UNIVERSITY OF COCHIN

B. Tech. Course

In Rubber Processing And Technology

PROJECT REPORT ON

A SMALL SCALE UNIT IN KERALA MANUFACTURING EBONITE BATTERY CONTAINERS

DISSERTATION REPORT

Submitted by

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SECTION A. INTRODUCTION

Product description and Innovation.

The electricity used in the normal running of a Commercial vehicle is derived from a generator or dynama. But since this is capable of providing electricity only when the engine is running it is necessary to provide a standbye sources for such items as parking lights and also for starting. This invariably takes the form of a storage battery of the lead acid type. Accumulators are absolutely essential in lighting and cooling systems in of railways, propulsion of barges and boats starting of generators of ships etc. Loud speakers emergency lighting systems, the telephone system and laboratories also make use of accumulator cells.

Accumulator is a device by which electrical energy is stored in the cell in the form of chemical energy, which is reconverted into electrical energy when a current is drawn from the cell. It consists of lead electrodes dipped in Sulphuric acid, the positive electrodes being coated with red lead and the negative electrodes by litharge. When these are connected externally an electric current flows. The discharged accumulator can be recharged by sending a current in the reversed direction whereby chemical actions are reversed, storing current.

Containerisation of the material for the storage of current is very important. The material for the container should be light and resistant to the action of acid and temperature variations (high temperature during running and low temperature during parking).

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Also it should not be brittle and at the same time should stand shocks and blows.

The box is rectangular, divided into several cavities and provided with a lid. Each cavity forms a separate cell. A single cell of this type when fully charged develops an e.m.f. of approximately 2.2.V between the electrodes. To obtain the standard 6-12 V (for a car) it is necessary to connect 3 or 6 cells in series. Thus one box holds a number of cells. Also at the bottom of the cases there are prisms or narrow rectangular plates of about 1" height to support the lead plate. These and the partitions are formed during the moulding itself. The lid is separately molded. The lids are either perforated or provided with screw caps to facillitate the escape of gases formed during charging or discharging, to see and maintain level of acid etc. Metallic handles are also provided sometimes at opposite ends of the containers. The present project envisages production of containers for 12 Volt 9 plates and 6 Volt 19 plates batteries.

The early containers were thickwalled, made up of bitumenous compositions, heavily loaded with fibrous material-usually asbestos. Then came glass and lead as container material. This was followed by ebonite and plastics which enables the construction of thin-walled containers.

Evaluation of prospects.

If the ebonite industry as a whole is considered its position is not rosy. This is due to the emergence of cheaper substitutes and to the increase in price of materials. The manufacture of

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accumulator cases seems to be the only branch of the ebonite industry which is not likely to be affected by competition of cheap substitutes. This is due to a combination of properties possessed by ebonite. The main requirement is that it should be resistant to sulphuric acid. The previous competetors, namely lead and glass are now completely out of the picture the former due to its high specific gravity and the latter due to its brittleness. In the case of ebonite it has got definite advantages to be used as battery containers. It is cheap, light, resistant to acid, possess good impact resistence and elasticity and not so brittle.

Presently high density polyethylene, Polystyrene, Polyvinyl Chloride, Poly Propylene etc. are coming into the market as container material. But these plastics are petroleum products which is now in short supply. In India these materials are not produced sufficiently. Since import will cause an increase in price to the container, plastics will take sometime to have a hold in the market. It can be expected that, at least for a few deeades more ebonite will be the dominating material for battery containers.

SECTION.B. MARKET SURVEY.

The uses of lead-acid type storage batteries are so many. The most important markets are the following.

(a) Transport. The life line of a nation is its transport system, particularly so for a developing nation like India. The automobile industry is the largest consumer of batteries. Batteries are also used in train lighting system and for horns of Scooters etc. (which are started by magneto).

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(b) Communication. An efficient communication system relies to a large extent on stand bye power provided by lead acid batteries. The reliability of communication system itself is dependent on reliability of stand-bye-batteries - a million voices would go dead in the event of a power failure, but for stand-bye batteries of telephone exchange's and over-seas communication centres.

(c) Agriculture. Mechanised farming is now the order of the day. Tractors are doing a grand job of ploughing, sowing and reaping at high speeds, covering larger acres. These tractors and various other equipments required for 'Green Revolution' are served by batteries.

(d) Industry. Our country is going through a phase of rapid industrialisation, and the part played by mechanical materials handling is vital. Battery operated electric vehicles, which result in increased productivity and better utilisation of space are now gradually becoming common.

(e) Diffence. Lead-acid batteries play a vital role in modern warfare and in a countrie's defence. It has a variety of applications it provides starting power to thousands of vehicles and helps the Jawan to communicate through wireless systems. It also provides emergency power and light. The requirements of the armed forces are highly specialised and have to be manufactured to exacting standards as often they have to function under extreme conditions.

Besides, aircrafts, see going vessels, loud-speakers and laboratories are also large users of batteries.

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A study of these markets and an analysis of its growth show that a great demand exists for batteries. Containers are needed for all these - not limitted to original equipments but also for replacement. The above facts can be established from a survey of the developments taken place in the automobile industry.

Based on the recommendations of the Tariff Commissions first report, the Government of India banned mere assembling of cars from imported parts and tried to Indianise vehicles production. Thus since Independence, the automobile industry has grown impressively. (Table I).

TABLE I AUTOMOBILE PRODUCTION

Year	Cars	Jeeps	Commercial vehicles.	Scooters, Motor cycles, Mopeds, three wheelers.
1964	23,227	10,391	33,507	37,839
1965	24,790	10,488	37,483	51,008
1966	27,597	9,777	35,362	52,857
1967	33,395	5,561	31,608	66,743
1968	37,333	7,293	34,940	79,223
1969	35,183	7,838	35,242	100,332
1970	35,205	9,344	41,136	117,400
1971	38,316	11,053	41,854	127,141
1972	38,827	12,518	38,734	146,765
1973	39,937	13,071	44,909	161,515

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From the licenced and installed capacities of the existing manufacturers and from the new licences already issued, it can be seen that the automobile industry - the largest consumer of batteries is rapidly developing. (Table 2 & 3).

