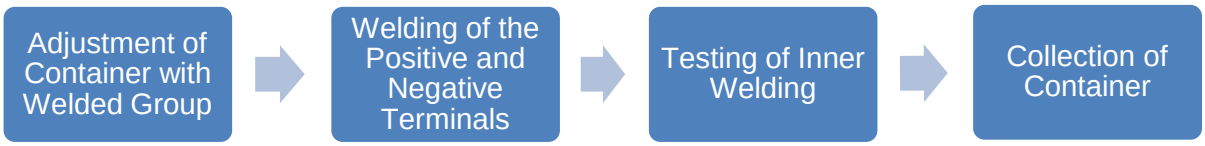
groups into cells 1, 3, and 5 and, then, into cells 2, 4, and 6. Figure 27 shows cast on strap (COS) machine.

Figure 27: Cast on Strap (COS) Machine

Inner Welding and Testing

Process flow of inner welding and testing is shown in Figure 28.

Figure 28: Flow Chart for Inner Welding Process



After COS welding, the cells are welded to make a link between them using inner welding machine having capacity of 50 batteries per hour with an electricity consumption of 6 KW. To achieve a battery voltage of 12 Volts, six cells must be connected in a series. Connections from cell to cell for automotive batteries are made within the polypropylene container through holes punched in the partitions. The positive strap terminal on one side and the negative strap terminal on the other side of the hole are pressed together and welded which make a series connection between cells. After the inner welding, inner welding testing is done using testing inner welding machine having a capacity of 2 batteries per minute with an electricity consumption of 2 KW. The testing of the welded cells is done to check for the strength of the weld. The activity is performed by a worker through a testing device which runs on pneumatic pressure. Figure 29 shows inner welding machine and testing inner welding machine.

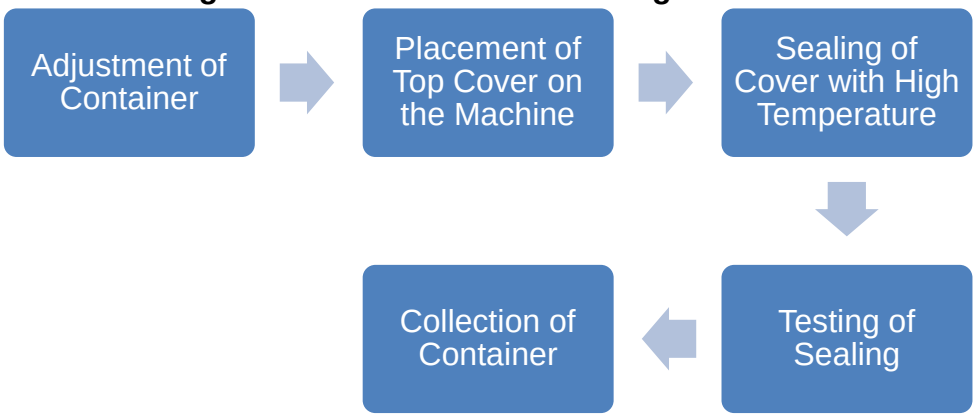
Figure 29: Inner Welding Machine and Testing Inner Welding Machine

	
Inner Welding Machine	**Testing Inner Welding Machine**

Sealing and Sealing Testing

Process flow of sealing and testing is shown in Figure 30.

Figure 30: Flow Chart for Sealing Process



After connections are made, the battery is sealed using top cover sealing machine having a capacity of 2 batteries per minute with an electricity consumption of 12 KW. The battery is shifted to the heat-sealing machine where the container and its cover is joined/sealed together by heating them up to certain temperature. After heat sealing, leak testing of the battery is done using top cover leakage testing machine having a capacity of 2 batteries per minute and an electricity consumption of 2 KW. A leak testing machine checks the batteries for leakage between the cells by applying and maintaining air pressure. The machine also checks the container outer walls for leakage. Figure 31 shows top cover sealing machine and top cover leakage testing machine.

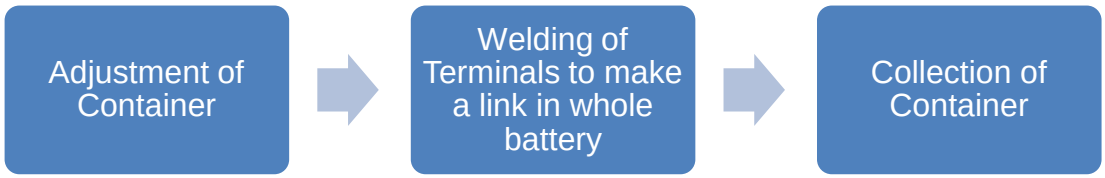
Figure 31: Top Cover Sealing Machine and Top Cover Leakage Testing Machine

	
Top Cover Sealing Machine	**Top Cover Leakage Testing Machine**

Battery Terminals Welding

Process flow of battery terminals welding is shown in Figure 32.

Figure 32: Flow Chart for Terminal Welding Process



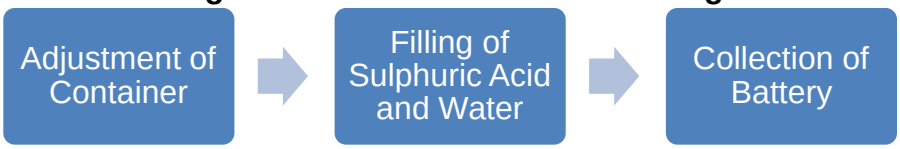
After sealing of batteries, two terminals are welded on the corners of the battery to make a link between the end to end corners of the battery. For this purpose, terminal welding machine having a capacity of 100 batteries per 8 hours with an electricity consumption of 3 KW is used. Figure 33 shows terminal welding machine.

Figure 33: Terminal Welding Machine

Acid Filling

Process flow of acid filling in the batteries is shown in Figure 34.

Figure 34: Flow Chart of Acid Filling



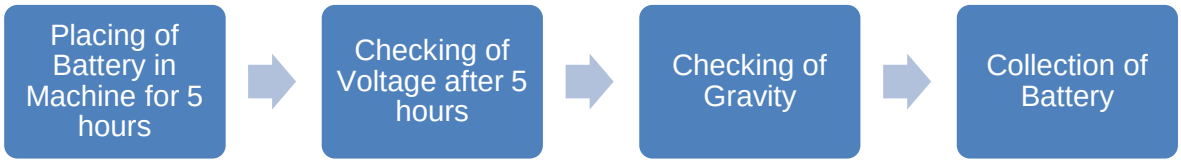
After the welding process, sulphuric acid and water is filled in a battery in a proportion of 33:67. The filling is done by using acid filling machine having a capacity of filling 2 batteries per minute with an electricity consumption of 2 KW shown in Figure 35.

Figure 35: Acid Filling Machine

Quality Testing

Process flow of quality testing of batteries is shown in Figure 36.

Figure 36: Flow Chart for Quality Testing



After manufacturing of the battery, a 5-hour test is done to check the quality of battery. In this process, the battery is discharged using High Rate Discharge Testing machine (having an electricity consumption of 3 KW). If the battery amperes reduce to 20% before 5 hours then the battery will not pass the quality test. This test is done randomly on one or two batteries from the produced batteries. With the help of hydrometer, the gravity of the sulphuric acid and the battery cell voltage is checked. After all these tests, the battery is cleared for packing. Figure 37 shows high rate discharge testing machine and Figure 38 shows hydrometer and multimeter.

