PROJECT REPORT ON A SMALL SCALE UNIT

TO MANUFACTURE

POLYETHYLENE PIPES

SUBMITTED TO THE UNIVERSITY OF COCHIN

IN PARTIAL FULFILMENT OF

BACHELOR OF TECHNOLOGY DEGREE COURSE IN

POLYMER SCIENCE AND RUBBER TECHNOLOGY

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SECTION - I

INTRODUCTION

This is a project report on the manufacture of Polyethylene pipes, the most common flexible plastic pipe used for transportation of fluids.

Plastic pipes have the following advantages over metal pipes:-

(i) Flexibility.

(ii) Resistance to corrosion by water, salts and chemicals.

(iii) Electrical resistance.

(iv) Easiness in joining.

(v) Less cost.

A wide range of plastics can be formed or moulded into pipe. PVC, PP and PE etc. are used to produce plastic pipes. Compared to other plastic pipes, polyethylene pipes have certain advantages like good chemical resistance, flexibility, easiness of processability, electrical resistance. Also it is available in long continuous length and has a long life.

The unit is estimated to produce 44.2 MT of LDPE pipes and 29.2 MT of HDPE pipes annually at 100% capacity utilisation on a single skig shift basis. The estimated amount of raw materials requirement annually is 44.5 MT of LDPE and 29.5 MT of HDPE granules.

A single extruder is enough to produce these two types of pipe.

PIPING MATERIAL:

A good piping material has the following properties. However the selection of a suitable piping material for a particular application depends on the medium being transported and the condision of use.

(i) Resistance to corrosion by water, salts and chemicals.

(ii) Resistance to erosion: This depends upon the plastic and the condition of use.

(iii) Less weight: The density of polyethylene ranges from 0.91 - 0.99 gm/cm^3. The low density results in lower transporting and handling cost.

(iv) Flexibility:- Use of a flexible plastics eases installation and permits some adjustment to subsoil movements.

(v) Low Thermal Conductivity: Plastics have low co-efficient of thermal conductivity, Compared to that of other piping materials, this results in low heat losses (or gain) and may result in outside surface of temperature significantly lower (or higher) than that of the fluid in the pipe line.

(vi) Low Electrical conductivity: Plastics are non conductors of electricity, which renders them not subject to electrolytic erosion. Most plastics can not be used for ground electrical conduits.

(vii) Good mechanical properties:- The mechanical strength of plastic varies inversely with change in temperature, increasing as the temperature decreases, and decreasing as the temperature increase. Impact resistance behave in the opposite manner.

(viii) Smooth internal walls:- Polyethylene pipe has smooth internal walls which give high flow rates and resist the formation of deposits.

Considering the above properties required for a good piping material, polyethylene is surely a very good choice as a piping material.

1.2. Product description:-

The unit proposes to produce the following items according to ISI specification standard, given in Appendix-II.

HDPE PIPES

A substitute for G.I. pipe conforming to Indian Standard Specification I.S - 1239 - 68.

Sizes (Nominal Diameter) (inch)	2	2½	3
Quantity/year (MT)	7.05	10.5	11.7

LDPE PIPES

Sizes (Nominal diameter) (inch)	1	1½	2	2½	3
Quantity/year (MT)	2.9	4.5	8.0	12.2	16.6

Applicantions:-

Water system and well casings

Irrigation & sprinkler system.

Industrial and chemical laboratory drainage system.

Natural gas distribution system.

Electrical conduits

Distilled & Demineralised water transportation.

Corrosive chemicals transportation.

Food processing plants

Industrial chemical transportation.

Joining Methods:-

Heat fusion:- Bud welding gives better strength. This is the one of the advantage of using plastic pipe. In this methods, Iron pipe requires higher heat of energy to weld it, so the cost of joining two metal pipes is more than the cost of joining two plastic pipes.

Inert Fitting:- Plastic pipes clamped together with help of small thin metal piece. This gives moderate strength.

1.3. Only few units in South India are producing Polyethylene pipes. Because of its outstanding properties,

Polyethylene pipes will have very good demand in the coming years. Considering this factor it is worthwhile to start a small scale unit to manufacture Polyethylene pipes.