TABLE II. MANUFACTURING CAPACITY

Vehicle	Licensed capacity.	Installed capacity.
Commercial Vehicles.	98,000	62,400
Jeeps.	20,000	15,000
Passenger cars.	51,400	47,400
Motor Cycle, Scooter, Three wheelers, mopeds.	4,60,800	4,05,000

TABLE III. LETTER OF INTENT.

Commercial Vehicle.	1,04,000
Cars.	1,67,500
Motor Cycle, Scooter, Three Wheelers, & Mopeds.	6,15,000

Automobile Ancillary Industry.

The Automobile Ancillary Industry has registered a rapid and vigorous growth over the last few years. (Table IV).

The automobile ancillary industry enjoys the same kind of protection as the automobile industry due to restrictions imposed on imported components. But in the context of higher targets fixed, this

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ban has been lifted. It is reviewed and expected that the demand for almost all items of automobile ancillaries could go in excess of the present capacity. (Table V)

TABLE IV. AUTOMOBILE ANCILLARY INDUSTRY
(Electrical Parts)

Year	1970	1971	1972	1973	1974
Electrical parts in Millionsof Rupees.	86	106	125	141	166

TABLE. V. PRODUCTION TARGET TILL THE END OF FIFTH FIVE YEAR PLAN 1974-75 to 1978-79

Industry	1974-75	75-76	76-77	77-78	78-79
Commercial Vehicles heavy and medium.	38,000	43,000	49,000	56,000	64,000
Commercial Vehicles light.	11,000	13,500	17,000	22,000	28,000
Jeeps.	14,000	15,000	16,000	17,000	18,000
Cars.	44,000	47,000	51,000	55,000	60,000
Autorickshaws.	15,000	19,000	24,000	31,000	40,000
Motor Cycles.	60,000	74,000	90,000	1,08,000	1,30,000
Moped.	33,000	46,000	65,000	93,000	1,30,000
Tractor.	28,000	36,000	47,000	61,000	80,000
Ancillaries. (Rs. Million)	1,950	2,750	3,800	5,300	7,400

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Also when we consider battery container, the industry has the dual function of manufacturing components for original fitments and for the replacement market. We have a large and growing replacement market to fall back on, and this market is becoming large day by day as an adequate supply of replacement component is most essential for keeping the rising vehicle population roadworthy.

The capacity of the container production industry is so meggre that it can satisfy only 25-30% of the need demanded by the automobile industry alone. Hence there is ample scope to start an industry at a Small Scale level.

Also in this connection it is worth mentioning that such an industry is technically assisted by Director of Industries and SISI at the state level and Development Commissioner at the Central level. Financial assistance is provided by the National Small Industries Corporation with Machinery supply under Hire purchase system. Financial assistance are also obtained from banks and other financial Corporation.

Export Possibilities.

From the informations gathered and statistics studied it is clear that there is ample scope for exporting batteries and containers It will be difficult for a small manufacturer to export and satisfy the large demands of importers. But this difficulty can be overcome achieved if combined export promotion efforts are made by manufacturers of goods having export potential.

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Year	Export earning in Rs.
1968-69	1,45,820
1969-70	1,79,932
1970-71	6,46,480
1971-72	6,14,514
1972-73	37,97,519

The data given overleaf are concerned with the export of lead-acid battery. Export of battery cases, other types of accumulators and parts of cases are excluded.

The countries ~~and~~ to which batteries are exported are mainly the Gulf States, some African countries, Eastern Europe, U.S.S.R. and our neighbouring countries.

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SECTION. C. PRODUCTION REQUIREMENTS.

Location

Location of the plant is a very important factor because

(a) a plant is relatively immobile and once it is established, it is permanent.

and (b) Location has a considerable influence on operating cost and productivity.

Plant site is selected after consideration of the following factors.

(1) Availability of raw materials.

(2) Availability of Labour.

(3) Availability of water, power etc.

(4) Facilities of transportation, Communication etc.

(5) Satisfactory climate.

An Industrial Estate in Kerala is selected for implimenting the project because of the following advantages.

(1) The Industrial Estate kindles the dorman capabilities of a potential Industrial mind, always stimulating to start new industries.

(2) The little capital the entrepreneur is having need not be locked up in bricks, mortar and other building materials as land and building are available at cheaper rates.

(3) Undue delay in getting electricity connection, water connection, transport facilities etc. can be avoided. The entsepreneur need not spend much on this as all these facilities are already available.

(4) Reduces overhead expenses to the minimum.

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(5) Industrial Estate provides accommodation for Banks, post and Telegraph Office, Canteens, Shops, dispensaries, recreation facilities, reading rooms etc.

(6) The proximity to a wide veriety of Industries will facilitiate intertrading and inter servicing.

(7) Labour will be available in the grade and quantity needed. Training facilities are available at less cost.

(8) Through association, observations and consultations, the management problems could be understood and handled more efficiently in a Industrial Estate.

Requirements of Main items of Raw Materials.

The raw materials for the manufacture of hard rubber may be divided into four groups.

(1) Polymer.

Hard rubber can be produced from Natural rubber, Styrene - Butadiene rubber, Polybutadiene rubber and Nitrile rubber. Considering the cost and service requirements either NR or SBR is sufficient. Eventhough SBR is produced in the country, the firm intends to use NR as it is locally available with an uninterupted supply. The present price of NR is Rs. 9.00 per Kg. including cess and excise duty.

(2) Fillers.

To increase service property and to reduce cost, fillers are used. The fillers with their prices are shown below.

Item	Price/Kg. Rs.
Clay	0.40
Ebonite dust	7.00

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Barium Sulphate	1.50
Magnesium Carbonate.	8.00
Saw dust.	1.00

(3) Process aid.

To improve processing characteristics, process oil is used. The price is Rs. 9.00/litre.

(4) Vulcanising system.