Figure 37: High Rate Discharge Testing Machine

Figure 38: Hydrometer and Multi-meter

	
Hydrometer	**Multi-meter**

Packing and Delivery

Batteries are packed in individual carton boxes and stored in the finished goods store for shipment to the customers. The cartons are shipped to the customers through loader rickshaw. The sales are done on average credit period of 30 days.

5.2. Installed and Operational Capacities

The proposed production unit will have maximum annual capacity of producing 143,485 batteries which include 22,400 batteries of NS40 12V 30Ah (9 plates), 91,636 batteries of NS40 12V 38Ah (11 plates), 12,218 batteries of NS60 12V 45Ah (11 plates) and 17,231 batteries of NS70 12V 70Ah (13 plates).

During 1st year of operation, the proposed production unit is expected to attain 40% of its installed capacity to produce 57,393 batteries which include 8,960 batteries of NS40 12V 30Ah (9 plates), 36,654 batteries of NS40 12V 38Ah (11 plates), 4,887 batteries of NS60 12V 45Ah (11 plates) and 6,892 batteries of NS70 12V 70Ah (13 plates).

The operational capacity is assumed to increase at the rate of 5% per annum to reach a maximum of 90%.

Table 1 shows details of the installed and operational capacity in panels and plates.

Table 2 shows annual distribution of positive and negative plates between NS40 and NS60 batteries.

Table 3 shows annual distribution of positive and negative plates for NS70 batteries.

Table 4 shows per battery required combination of positive and negative plates.

Table 5 and Table 6 shows details of maximum annual capacity and operational capacity utilized for product-wise production of batteries during 1st year of operations.

Table 1: Installed and Operational Capacity in Panels & Plates

Particular	Time Distribution of Gravity Casting Machine (hours)	Machine Capacity per min (panel)	Capacity per day (no. of panel)	Plates in a panel	Total Plates Produced Per Day (no. of plates)	Total Plates Produced per year (no. of plates)
Positive Panel-90 gram	3	40	7,200	2	14,400	4,032,000
Negative Panel-75 gram	3		7,200		14,400	4,032,000
Positive Panel-136 gram	0.50		1,200		2,400	672,000
Negative Panel-120 gram	0.50		1,200		2,400	672,000
Total	**7**		**16,800**		**33,600**	**9,408,000**

Table 2: Positive & Negative Plates into NS40 & NS60 Batteries

Product	Total 90 gram Positive Plates Produced Per Year	Distribution of Plates for Each Battery Type	Battery Wise Positive Plates	Total 75 gram Negative Plates Produced Per Year	Distribution of Plates for Each Battery Type	Battery Wise Negative Plates
NS40-12V 30Ah (9 Plates)	4,032,000	10%	403,200	4,032,000	20%	806,400
NS40-12V 38Ah (11 Plates)		80%	3,225,600		70%	2,822,400
NS60-12V 45Ah (11 Plates)		10%	403,200		10%	403,200

Table 3: Positive & Negative Plates into NS70 Batteries

Product	Total 136 gram Positive Plates Produced Per Year	Distribution of Plates for Each Battery Type	Battery Wise Positive Plates	Total 120 gram Negative Plates Produced Per Year	Distribution of Plates for Each Battery Type	Battery Wise Negative Plates
NS70-12V 70Ah (13 Plates)	672,000	100%	672,000	672,000	100%	672,000

Table 4: Per Battery Required Combination of Positive & Negative Plates

Batteries	No. of Positive Plates in one cell (A)	Weight of Positive Plate in one cell (grams)	No. of Negative Plates in one cell (B)	Weight of Negative Plate in one cell (grams)	Total Plates in one cell (A+B)	Sections in one battery (cells) (C)	Total Positive Plates Required Per Battery (No.) (D=A*C)	Total Negative Plates Required Per Battery (No.) (E=B*C)	Total Plates in one Battery (D+E)
NS40-12V 30Ah (9 Plates)	4	90	5	75	9	6	24	30	54
NS40-12V 38Ah (11 Plates)	5	90	6	75	11		30	36	66
NS60-12V 45Ah (11 Plates)	5	90	6	75	11		30	36	66

NS70-12V 70Ah (13 Plates)	6	136	7	120	13		36	42	78

Table 5: Installed and Operational Capacity of NS40 & NS60 Batteries

Product	Total Positive Plates of 90 grams	Total Negative Plates of 75 grams	Total Required Plates	Total Plates in one Battery	No. of Battery Produced@ 100% Capacity	No. of Battery Produced@ 40% Capacity
Battery-12V 30Ah (9 Plates)	806,400	806,400	1,209,600	54	22,400	8,960
Battery-12V 38Ah (11 Plates)	2,822,400	2,822,400	6,048,000	66	91,636	36,654
Battery-12V 45Ah (11 Plates)	403,200	403,200	806,400	66	12,218	4,887
Total	**4,032,000**	**4,032,000**	**8,064,000**		**126,254**	**50,501**

Table 6: Installed and Operational Capacity of NS70 Battery

Product	Total Positive Plates of 136 grams	Total Negative Plates of 120 grams	Total Required Plates	Total Plates in one Battery	No. of Battery Produced@ 100% Capacity	No. of Battery Produced@ 40% Capacity
Battery-12V 70Ah (13 Plates)	672,000	672,000	1,344,000	78	17,231	6,892
Total	**672,000**	**672,000**	**1,344,000**		**17,231**	**6,892**

6. CRITICAL FACTORS

Before making the decision to invest in "Manufacturing Unit for Primary Batteries" one should carefully analyze the associated risk factors. The important considerations in this regard include:

- Technical knowhow and basic knowledge of the business
- Production of a quality product, specific to user need and satisfaction
- Availability of specialized workforce
- Up-to-date knowledge of market needs and new technology
- Selection of appropriate machinery, technology and human resources
- Rigorous supervision of the production process at every level
- Quality products and customer satisfaction

7. GEOGRAPHICAL POTENTIAL FOR INVESTMENT

A production unit for manufacturing unit for primary batteries, wet can be established in major cities of Pakistan such as Karachi, Lahore, Peshawar, Rawalpindi, Quetta, Islamabad, Faisalabad, Sialkot, Hyderabad, Gujranwala, Multan, Sukkur, etc. The reason behind selection of these cities is presence of car manufacturing units in these cities which are the primary customers of these products.

As per Pakistan Automotive Manufacturers Association (PAMA), in the year 2020-2021, total number of cars produced were 151,794, while total number of cars sold were 151,182. However, in the year 2019-2020, total number of cars produced were 94,325 while total number of cars sold were 96,455.[6] This shows a growth in the automotive industry which is a direct indictor of rising demand of batteries in Pakistan.

8. POTENTIAL TARGET CUSTOMERS/MARKETS

The potential target customers of the proposed business mainly comprise of OEMs (automotive industry) and the owners of cars (replacement market). Wet charged batteries have liquid electrolyte while dry charged batteries have paste electrolyte. Wet charged batteries required maintenance while dry charged batteries are maintenance free. Wet charged batteries are less expensive then dry charged batteries. The market for these batteries are OEMs and car owners as per the increasing consumption and production the car the demand for batteries are also increasing.

In Pakistan, there are almost 5 to 6 manufacturers in Pakistan which are AGS Battery, Phoenix Battery, Atlas Battery, Exide Pakistan, National Battery, Volta Batteries,

[6] https://www.pama.org.pk/wp-content/uploads/2021/10/historical-data.pdf

Osaka Batteries, etc. There are 23.59 million car owners in Pakistan which constitute the replacement market of the car manufacturers. As per State bank of Pakistan, in financial year 2020 and 2019, total imports[7] of batteries are PKR 6,331 million and PKR 7,774 million respectively whereas the total exports[8] of batteries were PKR 3,991 million and PKR 2,735 million. This data shows an increasing of demand of batteries in Pakistan which is due to the increasing consumption and production of cars in Pakistan.