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SECTION - II

LITERATURE SURVEY

A lot of literatures is available on plastic pipe extrusion. Some of the literature which is relevent to our subject is given below.

2.1. A.B. Glanvill has given a good coverage of the property Vs extrusion para meters.

2.1.1. OUTPUT OF PIPE:-

$$Q = CPtV (d_1 + d_2)$$

where Q = Quantity of output (kg/hr.)

C = Constant (9.45 m.units)

P = Relative density of material at 20°C

t = Wall thickness of tube (cm)

V = Linear extrusion speed (m/min)

d_1 = Inside diameter of pipe (cm)

d_2 = Outside diameter of pipe (cm)

2.1.2. PIPE EXTRUDER SIZE:-

It is recommended that the pipe diameter produced on a given extruder should lie with in the range 25 - 100% of the screw diameter.

2.1.3. PIPE DIE SIZE

Material	Ring diameter		Die mandrel		Die land length
	Internal sizing	External sizing	Internal sizing	External sizing	
Poly Olefins	1.2-1.3D	0.9-1.05 D	1.25-1.35D	0.9 D-2t	15t
				1.05D-2t	20t

D = Nominal Diameter of pipe.

t = Pipe wall thickness.

2.1.4. PIPE SIZING:-

a. Internal (mandrel) sizing (applicable to pipe over 1" diameter)

Mandrel length 3" - 12" (75 - 300 m.m.) dependant upon wall thickness of pipe and rate of extrusion.

Mandrel taper 0.3% per side.

b. External sizing (tubes & dies)

Material	Internal Diameter	length
Poly Olefins	1.04 D	10 D

where D = nominal diameter of pipe.

Alternatively the length of calibrating tubes for press.or vacuum sizing may approximately be determined by the following formula.

Polyolefins

$$L = 100 \times t^2 \times V$$

where L = length of calibrating tube. (cm)

t = wall thickness of pipe. (cm)

V - Extrusion speed (cm/Sec.)

c. Diametric shrinkage of pipes on cooling.

Poly ethylene = 3%

2.1.5. Residence Time:-

$$R = \frac{M}{Q} = \frac{VL/t}{Q}$$

where R = Average residence time (Sec.)

M = Total volume of screw (cm^3)

V = Volume per screw flight (cm^3)

2.1.6. Extruder drives:- A number of formulae have been developed for determining the drive requirement for extruder.

2.1.6.1. Approximations:-

Polyolefins

0.123 - 0.2 HP /lb of output/hr.

0.2 - o.e KWh/Kg of output/hr.

2.1.6.2. Low density Polyethylene power

Melt temperature		Power required	
°F	°C	HP/lb/hr.	KWh/kg/hr.
338	170	0.084	0.14
392	200	0.098	0.16
446	230	0.112	0.19

example:-

Thus to extrude 200 lb/hr (90 kg/hr) at a temperature of 392°F (200°C) requires

90 x 0.16 KW = 14.4 KW.

2.1.6.3. Typical Power and output of Extruders

Extruder size (inch)	Average drive (HP)	Maximum drive (HP)	Output kg/hr	Barrel heater (KW)
1½"	10-15	8.7	23-34	7.5
2½	20-30	36.4	54-73	21
3½	40-75	168.4	113-181	45
4½	80-125	303	181-318	75
6	150-225	624	363-544	140

2.1.7. Heating:-

2.1.7.1. Heat Requirements:-

Extruder barrel heaters.

25 - 45 W/in^2 (3.85 - 7 W/Cm^2)

2.1.7.2. Life of main voltage induction Heaters:-

Temperature		Heater life
°C	°F	hr.
200	392	45000
250	482	30000
300	572	11000
350	662	7500
400	752	2000

2.2. FISHER E.G. gives a comprehension report on the different methods of plastic pipe extrusion.

2.2.1. Free Extrusion Process:-

The free extrusion procedure requires fairly inexpensive and simple sizing plates and a cooling trough. Furthermore, number tube sizes can be made from one die and mandrel setup. Tube dimensions can be changed by varying the speed, take-off rate or internal air pressure. Tubings upto 0.23" diameter can be made with dimensional tolerances of ± 0.002" by free extrusion.