This consists of the vulcanising agent sulphur, accelerator Vulcacit F, (70% Mercapto-benzothiazol disulphide and 30% Diphynyl guanidiene) and Activator Magnesium Oxide. The prices are given below.

Item.	Price/Kg.
Sulphur.	2.00
Vulcacit F.	37.00
Magnesium Oxide.	25.00

Lead ingots, for the manufacture of bushes are available at a price of Rs. 9.00 per Kg.

Regular supply of Saw dust can be had from a local saw mill at a price of Rs. 1.00 per Kg.

Source of Supply.

All important manufacturers of Rubber chemicals are having their agents and depots in Kerala.

It is always better to enter into contract with at least two firms as at one time one may not be in a position to supply due to unforseen strikes, lay-offs or other catastrophes.

Terms of Purchase.

All negotiations are done through banks. On a margin money of 30% the bank will spend 70% for the purchase of materials. The amount

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has to be paid back in 70 days with interest. The purchased material will be kept in the bank's godown and materials in small quantities are withdrawn whenever required, on payment of cash.

Requirements of main items of Plant and Machinery.

(a) Plant. The land and building are rented from an appropriate Industrial Estate.

(b) Machinery. Main items of machinery are the following.

(1) 300 S Boiler with water softner and accessories (Wanson India Pvt. Ltd., Bombay)

(2) Mixing mill with a capacity to compound approximately 35-40 Kg. batch. A 16" x 42" mill with chilled cast iron rollers, 50 H.P. MOTOR, reduction gear, water cooling arrangements etc.

(3) Hydraulic presses - Two hydraulic presses with 200 Ton capacity are needed for curing containers. Lids are cured by a double day-light, 200 Ton capacity hydraulic presses.

(4) Moulds. Moulds for containers and covers of 12 V, 9 P., and 6 V 19 P batteries are required.

(5) Dies. For the manufacture of lead bushes for covers, dies are needed.

Machinery from 2-5 are available from different sources like

Kelachandra Foundaries	-	Kerala
Alappattu Brothers.	-	Trichur, Kerala.
Sohal	-	Bombay.
Indian Expellers.	-	Bombay.
Richardson Crudas.	-	Bombay etc.

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Terms of Purchase.

(1) Quotations are made and satisfactory quotations are confirmed.

(2) Price quoted are exclusive of packing, transportation costs, sales tax, octroi, excise duty etc.

(3) 30% of the price should be paid in advance and the remaining at the time of purchase. Payment can be done through banks.

(4) Purchaser has the right for inspecting machinery.

(5) Supplier posses the right for cancellation, changing delivery time and price due to unforseen reasons.

(6) Warranty against manufacturing defects is assured.

(7) Liabilities passes on to customer immediately after despatch and shortages should be notified within one week.

In addition to the above mentioned machinery, the following are also essential.

(1) Compressor:- 14.7 cft/min. with 3 H.P. motor. This is needed for cleaning moulds by an air blast.

(2) ¾" drilling machine:- For drilling holes on lids.

(3) ½ H.P. bench grinder:- The lid should be exactly tight fitting to the container, for the purpose of which they need be precision ground.

(4) Sieving machine:- With a capacity of 30 Kg/hr. used for sieving saw dust and chemicals.

(5) Crucibles:- for melting lead.

(6) Weighing balances:- A platform balance for checking bulk arrivals of raw materials, and despatches. A Pan type balance of 20 Kg. capacity for weighing chemicals. A dial type balance of 20 Kg. capacity for weighing pieces of compounded sheets prior to feeding into the mould. This would reduce losses due to flash outs.

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Manpower requirements.

The manpower requirement may be divided into 3 catagories.

(a) Managerial.

(b) Clerical.

(c) Technical (both skilled and unskilled)

(a) Managerial:- Required number of persons is 2. One is the Manager of the firm and in the present case the owner himself can be the Manager. The Second is the works Engineer who directly deals with the production.

(b) Clerical:- People who are qualified in accounting, typing and other sorts of clerical jobs are sufficiently available and procurement can be done easily. One accountant and one typist along with a peon forms the required Office Staff.

(c) Workers (Skilled and Unskilled):- This is the catagory in which people are directly involved in production. The scheme envisages a three shift production. Since costly machinery are involved, unless it is utilised for all the three shifts, the idle time and the consequent loss will be too much. Also if presses, boilers etc. are switched off, considerable time will be lost in the second day, for the presses etc. to acquire the required heat.

The boiler and mixing mill require skilled labours.

Second class certificate holders are sufficiently available.

Operators of presses, grinders, sieving machine, lead bush making dies etc., need not be skilled. Also these people need work only in one shift, as they can cater for all the 3 shifts.

A Technologist/Chemist with two Assistants is essential for practical compounding manipulations.

Technical assistants for electrical and mechanical functions can be dispensed with and considerable personal savings can be obtained, if the Supervisors employed are at least I.T.I. diploma holders in the respective fields.

Watchers and Sweepers are also needed.

Training Programme: For the efficient functioning of the firm experienced and well trained technologists, Supervisors, mill-men and press operators are needed. Small industrialists cannot afford to have elaborate training programmes as it is a costly affair. However, the Government is giving considerable assistance in this field by arranging training programmes at institutions like Common Facility Service Centres etc. at affordable expenses.

MAN POWER REQUIREMENT FOR 3 SHIFTS.

	Catagory	No. of persons for 3 Shifts.
1.	Manager (Day Shift only)	1
2.	Works Engineer (")	1
3.	Accountant (")	1
4.	Typist (")	1
5.	Peon (")	1
6.	Boiler attendent 1/Shift.	3
7.	Mixing mill operators 2/shift.	6
8.	Hydraulic press operators 1/press/shift.	9
9.	Supervisors 1/shift.	3
10.	Lead bush making (Day shift only)	2
11.	Grinding (")	1
12.	Sieving (")	1
13.	Techonologist/Chemist (")	1

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(14)	Assistant to Technologist	(Day Shift only)	2
(15)	Inspection.	(")	1
(16)	Sweeper	(")	1
(17)	Watchers	(1 per"Shift)	3
		Total.	38

Infra structures and other facilities.