The Pakistan battery market is expected to grow at a CAGR of more than 3%[9] through the period 2020-2025. Factors such as the growing automotive sector in the country and the low cost of lead acid batteries, are likely to drive the Pakistani battery market during the forecast period. Moreover, there has been a sharp increase in the sales of automobiles, which is expected to create a surge in the demand for lead acid batteries.

The major battery manufacturing brands are AGS, Exide, Osaka, Daewoo, Millat, etc. The growth of the batteries can be determined from the entry of new companies setting up their manufacturing units in Pakistan; such as Phoenix, Atlas, National, etc. The increasing demand of batteries is leading the manufacturers to produce more batteries.

9. PROJECT COST SUMMARY

A detailed financial model has been developed to analyze the commercial viability of the Manufacturing Unit for Primary Batteries. Various costs and revenue related assumptions along with results of the analysis are outlined in this section.

The projected Income Statement, Cash Flow Statement and Balance Sheet are attached as annexure 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 7 provides fixed and working capital requirements for establishment and operations of the Manufacturing Unit for Primary Batteries.

Table 7: Project Cost

Description of Costs	Amount (PKR)	Reference
Land	-	9.1.1
Building / Infrastructure	902,750	9.1.2
Machinery & equipment	66,798,760	9.1.3

[7] https://www.sbp.org.pk/publications/import-07-08/2020/3.pdf
[8] https://www.sbp.org.pk/departments/stats/Annual_Export_Receipt/FY20/3.pdf
[9] https://www.mordorintelligence.com/industry-reports/pakistan-battery-market

Furniture & fixtures	2,305,000	9.1.4
Office vehicles	9,253,000	9.1.5
Office equipment	2,873,000	9.1.6
Security against building	2,700,000	9.1.7
Pre-operating costs	2,198,387	9.1.8
Total Capital Cost	**87,030,897**	
Equipment spare part inventory	278,328	
Raw Material Inventory	23,027,740	
Upfront building rent	900,000	
Cash	5,000,000	
Working Capital	**29,206,068**	
Total Project Cost	**116,236,966**	

9.1.1. Land

The manufacturing unit for primary batteries, dry will be established in a rented building to avoid the high cost of land. Suitable location for setting up the proposed business can be easily found on rent. Therefore, no land cost has been added to the project cost. Total space requirement for the proposed unit has been estimated as 18,000 sq. feet (80 Marla). The breakup of the space requirement is provided in Table 8.

Table 8: Breakup of Space Requirement

Description	% Break-Up	Area Sq. Feet
Executive Office	1%	120
Production Area	61%	11,000
Store Area-Raw Material	7%	1,200
Store Room-Finished Goods	5%	900
Admin Area	10%	1800
Conference Room	3%	500
Quality Assurance Lab	5%	900
Mechanical Workshop	2%	300
Electrical Workshop	1%	200
Kitchen	1%	180
Washrooms	5%	900
Total	**100%**	**18,000**

9.1.2. Building

There will be no cost of building construction since the proposed business will be started in rented premises. However, there will be a renovation cost required to make the building usable for the business. The proposed project requires electricity load of around 332 KW for which an electricity connection under the three phase Industrial Supply Tariff will be required. Building rent of PKR 900,000 per month has been included in the operating cost. Table 9 provides details of building renovation cost.

Table 9: Building Renovation Cost

Cost Item	Unit of Measurement	Total Units	Cost/Unit (PKR)	Total Cost (PKR)
Paint Cost	Liter	296	500	148,050
Labour Cost	Sq.Feet	29,610	10	296,100
Tile Cost	Sq.Feet	3,000	110	330,000
Labour Cost-Tile	Sq.Feet	3,000	10	30,000
Curtain	Units	10	6,000	60,000
Blinds	Units	2	5,000	10,000
Glass Partitions	Sq.Feet	52	550	28,600
Total (PKR)				**902,750**

9.1.3. Machinery and Equipment Requirement

Table 10 provides details of machinery and equipment required for establishing the proposed business.

Table 10: Machinery and Equipment Requirement

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Gravity Casting Machine (Grid Casting Machine) (20 grids/min)	2	1,755,000	3,510,000
Lead Oxide Mill Including Furnace (5 Ton/24 hrs)	1	15,000,000	15,000,000
Paste Mixer Machine(2500kg/hour)	1	5,300,000	5,300,000
Double Side Pasting Machine (80 pcs/min)	1	3,500,000	3,500,000
Rectifier (4 Circuit)	1	1,600,000	1,600,000
Stainless Steel Trolley Tubs (500 liter)	6	30,000	180,000
Inert Gas Oven (4 trays with 3000 panels each/3 hours)	1	6,000,000	6,000,000
Cutting and Lug Brushing Machine (80 pcs/min)	1	1,755,000	1,755,000

Plate Enevlope and Stacking Machine (80 plates/min)	1	2,500,000	2,500,000
Hold Punching Machine (4pcs/min)	1	3,335,000	3,335,000
Cast on Strap (COS) Machine (100 battery/8 hrs)	1	1,760,000	1,760,000
Inner Welding Machine (50 battery/hr)	1	5,000,000	5,000,000
Testing Inner Welding Machine (2 battery/min)	1	1,400,000	1,400,000
Top Cover Sealling Machine (2 battery/min)	1	1,400,000	1,400,000
Top Cover Leakage Testing Machine (2 battery/min)	1	1,873,000	1,873,000
Terminal Welding Machine (100 battery/8 hrs)	1	1,750,000	1,750,000
Acid Filling Machine (2 battery/min)	1	1,510,000	1,510,000
RO Plant (500 liter/hour)	1	440,000	440,000
High Rate Discharge Testing Machine	1	3,500,000	3,500,000
Large Side Racks for Chamber	18	15,000	270,000
Diesel Generator (300 KVA)	1	2,600,000	2,600,000
Plate Curring and Drying Chamber (3 racks/day)	1	1,755,000	1,755,000
Containers and Other Consumables			392,700
Hydrometer	15	700	10,500
Multimeter	15	1,350	20,250
Portable Digital pH meter	15	2,000	30,000
Electric Portable Gantry Crane	1	300,000	300,000
Mechincal and Electrical Tool Kit			107,310
Total Cost			**66,798,760**

Table 11: Containers and Other Consumables

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Container-NS40 (9 Plates)	60	360	21,600
Container-NS40 (11 Plates)	250	430	107,500
Container-NS60 (13 Plates)	40	540	21,600
Container-NS70 (13 Plates)	50	840	42,000
Foundry Gloves	80	2,500	200,000
Total			**392,700**

Table 12: Tool Kit

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Electrical Tool Kit			
Wire strippers	1	780	780
Insulated screwdrivers	1	750	750
Insulated pliers	1	2,100	2,100
Electrical tape	1	60	60
Cable cutters	1	560	560
Spanners	1	160	160
Voltage tester	1	800	800
Safety knife	1	170	170
Hex keys	1	600	600
Claw Hammer	1	660	660
Tape Measure	1	350	350
Torch	1	300	300
Mechanical Tool Kit			
Screwdrivers	1	750	750
Wrenches	1	800	800
Pliers	1	2,100	2,100
Ratchet and Socket Sets	1	2,200	2,200
Allen Wrenches	1	2,890	2,890
Mechanical gloves	1	160	160
Multimeter	1	450	450
Digital Vernier Caliper	1	670	670
Manual Pallet Jack (Load Capacity 1000 kg)	3	30,000	90,000
Total			**107,310**

9.1.4. Furniture & Fixtures Requirement

Table 13 provides details of the furniture and fixture requirement of the project.