In free extrusion process, it is necessary to supply air under regulated pressure through the mandrel.to act as an internal support for the tube. However this should be avoided, if possible, to simplify the operation and reduce the number of ~~xx~~ variable which must be controlled.

2.2.3. Vacuum sizing or Differential methods:-

Usually requires numbers of internal gas pressure to support the tube. Thus, tubing can be cut to any length without disturbing the process. In one thd tube is sized by circulat plates. Roundness is maintained by using sufficient vacuum in the air space of the quench tank to compensate for the weight of water over the extruded tube.

Some important points in the vacuum sizing process are:-

1. The ratio of die ID to sizing plate ID of at least 2 is nsually best for small diameter tubing.
2. The mandrel can be sized to give an annular opening which is proportional to tube wall thickness.
3. The entrance to the sizing plate should be cooled and lubricated by a circular spray of water or detergent.
4. The rubber gasket on the exist side of the vacuum tank should be soft and sized to hold vacuum.

2.2.3. Process for manufacturing Biaxially oriented pipe:-

An interesting development due to Farbwereke Hoechst in conjection with A.Reifen Hauser of Germany, is for the production of biaxially oriented ~~in~~ high density polyethylene pipe. It is known that PE film and sheet when

stretched in two directions under controlled temperature conditions.shows greatly increased tensile strength. This led to the development of pipe orientation equipment in order to duplicate these unproved strength properties, and thus to save material & cost.

One method of applying this development is to extrude a thickwalled tube using an external calibrator sizing system and internal air pressure. The cooled tube is hauled-off by a cater piller unit and led into a special heating bath where its temperature is raised by circulated ethylene glycol to approximately 125°C. The temperature of the bath and its length vary according to the tube dimensions are rate of output. A second calibration of larger bore is located immediately after the heating bath and the tube expands to fill this calibrator due to the internal air pressure, and is thus transversely oriented. A second caterpillar take-off unit which is adjusted to operate at a higher linear speed compared with the first units drawn the tube through the second calibrator and simultaneously stretches it longitudinally. But this process is very expensive one.

2.3. From the foregoing discussions it is clear that for obtaining optimum extruding efficiency, we should take a compromise between among all the relevent factors considered and for this project the simple free extrusion process is selected because it is easy and cheap.

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SECTION- III

3.0. PROCESS DETAILS OF MANUFACTURE

3.1. As mention earlier the Polyethylene pipe is made by free extrusion process, in which the molten plastic matierial is extruded through a tube shaped die and rapidly cooled.

Following processing steps are involved in Polyethylene pipes extrusion.

1. Clean the extruder and fit the cleaned die of required size.
2. Select the sizing die according to the requirements of pipe size.
3. Heat the Barrel of extruder and die.
4. When the processing temperature is reached start the extruder.
5. Feed the material to the extruder through hopper.
6. Fill the tank with cold water.
7. When the material extrudes in the form of pipe through the die, pass it through sizing die and cool it by passing through a water tank.
8. For getting the correct size air should be blown inside to expand the pipe into correct size. For ensuring this and also to make the haul-off easier an old oneside sealed pipe is joined with the extruding new pipe.
9. Pass the cooled pipe through a take-off unit which should pull the pipe at constant speed.
10. Cut the pipe into required length.

From experience the processing condition for extrusion of HPPE and LDPE pipes are found to be as follows:-

Processing condition	HDPE	LDPE
Barrel Temperature:		
Zone I (°C)	100	100
Zone II (°C)	150	130
Zone III (°C)	205	160
Die Temperature (°C)	225	175
RPM of the screw	20 - 35	25 - 40
Water bath temperature (°C)	28	27

The important equipments and parts are discussed below under the following heads:-

1. Extruder.
2. Extruder Drives
3. Die
4. Sizing Die
5. Mandrel.
6. Haul-off device.

EXTRUDER:- Extruder consists of a rotating screw enclosed in a cylinderical barrel. The proper combination of screw, barrel and heating/cooling system produces a fully homogeneous melt of thermoplastic which is passed through a die to give the product of desired shape at a continuous rate. Plastic extruder L/D ratio is between 15/1 to 25/1.

In order to melt the granules heat is generated by external heating. It is necessary to control its heat supply because if the material becomes too fluid otherwise. There are seven heaters in the barrel with a minimum heater band capacity of 1500 watts each. The temperature of each zone should be regulated by a separate thermocouple and controlled. This helps uniform control of the melt.