(a) Roads:-

For the successful functioning of any industry, big or small, transport facilities is essential. To bring the raw materials to the factory premises and to haul the manufactured products to the market, transport facilities are unavoidable. This presupposes availability of good roads or canals. If a small entrepreneur is to solve the problem of road building, or canal excavation, the little resources he may have should be spent, leaving him practically nothing to construct the building, buy machinery or to provide working capital. Hence it is always better to locate the factory in a place nearer to main roads having accessibility to market, port or railway stations.

The question of transportation is not a problem in the present case as it is proposed to locate the project in an Industrial Estate which will definitly have good accessibility.

(b) Water Supply:-

Water is an important indirect raw material for almost all products. The material, the process, the machinery and workers need water. In the present case water is required for boiler and mixing mill. In Kerala water is adequately available in all seasons, at no cost.

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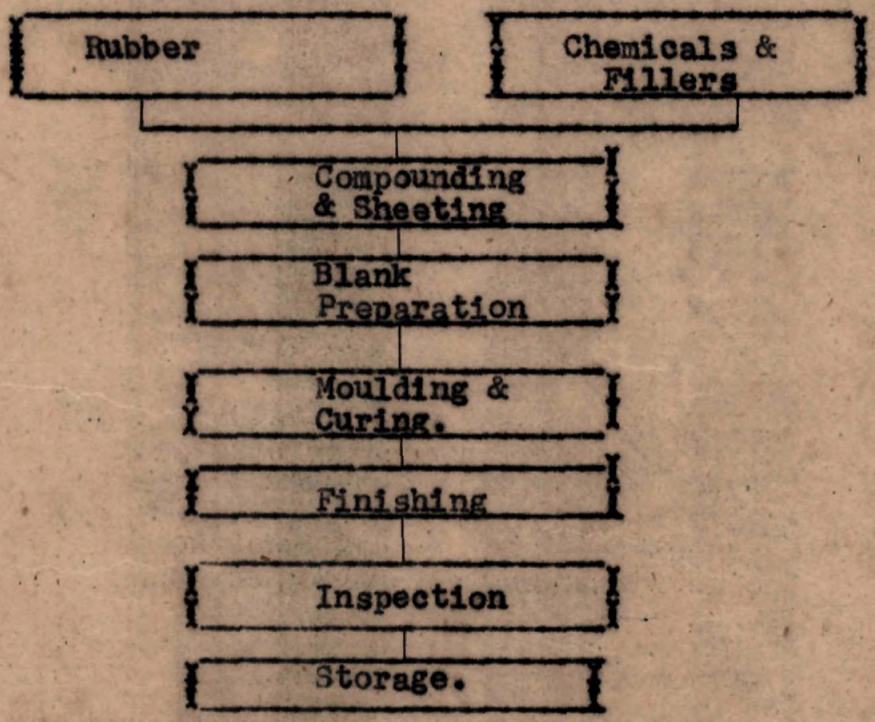
(c) **Electricity.**

The driving power behind many machinery is electricity. Adequate supply of electricity is an essential requirement for all Industries. Only few states in India (including Kerala) are out of the grips of power cut. Even in places where power is available, the small industrialist has to face several problems. He has to spend much time and money in getting connections, drawing three-phase line, installation of transformers etc. In this case also Industrial estates prove helpful.

SECTION. D. DESCRIPTION OF PROCESS OF MANUFACTURE

Flow chart of the process of manufacture of battery containers is given below.



1. **Process details:**

The process may be divided into six stages.

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(a) Compounding:

Polymers: Considering service property, cost and availability, Natural rubber is selected as the Polymer.

Sulphur ratio: The ultimate physical properties of hard rubber are related to the rubber-sulphur ratio and degree of vulcanisation. Most of the sulphur is in the combined state and is unextractable with acetone. The combined Sulphur exists partly as cross-links between rubber chain (inter molecular sulphur) and partly as Sulphur atoms linked to two carbon atoms in the same chain forming a cyclic structure (intra molecular sulphur). It is believed that only a small fraction of the combined sulphur in hard rubber consists of cross links, most of it occurs in the cyclic structure.

The double bond in each isoprene unit of Natural Rubber can react Theoretically with 32% Sulphur (Vulcanisation coefficient 47. Vulcanisation coefficient is expressed as the number of units by weight of Sulphur combined with 100 units by weight of rubber hydro-carbon). In some cases the above value is exceeded by substitution of Hydrogen atoms in the rubber forming hydrogen sulphide or by forming polysulfidic linkages. Vulcanisation coefficient for commercial hard rubber vary between 25 and 50. Those under 25 are flexible and find only limited application.

Accelerators: Unaccelerated rubber - Sulphur mixes without fillers need long cure times and create problems from shrinkage, poor processibility and heat evolution during curing. Preferred accelerators are vulcacit F along with activators such as Magnesium Oxide and Magnesium carbonate. Curing periods can be reduced from ten hours to ½ an hour using proper acceleration. Their application is limited only to highly filled compounds like that for battery boxes.

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The hard rubber vulcanisations reaction is exothermic and curing temperature must be closely controlled to avoid blowing of finished product.

Fillers: To some extent fillers can modify the physical properties to some extent even though not considerably.

The most important filler is hard rubber dust which is made by open-roll attrition mill grinding. A dust of known composition reduces the exothermic reaction temperature rise, permits faster cures without blowing, reduces shrinkage and imparts good machining properties. It also aids acid resistance. The flexural strength, elongation and impact strength are relatively unaffected, at the same time improving processibility. Other fillers are China clay, barytes, talc, silica, Magnesium Oxide and Magnesium Carbonate. Silica and Kieselghur improve heat and acid resistence. Barytes and hard rubber dust also increase acid resistance. Carbon black does not reinforce ebonite and is used only for pigmentation. Zinc Oxide tends to retard ebonite vulcanisation. Clay and saw dust are used as diluents and cheapens the compound.