Table 13: Furniture and Fixtures Requirement

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Executive Table	1	40,000	40,000
Executive Chair	1	20,000	20,000
Conference Room Table	1	70,000	70,000
Conference Room Chairs	10	10,000	100,000
Staff Chairs	112	10,000	1,120,000
Staff Table	21	35,000	735,000
Visitor Chairs	15	10,000	150,000
Sofa Set	2	35,000	70,000
Total			**2,305,000**

9.1.5. Office Equipment Requirement

Details of office equipment required for the project is provided in Table 14.

Table 14: Office Equipment Requirement

Cost Item	No.	Unit Cost (PKR)	Total Cost (PKR)
Air Conditioners	9	90,000	810,000
Laptop	9	80,000	720,000
Desktop Computer	13	30,000	390,000
Printer	5	40,000	200,000
Water Dispenser	6	20,000	120,000
Security System (6 Cams , 2 MP)	48	2,000	96,000
DVR	6	12,000	72,000
LED/LCD TV	2	40,000	80,000
WI-FI/ Internet Connection	4	5,000	20,000
Ceiling Fan	51	5,000	255,000
Exhaust Fan	55	2,000	110,000
Total Cost			**2,873,000**

9.1.6. Office Vehicle Requirement

Details of office vehicle required for the project is provided in Table 15.

Table 15: Office Vehicle Requirement

Cost Item	Unit(s)	Unit Cost (PKR)	Registration fee @ 1%	Total Cost (PKR)
Mazda Truck	1	2,500,000	25,000	2,525,000
Car 1800 CC	1	4,500,000	45,000	4,545,000
Carry Van	1	1,750,000	17,500	1,767,500
Loader Rickshaw	1	250,000	2,500	252,500
Motorcycle	2	80,000	1,500	163,000
Total Cost				**9,253,000**

9.1.7. Security against Building

Details of security against building for the project are provided in Table 16.

Table 16: Security against Building

Cost Item	Months	Unit Cost (PKR)	Total Cost (PKR)
Security Against Building	3	900,000	2,700,000
Total (PKR)			**2,700,000**

9.1.8. Pre-Operating Cost

Details of pre-operating cost for the project are provided in Table 17.

Table 17: Pre-Operating Cost

Cost Item	Number / Months	Hiring before Year 0	Unit Cost (PKR)	Total Cost (PKR)
Production Supervisor-Electrical Engineer	1	1	150,000	150,000
Production Supervisor-Chemical Engineer	1	1	150,000	150,000
Shift Supervisors	1	1	70,000	70,000
Sales & Marketing Manager	1	1	150,000	150,000
Procurment Officer	1	1	50,000	50,000
Quality Manager	1	1	100,000	100,000
Quality Officer	1	1	50,000	50,000
Lab Attendents	1	1	45,000	45,000
Driver	1	1	30,000	30,000

Office Boy	1	1	22,000	22,000
Security Guard	1	1	22,000	22,000
Sweeper	1	1	22,000	22,000
Utilities expense				1,337,387
Total				**2,198,387**

9.2. Breakeven Analysis

Breakeven analysis is provided in Table 18.

Table 18: Breakeven Analysis

Particulars	Amount First Year (PKR)	Ratios
Sales	418,768,500	100%
Variable Cost	353,997,721	85%
Contribution	64,770,779	15%
Fixed Cost	48,001,185	11%
Breakeven		
Breakeven (No. of Batteries)		42,534
Breakeven Revenue (PKR)		310,346,497
Breakeven Capacity		30%

9.3. Revenue Generation

Table 19 provides details for revenue generation of the Manufacturing Unit for Primary Batteries during the first year of operations, based on 40% capacity utilization.

Table 19: Revenue Generation of NS40, NS60 & NS70 Batteries

Products	No. of Battery Produced Annually @ 100% Capacity	No. of Battery Produced Annually @ 40% Capacity	Quantity Sold (Initial Year @ 40% Capacity)	Price per Battery (PKR)	Revenue at 40% Capacity (PKR)
Battery-12V 30Ah (9 Plates)	22,400	8,960	8,773	6,000	52,638,000
Battery-12V 38Ah (11 Plates)	91,636	36,654	35,890	7,000	251,230,000
Battery-12V 45Ah (11 Plates)	12,218	4,887	4,785	8,500	40,672,500
Battery-12V 70Ah (13 Plates)	17,231	6,892	6,748	11,000	74,228,000
Total	**143,485**	**57,393**	**56,196**		**418,768,500**

9.4. Variable Cost Estimate

Variable costs of the project have been provided in detail in Table 20.

Table 20: Variable Cost Estimate

Description of Costs	Total Cost (PKR)
Raw Material Cost-NS40 12V 30Ah (9 Plates)	32,250,688
Raw Material Cost-NS40 12V 38Ah (11 Plates)	162,525,712
Raw Material Cost-NS60 12V 45Ah (11 Plates)	23,900,597
Raw Material Cost-NS70 12V 70Ah (13 Plates)	57,655,884
Gas Cost	3,920,000
Direct Utilities Cost	6,085,553
Direct Labor	39,600,000
Machinery Maintenance Cost	3,339,938
Fuel Cost-Generator	365,133
Communications expense (phone, mail, internet, etc.)	1,892,160
Office vehicles running expense	5,913,000
Office expenses (stationery, entertainment etc.)	1,892,160
Bad debt expense	14,656,898
Total Variable Cost (PKR)	**353,997,721**

Table 21: Raw Material Cost-NS40 12V 30Ah (9 Plates)

Product	Basis	Required Material per battery	Cost Per Unit (PKR)	Cost Per Battery (PKR)
Container-NS 40	No.	1	320	320
Valve	No.	6	10	60
Postive Grid **(Table 22)**	No.	24	41	994
Negative Grid **(Table 22)**	No.	30	35	1,035
Other Material Cost of Grid*	15% of Total Cost of Positive and Negative Grid			304
Paste Mixture for Both Grids	2.5 times of lead for plate grouping			345

Charging Stage-Sulphuric Acid	Liter	0.036	40	1
Separaters	No.	48	6	288
Lead for Plate Grouping	kg	0.30	460	138
Terminal	No.	2	58	116
Final Stage-Sulphuric Acid	Liter	0.12	40	5
Packing Carton	No	1	70	70
Total Cost Per Battery (PKR)				**3,676**

Table 22: Cost per Grid for NS40 12V 30Ah (9 Plates)

Product	Weight of Lead in a grid (grams)	Cost of Lead per kg (PKR)	Cost of Lead per gram(PKR)	Cost of grid (PKR)
Postive Grid	90	460	0.46	41
Negative Grid	75	460	0.46	35

*As per the market research and information, a grid contains around 85% of lead in it and 15% of other materials. These other materials are treated as business secret/business proprietary information of the company and were not disclosed during the primary research and were also not available from secondary, because these formulations are prepared by the technical experts at the time of setting up the battery manufacturing plant. Therefore, for calculating cost per grid, the cost of lead is taken as 85% of cost per grid, while for the cost calculation of other materials 15% of the sum of cost of positive and negative grid is assumed as the cost of other materials.