Processing aids: Hard rubbers are often plasticized by reclaim rubber to lower cost and improve processing. Process oils also help to achieve processibility and increase lustre.

The mixing is done on a 16"x42" mill. The batching timeis approximately 35 minutes. The compound is finally sheeted out.

b) Blank Preparation:

The compounded sheet is brought to a working table. It is cut into small sheets with a sharp knife. That much amount required

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for one container is weighed on a dial type weighing balance. This procedure minimises wastage of compound. Always weight of the compound taken is made a little more than that of a container to ensure good and adequate flow.

c) Moulding and Curing

The female part of the mold consists of four plates which when needed can be assembled or disassembled. The core consists of an iron block with cavities corresponding to the partitions of the container. The cut and weighed sheets are placed in the cavity and also inside the recesses in the core after applying a mould release agent. The press is closed. It is kept under a pressure of about 3000 Psi and at a temperature of 350°F for a period of about 20 minutes. At the end of cure, the mould is opened and the article is taken out. The mould is cleaned by an air blast.

In the case of lids, the lead bushings are also inserted on the pins in the mould when the blank is placed.

d) Finishing:

The flashings are removed. The ends are trimmed by buffing. In the case of lids they should be exactly tight fitting when placed in the container. For this purpose the edges of the lids are buffed within close tolerences.

e) Inspection:

The next stage is inspection. All containers are checked for porosity. A visual inspection also is done for manufacturing defects. Defective items are retained and repaired if the defect is a minor

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one and scraped if the defects is a major one. If the surface is marked by a number of small cavities the fault can be made good simply by applying a coating of asphalt with a sheet-metal spatula to the cavities in question. Deeper cavities are filled with the same compound at vulcanised by keeping a metal piece tightly against it and heating.

f) Storage:

Those items which passes the test successfully go to the stores and are ready for despatching. No special packing is needed before despatching.

2. Process loss:

Process losses are there in every industry. Trying to control them to the minimum possible level is what is practicable.

In battery container manufacture losses occur mainly in four different ways.

(a) During handling:

The ingradients may fly off during unloading, weighing and compounding. Also some amount of the material may be sticking to the packing materials.

(b) Mould flow:

To ensure sufficient flow during moulding a little excess amount of the compound is used as blank for placing into the mould. This excess will be lost in the form of flash outs. A weighing balance is used to keep this excess in the lowest possible minimum.

(c) Scrap:

These are defective containers which do not conform to the specifications. These may result from insufficient dispersion, improper flow, careless handling etc.

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d) A very small percentage is lost as powder during the grinding operation.

Maximum care is taken to see that process losses are minimal. The anticipated process loss is about 6%.

3. Quality control measures:

Quality is the surest foundation of success. It is not the best quality that matters, but is the right quality. Every product should have a certain level of quality, worth of its price. By quality what is meant is a certain characteristics assigned to a product. These characteristics are highly variable. Consistancy of quality means, these variations are ewithin fixed tolerence and in order to keep variation the minimum, within tolerence, quality control measures are necessary. Quality control should be there from the very start of purchase of raw material to the final despatch of finished product.

First the raw materials are tested for the desired level of purity and these tests need not be repeated frequently, once an agreement with an established supplier has been made.

Strict supervision of the machinery and processes are made.

Finally the finished products are tested according to the I.S.I. proceedures. Statistical quality control is followed.

Sampling for acceptance of a lot:

In any consignment all containers of the same size shall be grouped together to form a lot. For convenience this may be devided into sub-lots and the number of containers selected at random for testing depends on its size (as in table)

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Size of sub lot.	No. of containers to be selected.
Up to 200	2
201 - 500	3
501 - 800	4
801 - 1000	5

Criterion for conformity:

A sub lot shall be considered as conforming to the requirements of the standard, if all the containers selected from the sub lot satisfy the requirements of all the tests. If one or more containers fail to satisfy the requirements of any of the tests, twice the number of containers specified under column 2 of table above shall be selected from the lot and subjected to the tests in which failure(s) has(have) occured. If anyone or more of these containers fail, the lot shall be considered as not conforming to the requirements of this standard.

Classification of Tests:-

(a) Material, Construction and Workmanship.

(b) High voltage test:- is intended to determine whether cracks and other imperfections exist in the battery container. This test is done ~~in~~ ~~them~~ on every container.

Containers are tested by applying an alternating voltage of T x 3000 V(where T is the minimum thickness of walls) to the electrodes covering the inner and outer surfaces of the walls and the base and the intercell portions. There shall be no break down or flashover.

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C. Test for impact Resistance:

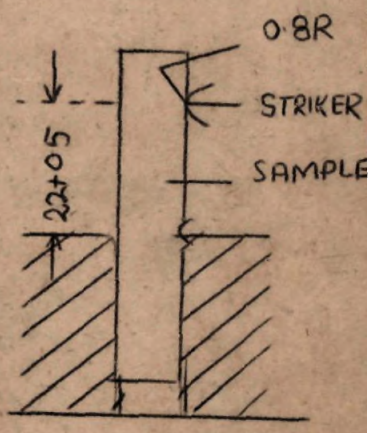
Two alternative methods are there.

1. Izod impact test on cut samples and
2. Drop ball test on entire container.

The purpose is ~~xxx~~ to determine the ability of the container to withstand the impact normally experienced in handling and during service.

1. Izod impact test:

The conditioned test specimen of 64 mm long and having a thickness that of the container is clamped with the centre -line of the notch on the level of the top of the clamping surface and struck with a striker on the notched side. The value of the energy expended in breaking each individual specimen shall be noted, and the average of at least 5 tests shall be taken as the impact resistance of the material, expressed in kilogram-meter.



The values shall be not less than the value given below:

0.11 N-m = automotive, aircraft and stationary battery containers;

0.17 N-m = trainlighting and airconditioning, diesel and electric locomotives and electric multiple unit battery containers;

2. Drop ball test:

A one Kg. weight ball is dropped on to the container and the height in m.m. from A which the ball is dropped causing the container to fracture shall be taken as the impact limit of that container.

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*WALL THICKNESS AT POINT OF IMPACT	MINIMUM HEIGHT OF FALL	
	Average Value	Single Value
(1)	(2)	(3)
mm	mm	mm
Below 7.2	Under consideration	Under consideration
7.2 to 7.5 (inclusive)	150	100
7.6 to 8.8 (inclusive)	200	150
Greater than 8.8	250	200

*The wall thicknesses given are those below the top hand of the container.

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d. Plastic yield test:

The test is intendented to determine the extent of yield of the container which may occur due to heat developed in the battery. The specimen is kept at 60°C on two eually spaced supports and a load is applied centrally, the deflection being measured by a vernier. The average plastic yield shall not be greater than 5.0 m.m.

e. Acid Resistance Test:

The test is intended to assess the ability of the container material to resist acid action. The cleaned and conditioned sample is immersed in Sulphuric Acid (Specific Gravity 1.25) at 60°C for 28 days. The amount of extractable impurities, changes in mass and volume, blisters on surface, warping or distortion of test piece etc. are noted.

The extractable impurities shall not exceed the following limits:

Iron	0.16 mg/cm^2 of unpainted surface.
Chlorine	0.08 " "
Manganese	0.001 6 " "

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The change in mass and volume shall not be more than 4.0 mg/cm^3 respectively.

There shall be no significant blistering, warping or distortion of the test piece.

4. Utilisation of bye-products, if any:

In many chemical Industries in addition to the main product so many bye-products are also obtained. These can be either used as such or may be used for manufacture of other useful products. But as far as the ebonite manufacture is considered all the compounded material is used for the production of containers and there is no formation of any bye-products.

5, Waste disposal:

Wastes are a loss and its disposal is a problem in many industries. But in ebonite battery containers, the wastes can be disposed in a most economical way.

The important forms of wastes are flash outs and scraped containers.

These wastes can be powdered to obtain abonite dust which is an important filler in ebonite manufacture. Ebonite is broken down by an ore-making mill. It is further comminuted and iron particles are removed by magnetic separators. The dirt is removed by warming with Sodium Hydroxide. The Sodium hydroxide is washed off, dried and fed to a grinding mill, capable of working under high pressure and standing great stresses. It is finelly grount and finally seperated by levigation or air separation.

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Another waste is the powder that is formed during the grinding operation. These also can be collected by using a vacuum device.

SECTION. E. SELLING AND DISTRIBUTION ARRANGEMENTS.

The marketability of the product is the driving force behind every industry. All the articles produced should be sold out at least cost.

The two most commonly adopted procedures namely Direct Sales by opening depots and sales through agents on commission basis are not applicable for the sales of battery boxes. Here the best method is to enter into long term contracts with important battery manufacturers. Since containers are in short supply, an entrepreneur can easily enter into such contract provided he can supply containers according to their specifications. Also he should be prompt in despatching consignment.

Delivery arrangements:

The containers are sent either by trucks or by railway wagons. Supply by railway wagons will be cheaper.

SECTION F. CAPITAL REQUIREMENTS.

The total capital employed for the project may be divided into Fixed Capital and Working Capital.

1. Fixed Capital:

The fixed capital includes amount spent for purchase of land, construction of building, purchase errection and installation of

Contd....30

machinery etc. Priliminary and pre-operative expenses for a definite period which can be capitalised also come under fixed capital. Fixed Capital also includes expenses incurred on Office furniture and machineries etc.

In the present scheme, no expense is incurred on land and building as these are rented from an Industrial Estate. Other fixed expenses are given below.

a)	Machinery.	9,00,900.00
b)	Other fixed expenses.	22,000.00
c)	Priliminary and pre-operative expenses.	50,000.00
	Total fixed Capital.	9,72,900.00

Details of fixed capital shown in Annexure I.

2. Working Capital:

This is to provide funds for a definite period for production. In the present case it is calculated for 3 months. This includes investment on raw material, salaries and wages, utilities and other overheads consisting of Repairs and maintenance on machinery, Travelling and advertisements, Printing and Stationery, Postage and telephone, Rent, Audit fee and legal charges, etc. For the rest of the period Capital can be had from the sales of goods produced by the original working capital. The working capital requirement for 3 months is given below.

a.	Raw material.	5,01,900.00
b.	Salaries and Wages.	80,000.00

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c) Utilities.	63,900.00
d) Other overheads.	24,000.00
Total (a + b + c + d)	6,69,800.00

Details of Working Capital components are shown in Annexure 3.

SECTION. G. FINANCING PLAN.

Before starting the project sufficient planning should be done to finance it. For the present scheme an amount of Rs. 9,72,900.00 is required as fixed capital and Rs.6,69,800.00 as working capital. Normally an entrepreneur cannot meet all the financial requirements needed for an industry, from his own pocket. One can get financial assistance from several sources in order that he is not hampered by lack of funds.

Sources of financial aid.

1. State financial Corporations.

They grant loans from Rs. 10,000 to Rs. 10,00,000 to any single concern. They provide 100% of machinery cost, 75% of building cost and 40% of working capital at 7.5% interest. Repayment starts only after two years and should be complete within 10 years thereafter.

2. Kerala State Small Industries Corporation.

Provides Hire purchase fascilities for machinery upto 10 lakhs of rupees on a marginal money deposit of 20% (10% for technically qualified but unemployed).The interest is 7½%. Repayment starts after two years and should be complete within 7 years.

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3. National Small Scale Industries Corporation, New Delhi.

Hire purchase facilities are available for both indegeneous and imported machineries. Interest is 7½%, with a pay back period of 7½ years. The facility can be availed by pledging the machinery.

4. Commercial Banks.

Nationalised banks provide loans for machinery on 25% margin money and 12% interest. Payback period is 3 years and monthly repayment starts from the third month. For working capital, any amount can be drawn.

Key loan facility:- eg. for purchase of raw material bank will advance money on 25% margin money and (16%)interest. The material will be under bank's lock and key. Small amounts can be drawn according to requirement.