Table 23: Raw Material Cost-NS40 12V 38Ah (11 Plates)

Product	Basis	Required Material per battery	Cost Per Unit (PKR)	Cost Per Battery (PKR)
Container-NS 40	No.	1	360	360
Valve	No.	6	10	60
Postive Grid **(Table 24)**	No.	30	41	1,242
Negative Grid **(Table 24)**	No.	36	35	1,242

Other Material Cost of Grid*	15% of Total Cost of Positive and Negative Grid			373
Paste Mixture for Both Grids (5%)	2.5 of lead for plate grouping			414
Charging Stage-Sulphuric Acid	Liter	0.036	40	1
Separaters	No.	60	8	480
Lead for Plate Grouping	kg	0.36	460	166
Terminal	No.	2	58	116
Final Stage-Sulphuric Acid	Liter	0.12	40	5
Packing Carton	No	1	70	70
Total Cost Per Battery (PKR)				**4,528**

Table 24: Cost per Grid for NS40 12V 38Ah (11 Plates)

Product	Weight of Lead in a grid (grams)	Cost of Lead per kg (PKR)	Cost of Lead per gram(PKR)	Cost of grid (PKR)
Postive Grid	90	460	0.46	41
Negative Grid	75	460	0.46	35

*As per the market research and information, a grid contains around 85% of lead in it and 15% of other materials. These other materials are treated as business secret/business proprietary information of the company and were not disclosed during the primary research and were also not available from secondary, because these formulations are prepared by the technical experts at the time of setting up the battery manufacturing plant. Therefore, for calculating cost per grid, the cost of lead is taken as 85% of cost per grid, while for the cost calculation of other materials 15% of the sum of cost of positive and negative grid is assumed as the cost of other materials.

Table 25: Raw Material Cost-NS60 12V 45Ah (13 Plates)

Product	Basis	Required Material per battery	Cost Per Unit (PKR)	Cost Per Battery (PKR)
Container-NS 60	No.	1	440	440
Valve	No.	6	10	60
Postive Grid **(Table 26)**	No.	30	41	1,242
Negative Grid **(Table 26)**	No.	36	35	1,242
Other Material Cost of Grid*	15% of Total Cost of Positive and Negative Grid			373
Paste Mixture for Both Grids	2.5 of lead for plate grouping			518
Charging Stage-Sulphuric Acid	Liter	0.045	40	2
Separaters	No.	72	10	720
Lead for Plate Grouping	kg	0.45	460	207
Terminal	No.	2	58	116
Final Stage-Sulphuric Acid	Liter	0.15	40	6
Packing Carton	No	1	70	70
Total Cost Per Battery (PKR)				**4,995**

Table 26: Cost per Grid for NS60 12V 45Ah (11 Plates)

Product	Weight of Lead in a grid (grams)	Cost of Lead per kg (PKR)	Cost of Lead per gram(PKR)	Cost of grid (PKR)
Postive Grid	90	460	0.46	41
Negative Grid	75	460	0.46	35

*As per the market research and information, a grid contains around 85% of lead in it and 15% of other materials. These other materials are treated as business secret/business proprietary information of the company and were not disclosed during the primary research and were also not available from secondary, because these

formulations are prepared by the technical experts at the time of setting up the battery manufacturing plant. Therefore, for calculating cost per grid, the cost of lead is taken as 85% of cost per grid, while for the cost calculation of other materials 15% of the sum of cost of positive and negative grid is assumed as the cost of other materials.

Table 27: Raw Material Cost-NS70 12V 70Ah (13 Plates)

Product	Basis	Required Material per battery	Cost Per Unit (PKR)	Cost Per Battery (PKR)
Container-NS 70	No.	1	740	740
Valve	No.	6	10	60
Postive Grid **(Table 28)**	No.	36	63	2,252
Negative Grid **(Table 28)**	No.	42	55	2,318
Other Material Cost of Grid*	15% of Total Cost of Positive and Negative Grid			686
Paste Mixture for Both Grids	2.5 of lead for plate grouping			805
Charging Stage-Sulphuric Acid	Liter	0.075	40	3
Separaters	No.	72	16	1,152
Lead for Plate Grouping	kg	1	460	322
Terminal	No.	2	58	116
Final Stage-Sulphuric Acid	Liter	0.25	40	10
Packing Carton	No	1	80	80
Total Cost Per Battery (PKR)				**8,544**

Table 28:Cost per Grid for NS70 12V 70Ah (13 Plates)

Product	Weight of Lead in a grid (grams)	Cost of Lead per kg (PKR)	Cost of Lead per gram(PKR)	Cost of grid (PKR)
Postive Grid	136	460	0.46	63
Negative Grid	120	460	0.46	55

*As per the market research and information, a grid contains around 85% of lead in it and 15% of other materials. These other materials are treated as business secret/business proprietary information of the company and were not disclosed during the primary research and were also not available from secondary, because these formulations are prepared by the technical experts at the time of setting up the battery manufacturing plant. Therefore, for calculating cost per grid, the cost of lead is taken as 85% of cost per grid, while for the cost calculation of other materials 15% of the sum of cost of positive and negative grid is assumed as the cost of other materials.

Table 29: Gas Cost

Cost Item	Gas Consumption of Machine (kg/hr)	Working Hours for Machine	Consumption per day (kg)	Total Working Days	Consumption per year (kg)	Unit Cost per kg (PKR)	Total Cost per Year (PKR)
Gas Consumption -Inert Gas Oven	8	7	56	280	15,680	250	3,920,000
Total (PKR)							**3,920,000**

Table 30: Direct Labor

Post	No.of Employees	Monthly Salary (PKR)	Annual Salary (PKR)
Production Manager	1	200,000	2,400,000
Production Supervisor-Electrical Enginer	2	150,000	3,600,000
Production Supervisor-Chemical Engineer	2	150,000	3,600,000
Shift Supervisor	2	70,000	1,680,000
Gravity Casting Machine-Skilled	3	35,000	1,260,000
Gravity Casting Machine-UnSkilled	3	25,000	900,000
Lead Oxide Mill-Skilled	3	35,000	1,260,000
Lead Oxide Mill-UnSkilled	3	25,000	900,000
Paste Mixer Machine-Skilled	2	35,000	840,000
Paste Mixer Machine-UnSkilled	1	25,000	300,000

Pasting Machine-Skilled	3	35,000	1,260,000
Pasting Machine-Unskilled	3	25,000	900,000
Chamber-Skilled	2	35,000	840,000
Chamber-Unskilled	2	25,000	600,000
Charging Phase-Skilled	3	35,000	1,260,000
Charging Phase-Unskilled	2	25,000	600,000
Oven-Skilled	2	35,000	840,000
Oven-UnSkilled	1	25,000	300,000
Cutting Machine-Skilled	2	35,000	840,000
Cutting Machine-UnSkilled	2	25,000	600,000
PE Enveloping Machine-Skilled	3	35,000	1,260,000
PE Enveloping Machine-UnSkilled	3	25,000	900,000
COS Machine-Skilled	2	35,000	840,000
COS Machine-UnSkilled	1	25,000	300,000
Inner Welding and Testing-Skilled	2	35,000	840,000
Inner Welding and Testing-UnSkilled	2	35,000	840,000
Terminal Welding-Skilled	2	35,000	840,000
Terminal Welding-UnSkilled	1	25,000	300,000
Sealing and Sealing Testing-Skilled	2	35,000	840,000
Sealing and Sealing Testing-UnSkilled	1	25,000	300,000
Acid Filling Machine-Skilled	3	35,000	1,260,000
Acid Filling Machine -UnSkilled	3	25,000	900,000
Packing-UnSkilled	10	25,000	3,000,000
Loading/Unloading-UnSkilled	8	25,000	2,400,000
Total	**87**		**39,600,000**

Table 31: Machinery Maintenance Cost

Cost Item	Machinery Cost (PKR)	Rate	Total Cost (PKR)
Maintenance Cost	66,798,760	5%	3,339,938
Total (PKR)			**3,339,938**

Table 32: Variable Cost Assumptions

Description of Costs	Rate	Rationale
Fuel Cost-Generator	6%	of Direct Utilities
Communications expense (phone, mail, internet, etc.)	8%	of management expense
Office vehicles running expense	25%	of management expense5
Office expenses (stationery, entertainment etc.)	8%	of management expense
Bad debt expense	3.5%	of revenue

9.5. Fixed Cost Estimate

Details of fixed cost for the project are provided in Table 33.

Table 33: Fixed Cost Estimate

Description of Costs	Amount (PKR)
Management Staff	23,652,000
Building rental expense	10,800,000
Indirect Utilities	834,768
Depreciation expense	12,274,739
Amortization of pre-operating costs	439,677
Total Fixed Cost	**48,001,185**

Table 34: Management Staff

Post	No.of Employees	Monthly Salary (PKR)	Annual Salary (PKR)
Accounts Manager	1	80,000	960,000
Account Assistant	2	40,000	960,000
Admin and HR Manager	1	80,000	960,000
Admin and HR Officer	2	40,000	960,000

Sales and Marketing Manager	1	150,000	1,800,000
Sales & Marketing Officer	5	50,000	3,000,000
Procurement Manager	1	150,000	1,800,000
Procurment Officer	1	50,000	600,000
Raw Material Store Incharge	2	50,000	1,200,000
Finished Goods Store Incharge	2	50,000	1,200,000
Storekeeper	1	45,000	540,000
Quality Manager	1	100,000	1,200,000
Quality Officer	2	50,000	1,200,000
Lab Attendents	2	45,000	1,080,000
Driver	4	30,000	1,440,000
Office Boy	3	22,000	792,000
Security Guard	12	22,000	3,168,000
Sweeper	3	22,000	792,000
Total	**46**		**23,652,000**

Table 35: Fixed Cost Assumption

Description of Costs	Rate	Rationale
Depreciation		
Building	10%	of Cost
Machinery and Equipment	15%	of Cost
Office Equipment/Office Vehicle/Furniture and Fixture	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 36.

Table 36: Financial Feasibility Analysis

Description	Project
IRR	39%
NPV (PKR)	184,008,877
Payback Period (years)	3.84
Projection Years	10

Discount Rate used for NPV	20%

9.7. Financial Feasibility with 50% Debt Financing

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 37.

Table 37: Financial Feasibility Debt Financing

Description	Project
IRR	37%
NPV (PKR)	306,213,873
Payback Period (years)	4.09
Projection Years	10
Discount Rate used for NPV	14%

9.8. Human Resource Requirement

For the 1st year of operations, the human resource requirements are projected in Table 38.

Table 38: Human Resource Requirement

Post	No.of Employees	Monthly Salary (PKR)	Annual Salary (PKR)
Production Manager	1	200,000	2,400,000
Production Supervisor-Electrical Enginer	2	150,000	3,600,000
Production Supervisor-Chemical Engineer	2	150,000	3,600,000
Shift Supervisor	2	70,000	1,680,000
Gravity Casting Machine Operator-Skilled	3	35,000	1,260,000
Gravity Casting Machine Operator-UnSkilled	3	25,000	900,000
Lead Oxide Mill Operator-Skilled	3	35,000	1,260,000
Lead Oxide Mill Operator-UnSkilled	3	25,000	900,000
Paste Mixer Machine Operator-Skilled	2	35,000	840,000

Paste Mixer Machine Operator-UnSkilled	1	25,000	300,000
Pasting Machine Operator-Skilled	3	35,000	1,260,000
Pasting Machine Operator-UnSkilled	3	25,000	900,000
Chamber Operator-Skilled	2	35,000	840,000
Chamber Operator-UnSkilled	2	25,000	600,000
Charging Phase Operator-Skilled	3	35,000	1,260,000
Charging Phase Operator-Unskilled	2	25,000	600,000
Oven Operator-Skilled	2	35,000	840,000
Oven Operator-UnSkilled	1	25,000	300,000
Cutting Machine Operator-Skilled	2	35,000	840,000
Cutting Machine Operator-UnSkilled	2	25,000	600,000
PE Enveloping Machine Operator-Skilled	3	35,000	1,260,000
PE Enveloping Machine Operator-UnSkilled	3	25,000	900,000
COS Machine Operator-Skilled	2	35,000	840,000
COS Machine Operator-UnSkilled	1	25,000	300,000
Inner Welding and Testing Operator-Skilled	2	35,000	840,000
Inner Welding and Testing Operator-UnSkilled	2	35,000	840,000
Terminal Welding Operator-Skilled	2	35,000	840,000
Terminal Welding Operator-UnSkilled	1	25,000	300,000
Sealing and Sealing Testing Operator-Skilled	2	35,000	840,000
Sealing and Sealing Testing Operator-UnSkilled	1	25,000	300,000
Acid Filling Machine Operator-Skilled	3	35,000	1,260,000
Acid Filling Machine Operator - UnSkilled	3	25,000	900,000
Packing Operator-UnSkilled	10	25,000	3,000,000

Loading/Unloading Operator-UnSkilled	8	25,000	2,400,000
Accounts Manager	1	80,000	960,000
Account Assistant	2	40,000	960,000
Admin and HR Manager	1	80,000	960,000
Admin and HR Officer	2	40,000	960,000
Sales and Marketing Manager	1	150,000	1,800,000
Sales & Marketing Officer	5	50,000	3,000,000
Procurement Manager	1	150,000	1,800,000
Procurment Officer	1	50,000	600,000
Raw Material Store Incharge	2	50,000	1,200,000
Finished Goods Store Incharge	2	50,000	1,200,000
Storekeeper	1	45,000	540,000
Quality Manager	1	100,000	1,200,000
Quality Officer	2	50,000	1,200,000
Lab Attendents	2	45,000	1,080,000
Driver	4	30,000	1,440,000
Office Boy	3	22,000	792,000
Security Guard	12	22,000	3,168,000
Sweeper	3	22,000	792,000
Total	**133**		**63,252,000**

10. CONTACT DETAILS

Details of suppliers of machinery and equipment for the proposed business are provided in Table 39.

Table 39: Contact Details

Name of Supplier / Manufacturer	City/ Country	Contact No.	Email Address/ Website
Better Technology Group Limited (China)	Machinery & Raw Material	+86-592-6027185	https://www.better-tech.net/
Sovema Group (Italy)	Machinery	+39 045 6335711	https://www.sovemagroup.com/
Devaki Engineering (India)	Machinery	+91 80 2836 0285	http://www.devakiengineering.com/
Zesar Technology (Turkey)	Machinery	+90 (216) 540 05 79	https://www.zesartech.com/
Wirtz Manufacturing Co Inc (US)	Machinery	+810.987.7600	https://www.wirtzusa.com/
Gang Lih Industrial Co,.Ltd (Taiwan)	Machinery	+886-6-5993991	http://www.battery-machine.com.tw/
TC Machinery Co, Ltd (Taiwan)	Machinery	+886-2-25410850	https://www.tcmac.com.tw/
Shingania Services (India)	Machinery	+91-20-27472892	http://www.shinganiabatteries.com/
Nantong Zhenhuan Trade Co., Ltd (China)	Machinery	+86-13962724758	https://www.zhenhuan-machine.com/
Wuhan Zhongyuetong Metal Material Co., Ltd (China)	Raw Material	+86-18171233163	https://www.zytmetal.com/index.html
Yuntai Metal Supplier (China)	Raw Material	+86 310 5601687	https://www.hbytmetal.com/
Evergrow Industries (Egypt)	Raw Material	+20235371091	https://evergrowfert.com/
Galaxy Pigments Private Limited (India)	Pure Lead	+91-8048720457	https://www.indiamart.com/
M/S PSR Metals Private Limited (India)	Lead Alloy	+91-8046064264	https://www.indiamart.com/