Bill discounting facility:- Up to 80% of a marketed consignment is advanced.

5. The Industrial Development Bank of India.

With a view to further streamline the availability of credit to Industrial Development, and to give more freedom of action to the credit giving agency, the Reserve Bank has a wholly owed subsidiary under the name the Industrial Development Bank of India. The Bank is authorised to give all types of financial assistance to directly to industries orto other banks and institutions which in turn help the industries. Thus if a bank loan is rediscounted with IDBI, the interest rate may fall from 15% to 10½%.

Contd... 33

6. The Unit Trust of India.

The Unit Trust of India aims at the mobilisation of monetary resources of the nation, mainly from the middle income group and ~~fmr ihm~~ to raise Capital for nation-building activities, mostly as industrial capital.

OWN FUNDS AND BORROWINGS

The present scheme envisages the following financing plan.

100% of the machinery cost is taken as loan from Kerala Financial Corporation against hypothecation of machinery. The rest of the fixed capital is taken by the entrepreneur. The working capital is acquired by taking loan from banks. Thus own funds amounts to a total of Rs. 1,89,400.00 and borrowings come to Rs. 14,53,300.00.

SECTION H. PRICING POLICY

Eventhough the product is under short supply, the scheme plans to sell quality products at reasonable prices, slightly lesser than current market price. The price is fixed on a number basis. The proposed price for one container is Rs. 40.00. The price for lids of 6 V 19P and 12V 9P batteries are Rs.2.00 and Rs. 1.10 respectively.

SECTION I. PROFITABILITY

1. Rate of Return on own capital:

Own Capital.	1,89,400
Net Profit.	2,61,200
∴ Rate of return on own capital.	1.38 (138%)

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2. Rate of return on Capital employed.

Fixed Capital.	9,72,900.00
Working Capital.	6,69,800.00
Total Capital employed.	16,42,700.00
Net profit.	2,61,200.00
∴Rate of return on capital employed.	0.159 (15.9%)

3. Percentage Profit on sales turn over.

Annual receipts from Sales.	35,75,600.00
Annual Profit.	2,61,200.00
% Profit on sales turn over.	7.3%

SECTION. J. ECONOMIC VIABILITY

1. Interest Commitments.

7.5% interest on term loan from K.F.C.	58,800.00
16% interest on working capital loan from Commercial Banks.	1,07,200.00
Total interest commitments.	1,66,000.00

2. Ability to pay back borrowed funds.

The term loan has to be paid back within the prescribed time. Considerable amount on interest can be saved, if the term loan is paid back quickly. Of the total profit approximately 25% is retained and 75% used to pay back term loan. Since part of the money is paid back in the first year, the ability to pay back borrowings will be more, as cash inflows are higher due to decrease in interest.

Contd.....35

3. Pay back period.

a)	Annual Profit.	2,61,200.00
b)	Depreciation.	1,42,400.00
c)	Available surplus (a + b)	4,03,600.00
d)	Less drawings.	1,00,900.00
e)	Amount used for repayment.	3,02,700.00
f)	Term loan to be paid back	7,83,500.00
g)	Pay back period.	2.6 years.

SECTION K. SOCIAL BENIFITS.

This Industry along with other small scale Industries, serve the nation in several different ways.

1. Provide immediate large scale employment.
2. Offer a method of ensuring a more equitable, distribution of the national income (by breaking monopolies)
3. Facilitates an effective mobilisation of resources of capital and skill.
4. Helps to avoid congestion in towns by dispersal of industry.
5. Increases the revenue earnings of the nation through taxes, excise duty etc.
6. Brings personal profits to the entrepreneur.

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ANNEXURE I

DETAILS OF FIXED ASSETS

A.	Land and building.		Rented.
B.	Machinery.		
1.	300 S boiler with Water Softner and accessories.	...	50,000.00
2.	16"x42" mixing mill with reduction gear and accessories.	...	1,48,000.00
3.	Hydraulic press (200 ton capacity) + Mould for 12 V 9 P container and accessories.	...	1,80,000.00
4.	Hydraulic press (200 ton capacity) + mould for 6V 19 P container and accessories.	...	1,80,000.00
5.	Hydraulic press (200 ton capacity) 2 day light + cover molds and accessories.	...	2,00,000.00
6.	Dies for making lead bushes	...	2,500.00
7.	Crucibles.	...	2,000.00
8.	Compressor 14.7 cft/min.3 HP motor	...	4,500.00
9.	¾" drilling machine.	...	2,500.00
10.	Bench grinder ½ H.P. 2 Nos.	...	2,000.00
11.	Sieving machine 30 Kg/hr.	...	4,000.00
12.	Testing equipment and meters.	...	4,000.00
13.	Weighing balances.		
	i. platform balance	...	1,200.00
	ii. pan type balance	...	800.00
	iii. dial type balance	...	2,000.00
		Total.	7,83,500.00

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	B/F	7,83,500.00
	Tax @ 7.5%	58,800.00
	Transportation @ 2.5%	19,600.00
	Errection and Installation @ 5%	39,000.00
	Total.	9,00,900.00
C.	Other Fixed Expenses.	
1.	Tank and motors for water supply.	12,000.00
2.	Tools and accessories.	6,000.00
3.	Office machinery and equipments.	2,500.00
4.	Furniture.	1,500.00
	Total.	22,000.00
D.	Priliminary and Pre-operative Expenses.	50,000.00
	Total fixed capital B + C + D.	9,72,900.00

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ANNEXURE II

WORKING CAPITAL COMPONENTS

(For 3 months)

		₹
1.	Raw Material.	5,01,900.00
2.	Salaries and Wages.	80,000.00
3.	Utilities.	63,900.00
4.	Other overheads.	24,000.00
	Total.	6,69,800.00

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ANNEXURE III. 1.