11. USEFUL LINKS

Table 40: 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
Pakistan Plastic Manufacturers Association	https://www.pakplas.com.pk/
Pakistan Electronics Manufacturers Association (PEMA)	http://pema.org.pk/
Government of Punjab	www.punjab.gov.pk
Government of Sindh	sindh.gov.pk/
Government of Balochistan	balochistan.gov.pk/
Government of KPK	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/

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
Revenue										
Revenue-NS40 12V 30Ah (9 Plates)	52,638,000	66,416,428	81,243,407	98,374,502	118,148,966	140,898,092	167,019,411	196,995,477	231,301,262	270,503,412
Revenue-NS40 12V 38Ah (11 Plates)	251,230,000	316,977,691	387,734,895	469,544,368	563,885,323	672,439,383	797,172,043	940,175,796	1,103,922,763	1,291,076,728
Revenue-NS60 12V 45Ah (13 Plates)	40,672,500	51,315,832	62,783,677	76,017,691	91,292,392	108,885,784	129,065,950	152,222,265	178,714,484	209,038,188
Revenue-NS70 12V 70Ah (13 Plates)	74,228,000	93,662,331	114,578,136	138,755,838	166,624,063	198,696,970	235,558,249	277,805,854	326,195,910	381,487,195
Total Revenue	**418,768,500**	**528,372,282**	**646,340,116**	**782,692,399**	**939,950,745**	**1,120,920,229**	**1,328,815,653**	**1,567,199,392**	**1,840,134,419**	**2,152,105,522**
Cost of sales										
Raw Material Cost-NS40 12V 30Ah (9 Plates)	32,250,688	40,692,571	49,776,888	60,272,910	72,388,493	86,326,617	102,330,845	120,696,830	141,715,585	165,734,284
Raw Material Cost-NS40 12V 38Ah (11 Plates)	162,525,712	205,059,208	250,833,458	303,757,643	364,788,693	435,014,485	515,706,538	608,218,526	714,149,714	835,223,357
Raw Material Cost-NS60 12V 45Ah (11 Plates)	23,900,597	30,154,994	36,893,905	44,670,678	53,646,632	63,985,130	75,843,707	89,451,176	105,018,939	122,838,217
Raw Material Cost-NS70 12V 70Ah (13 Plates)	57,655,884	72,751,313	88,997,463	107,777,260	129,423,635	154,335,957	182,967,600	215,783,020	253,369,530	296,316,502
Gas Cost	3,920,000	4,314,613	4,748,951	5,227,012	5,753,198	6,332,353	6,969,810	7,671,438	8,443,696	9,293,695
Direct Utilities Cost	6,085,553	7,464,919	9,043,888	10,847,269	12,902,728	15,241,096	17,896,721	20,907,844	24,317,031	28,171,635
Direct Labor	39,600,000	43,441,200	47,654,996	52,277,531	57,348,452	62,911,251	69,013,643	75,707,966	83,051,639	91,107,648
Machinery Maintenance Cost	3,339,938	3,676,158	4,046,225	4,453,545	4,901,869	5,395,323	5,938,453	6,536,257	7,194,240	7,918,460
Fuel Cost-Generator	365,133	488,370	645,136	843,703	1,094,266	1,409,387	1,804,513	2,298,627	2,915,025	3,682,276
Total cost of sales	329,643,504	408,043,346	492,640,911	590,127,551	702,247,966	830,951,601	978,471,829	1,147,271,683	1,340,175,397	1,560,286,074
Gross Profit	89,124,996	120,328,936	153,699,205	192,564,849	237,702,779	289,968,628	350,343,823	419,927,709	499,959,022	591,819,448
General administration & selling expenses										
Management Staff	23,652,000	25,946,244	28,463,030	31,223,944	34,252,666	37,575,175	41,219,967	45,218,303	49,604,479	54,416,113
Building rental expense	10,800,000	11,880,000	13,068,000	14,374,800	15,812,280	17,393,508	19,132,859	21,046,145	23,150,759	25,465,835
Indirect Utilities	834,768	910,204	992,456	1,082,141	1,179,930	1,286,557	1,402,818	1,529,586	1,667,810	1,818,524
Communications expense (phone, mail, internet,	1,892,160	2,075,700	2,277,042	2,497,915	2,740,213	3,006,014	3,297,597	3,617,464	3,968,358	4,353,289
Office vehicles running expense	5,913,000	6,508,242	7,163,405	7,884,521	8,678,230	9,551,838	10,513,390	11,571,738	12,736,626	14,018,780
Office expenses (stationery, entertainment etc.)	1,892,160	2,075,700	2,277,042	2,497,915	2,740,213	3,006,014	3,297,597	3,617,464	3,968,358	4,353,289
Depreciation expense	12,274,739	12,274,739	12,274,739	12,274,739	12,274,739	12,274,739	8,213,251	22,670,946	22,670,946	22,670,946
Amortization of pre-operating costs	439,677	439,677	439,677	439,677	439,677	-	-	-	-	-
Bad debt expense	14,656,898	18,493,030	22,621,904	27,394,234	32,898,276	39,232,208	46,508,548	54,851,979	64,404,705	75,323,693
Subtotal	72,355,402	80,603,535	89,577,296	99,669,887	111,016,225	123,326,052	133,586,027	164,123,625	182,172,041	202,420,470
Operating Income	16,769,594	39,725,401	64,121,909	92,894,962	126,686,554	166,642,576	216,757,796	255,804,083	317,786,981	389,398,978
Other income (interest on cash)	-	-	-	-	-	-	-	-	-	-
Other income 2										
Gain / (loss) on sale of machinery & equipment	-	-	-	-	-	-	16,699,690	-	-	
Gain / (loss) on sale of office equipment	-	-	-	-	-	-	718,250	-	-	
Gain / (loss) on sale of office vehicles	-	-	-	-	-	-	2,313,250	-	-	
Earnings Before Interest & Taxes	16,769,594	39,725,401	64,121,909	92,894,962	126,686,554	166,642,576	236,488,986	255,804,083	317,786,981	389,398,978
Subtotal	-	-	-	-	-	-	-	-	-	-
Earnings Before Tax	16,769,594	39,725,401	64,121,909	92,894,962	126,686,554	166,642,576	236,488,986	255,804,083	317,786,981	389,398,978
Tax	5,234,606	11,520,366	18,595,354	26,939,539	36,739,101	48,326,347	68,581,806	74,183,184	92,158,224	112,925,704
NET PROFIT/(LOSS) AFTER TAX	**11,534,987**	**28,205,034**	**45,526,556**	**65,955,423**	**89,947,453**	**118,316,229**	**167,907,180**	**181,620,899**	**225,628,756**	**276,473,275**

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	5,000,000	5,959,413	12,677,930	20,891,465	28,714,349	35,029,285	38,502,808	135,004,276	288,305,278	473,394,664	507,907,913
Accounts receivable	-	14,956,018	18,870,439	23,083,576	27,953,300	33,569,669	40,032,865	47,457,702	55,971,407	65,719,086	76,860,912
Equipment spare part inventory	278,328	335,654	404,786	488,157	588,700	709,951	856,175	1,032,517	1,245,178	1,501,639	-
Raw material inventory	23,027,740	31,979,694	43,057,733	57,390,292	75,858,980	99,570,627	129,920,683	168,652,507	217,958,960	280,571,652	-
Finished goods inventory		6,875,111	8,506,169	10,265,784	12,293,545	14,625,408	17,302,396	20,379,959	23,901,938	27,915,456	32,507,559
Pre-paid building rent	900,000	990,000	1,089,000	1,197,900	1,317,690	1,449,459	1,594,405	1,753,845	1,929,230	2,122,153	-
Total Current Assets	29,206,068	61,095,890	84,606,057	113,317,174	146,726,564	184,954,400	228,209,334	374,280,805	589,311,990	851,224,650	617,276,384
Fixed assets											
Land	-	-	-	-	-	-	-	-	-	-	-
Building Infrastructure Renovation	902,750	812,475	722,200	631,925	541,650	451,375	361,100	270,825	180,550	90,275	-
Machinery & equipment	66,798,760	56,778,946	46,759,132	36,739,318	26,719,504	16,699,690	6,679,876	126,624,442	107,630,776	88,637,110	69,643,443
Furniture & fixtures	2,305,000	1,959,250	1,613,500	1,267,750	922,000	576,250	230,500	4,369,383	3,713,975	3,058,568	2,403,160
Office vehicles	9,253,000	7,865,050	6,477,100	5,089,150	3,701,200	2,313,250	925,300	14,097,892	11,983,208	9,868,524	7,753,841
Office equipment	2,873,000	2,442,050	2,011,100	1,580,150	1,149,200	718,250	287,300	5,446,089	4,629,176	3,812,263	2,995,349
Security against building	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000
Total Fixed Assets	84,832,510	72,557,771	60,283,032	48,008,293	35,733,554	23,458,815	11,184,076	153,508,632	130,837,686	108,166,740	85,495,794
Intangible assets											
Pre-operation costs	2,198,387	1,758,710	1,319,032	879,355	439,677	-	-	-	-	-	-
Total Intangible Assets	2,198,387	1,758,710	1,319,032	879,355	439,677	-	-	-	-	-	-
TOTAL ASSETS	**116,236,966**	**135,412,371**	**146,208,122**	**162,204,822**	**182,899,796**	**208,413,215**	**239,393,410**	**527,789,437**	**720,149,676**	**959,391,390**	**702,772,177**
Liabilities & Shareholders' Equity											
Current liabilities											
Accounts payable		7,640,418	10,101,145	13,269,573	17,335,977	22,539,096	29,179,753	37,633,602	48,372,942	61,985,899	1,696,813
Total Current Liabilities	-	7,640,418	10,101,145	13,269,573	17,335,977	22,539,096	29,179,753	37,633,602	48,372,942	61,985,899	1,696,813
Other liabilities											
Shareholders' equity											
Paid-up capital	116,236,966	116,236,966	116,236,966	116,236,966	116,236,966	116,236,966	116,236,966	228,271,964	228,271,964	228,271,964	228,271,964
Retained earnings		11,534,987	19,870,011	32,698,283	49,326,853	69,637,153	93,976,691	261,883,871	443,504,770	669,133,527	472,803,401
Total Equity	116,236,966	127,771,953	136,106,976	148,935,249	165,563,819	185,874,119	210,213,657	490,155,835	671,776,734	897,405,490	701,075,364
TOTAL CAPITAL AND LIABILITIES	**116,236,966**	**135,412,371**	**146,208,122**	**162,204,822**	**182,899,796**	**208,413,215**	**239,393,410**	**527,789,437**	**720,149,676**	**959,391,390**	**702,772,177**

12.3. Cash Flow Statement

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		11,534,987	28,205,034	45,526,556	65,955,423	89,947,453	118,316,229	167,907,180	181,620,899	225,628,756	276,473,275
Add: depreciation expense		12,274,739	12,274,739	12,274,739	12,274,739	12,274,739	12,274,739	8,213,251	22,670,946	22,670,946	22,670,946
amortization of pre-operating costs		439,677	439,677	439,677	439,677	439,677	-	-	-	-	-
Accounts receivable		(14,956,018)	(3,914,421)	(4,213,137)	(4,869,724)	(5,616,369)	(6,463,196)	(7,424,837)	(8,513,705)	(9,747,680)	(11,141,825)
Finished goods inventory		(6,875,111)	(1,631,058)	(1,759,615)	(2,027,761)	(2,331,863)	(2,676,989)	(3,077,562)	(3,521,979)	(4,013,518)	(4,592,103)
Equipment inventory	(278,328)	(57,326)	(69,133)	(83,371)	(100,543)	(121,251)	(146,224)	(176,341)	(212,661)	(256,461)	1,501,639
Raw Material Iventory	(23,027,740)	(8,951,954)	(11,078,039)	(14,332,559)	(18,468,688)	(23,711,647)	(30,350,056)	(38,731,824)	(49,306,453)	(62,612,692)	280,571,652
Pre-paid building rent	(900,000)	(90,000)	(99,000)	(108,900)	(119,790)	(131,769)	(144,946)	(159,440)	(175,385)	(192,923)	2,122,153
Accounts payable		7,640,418	2,460,727	3,168,428	4,066,404	5,203,119	6,640,658	8,453,849	10,739,340	13,612,958	(60,289,087)
Cash provided by operations	(24,206,068)	959,413	26,588,528	40,911,818	57,149,737	75,952,089	97,450,215	135,004,276	153,301,003	185,089,386	507,316,650
Financing activities											
Issuance of shares	116,236,966	-	-	-	-	-	-	112,034,998	-	-	-
Cash provided by / (used for) financing activities	116,236,966	-	-	-	-	-	-	112,034,998	-	-	-
Investing activities											
Capital expenditure	(87,030,897)	-	-	-	-	-	-	(150,537,807)	-	-	-
Cash (used for) / provided by investing activities	(87,030,897)	-	-	-	-	-	-	(150,537,807)	-	-	-
NET CASH	5,000,000	959,413	26,588,528	40,911,818	57,149,737	75,952,089	97,450,215	96,501,467	153,301,003	185,089,386	507,316,650

13. KEY ASSUMPTIONS

13.1. Operating Cost Assumptions

Table 41: Operating Cost Assumptions

Description	Details
Furniture and fixture depreciation	15%
Vehicle depreciation	15%
Office equipment depreciation	15%
Inflation rate	10.1%
Wage growth rate	9.7%
Gas price growth rate	9.0%
Electricity price growth rate	9.0%
Office equipment price growth rate	9.6%
Office vehicle price growth rate	6.2%

13.2. Revenue Assumptions

Table 42: Revenue Assumptions

Description	Details
Sale price growth rate	10.1%
Initial capacity utilization	40%
Capacity growth rate	5%
Maximum capacity utilization	90%

13.3. Financial Assumptions

Table 43: Financial Assumptions

Description	Details
Project life (Years)	10
Debt: Equity	0:100
Discount Rate used for NPV (100% Equity)	20%

13.4. Debt-Related Assumption

Table 44: Debt-Related Assumption

Description of Cost	Details
Project Life (Years)	10
Debt: Equity	50:50
Discount Rate	14%
Debt Tenure	5 years
Grace Period	1 Year
Interest Rate (KIBOR+3%)	11.3%

13.5. Cash Flow Assumption

Table 45: Cash Flow Assumption

Description	Days
Accounts receivable cycle	10
Accounts payable cycle	60

Small and Medium Enterprises Development Authority

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