DETAILS OF WORKING EXPENSES ON
RAW MATERIAL
(For 3 Months)

Sl. No.	Material.	Price per Kg. Rs.	Quantity required Kg.	Total Cost Rs.
1	Natural Rubber.	9.00	5,000	45,000.00
2	Reclaimed Rubber.	3.30	30,000	99,000.00
3	Clay	0.40	11,000	4,400.00
4	Ebonite dust.	7.00	13,000	91,000.00
5	Saw dust.	1.00	2,000	2,000.00
6	Magnesium Carbonate.	8.00	10,000	80,000.00
7	Barium Sulphate	1.50	9,000	13,500.00
8	Process Oil.	9.00/ litre.	2,200/ litre.	19,800.00
9	Magnesium Oxide.	25.00	2,800	70,000.00
10	Vulcacit F.	37.00	400	14,800.00
11	Sulphur	2,00	6,000	12,000.00
12	Lead ingots	9,00	5,600	50,400.00
	Total.			5,01,900.00

Contd.....40

ANNEXURE III. 2

DETAILS OF WORKING EXPENSES ON MAN POWER REQUIREMENTS

(for 3 months)

Catagory.	No. of persons for 3 shifts.	Rate of pay p.m.	Total p.m.
Manager.	1	850.00	850.00
Works Engineer.	1	800.00	800.00
Accountant.	1	400.00	400.00
Typist.	1	350.00	350.00
Peon.	1	300.00	300.00
Boiler Attendent.	3	600.00	1,800.00
Mill Operators.	6	600.00	3,600.00
Press Operators.	9	550.00	4,950.00
Bush making.	2	500.00	1,000.00
Grinding.	1	450.00	450.00
Sieving.	1	450.00	450.00
Technologist.	1	750.00	750.00
Assistants to technologist.	2	450.00	900.00
Supervisors.	3	700.00	2,100.00
Inspection.	1	450.00	450.00
Watchmen.	3	350.00	1,050.00
Sweeper.	1	300.00	300.00
Total.	38		20,500.00
Total for 3 months.			61,500.00
Terminal Welfare @ 30%			18,500.00
Total.			80,000.00

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ANNEXURE III. 3.

DETAILS OF WORKING EXPENSES ON UTILITIES

(for 3 months)

A. ELECTRICITY.

Item.	Power Required (K.W.)
2 H.P. Motor for pumping water.	1.5
½ H.P. motor for recirculation.	0.4
60 H.P. motor for mill.	45.0
½ H.P. grinders (2 Nos)	0.75
Drilling machine 1 H.P.	0.75
Compressor 3 H.P.	2.25
Sieving	1.75
Bush making.	1.50
Lighting.	2.00
Total.	55.90
Average power consumption/day	1,000.00 K.W.H.
Cost of power.	Rs. 0.18/k.w.h.
Total cost for power for 3 months (A)	Rs. 13,500.00

B. FUEL.

Furnace oil consumption per day	610 litres.
Furnace oil consumption for 3 months.	45,750 litres.
Price of furnace oil.	Rs. 1.05/litre.
Transportation cost.	Rs. 0.05/litre.
Total cost for 3 months (B)	Rs. 50,400.00
Total expenses on utilities (A+B)	Rs. 63,900.00

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ANNEXURE III. 4

OTHER OVERHEADS

(For 3 months)

Sl. No.	Item.	Expense. Rs.
1	Repairs and maintenance on machinery @ 5%	12,500.00
2	Travelling and advertisement.	4,000.00
3	Printing anc Stationary.	1,500.00
4	Postage and telephone.	1,000.00
5	Rent.	3,000.00
6	Audit fee and legal charges.	500.00
7	Miscellaneous.	1,500.00
	Total.	24,000.00

ANNEXURE III.5

DEPRECIATION AND INTEREST

(For 3 months)

1	Depreciation on machinery @ 15%	33,800.00
2	Depreciation on other fixed capital @ 10%.	1,800.00
	Total.	35,600.00
3.	Interest on term loan for machinery @ 7.5%	14,700.00
4	Interest on working capital loan, @ 16%.	26,800.00
	Total	41,500.00

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ECONOMICS OF THE PROJECT

Cost of Production for 3 months.

(1)	Working Capital.	6,69,800.00
(2)	Depreciation.	35,600.00
(3)	Interest.	41,500.00
	Total.	7,46,900.00

Receipts for 3 months.

Sales

(1)	18,600 battery containers @ 40/- per container.	7,44,000.00
(2)	29,500 lids of 6V 19P @ Rs.2.00/lid.	59,000.00
(3)	59,000 lids of 12V 9P @ Rs.1.10 per lid.	64,900.00
(4)	Scrap.	26,000.00
	Total.	8,93,900.00
	Less Selling cost @ 6%	53,700.00
	Total income.	8,40,200.00

Profit for 3 months.

A.	Receipts for 3 months.	8,40,200.00
B.	Total expenses for 3 months.	7,46,900.00
	Profit (Before taxation) A - B	93,300.00

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ANNEXURE IV.

ANNUAL COST OF PRODUCTION

1.	Raw Material.	20,07,600.00
2.	Salaries and wages.	3,20,000.00
3.	Utilities.	2,55,600.00
4.	Other overheads.	96,000.00
5.	Depreciation on machinery @ 15%	1,35,200.00
6.	Depreciation on other fixed assets @ 10%	7,200.00
7.	Interest on term loan for machinery @ 7.5%	58,800.00
8.	Interest on working capital loan @ 16%	1,07,200.00
	Total.	29,37,600.00

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ANNEXURE. V

SALES INCOME AND PROFIT

Sale

(1)	74,400 battery containers @ Rs. 40/- per container.	29,76,000.00
(2)	1,18,000 6V, 19P lids @ Rs. 2.00 per lid.	2,36,000.00
(3)	2,36,000 12V 9P lids @ Rs.1.10/lid.	2,59,600.00
(4)	Scraps.	1,04,000.00
	Total Income.	35,75,600.00
Less	Selling cost @ 6%	2,14,800.00
	Net Income.	33,60,800.00
Less	Cost of production.	29,87,600.00
	Profit before tax.	3,73,200.00
	Tax incidences.	1,12,000.00
	Net Profit after taxation.	2,61,200.00

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