Extruder Drives:- The function of the extruder drive is to turn the screw, supply energy to the extruder, generate extrusion pressure and convey the product through the barrel.

Typical power required and output of extruder are given in literature survey (Section-II)

DIE:- There are two types of dies namely in-line die and cross-head die. The choice of the type of head for tubing extrusion generally depends upon the orientation of the extruder relative to the cooling trough. If an extruder is used for both wire coating and pipe extrusion, a cross-head system is normaly used. For the production of polyethylene pipes, the in-line type is enough.

The primary requirement of die design is the minimizing of hold-up area. Thus the spider holding the mandrel should be steam lined on the entrance and exist ends, and the die should be held snug enough to prevent leakage, but should be free to be moved for adjustments. The die carries an opening of the desired shape, and the screw proples the hot plastic material. The head and the die are electrically heated

and tapered internally to produce the necessary compression. The walls are polished to facilitate the flow and to get smooth surface of the product. The required size of die for different sizes of pipes is given in Appendix - II.

Sizing Die:- The sizing die is a cylinderical water jacketed die, whose internal bore is identical to that of the external pipe dimension. It is located close to the die face and is of slightly greater diameter than the die orifice. By means of compressed air introduced through the torpedo the pipe is inflated to the size of the die. The use of sizing die offers the advantage of high gloss finish. The various dimensions of sizing die for different sizes of pipe are given in Appendix-II.

Mandrel:- Mandrel offers the advantage of smooth inside surface and broad size range; the material is suitable for several OD sizes with same ID.

The required size of mandrel for different sizes of pipe production is given in Appendix - II.

Haul-off device:- The cater-pillar system, which is now probably the most widely used in the Polyethlene pipe manufacturing process. It consists of two endless belts which can be pressurised against the extruded product. On the endless belt are a series of resilient pads which readily conform to the shape of the section. The belts are supported on the contact run by a series of small steel rollers which ensure contact with the extrusion over the full distance between the belt pulley centres. The distance between the belts can be adjusted without

disturbing the centre height and a separate adjustment is provided to vary the overall height to suit different extruders.

3.2. QUALITY CONTROL:-

The following quality control measures may be taken.

Dimensional measurement and control:-

The outside diameter of a pipe can be easily measured during extrusion end, the necessary correction applied manually by the operator. The only method available is to cut off a length of the pipe and measure it with verniercalipers manually.

Accurate control of pipe wall thickness is also desirable since thickness of pipes are usually laid down in standard specifications, or are specified by the customer. In order to ensure that the pipe walls are of adequate thickness at all points, it is common practice to run the product on the top limit or even a little over. However this represents a wastage of material.

To over come this problem, systems are now available for the continuous measurements of the wall thickness of non-metallic tubes and pipes by the detection and continuous recording of capacitance changes. If desired, this equipment can also be arranged to control automatically the speed of the take-off to keep the wall thickness constant.

By the use of such equipment it is possible to detect roughness of the bore and ripples etc. whilst the pipe is running and to observe the effects of temperature adjustments.

Bursting Pressure Strength:-

The method of test for bursting pressure strength procedure is given in ASTM standard D1599-62.

The specimen length, between the end closure shall be seven times the nominal outside diameter of the pipe or a minimum length of 30.5 cm for sizes upto and including 15.2 cm.

The wall thickness of the specimen shall be measured to the nearest 0.00025 cm using a vernier calipers. The average diameter for roundable pipe shall be measured to the nearst 0.025 cm with a tape at three points, one near each end and one near the center of the specimen. Calculate the mean value of wall thickness and outside diameter.

Attach the end closures to the specimen without causing damage to the test section. Completely fill the specimen with the test fluid (water). The choice of closure will govern the method of filling. End closures must not reinforce or weaken the test specimen. Attach the specimen to the manifold, purge system of air before the test, and have the specimen immersed completely in the selected testing fluid.

Increase the pressure continuously until the pipe fails, measuring the time with a stop watch. If failure time is less than 1 minute lower the rate of loading and repeat the test. A maximum ~~time~~ pressure and time to failure for each particular size is to be recorded.

The test specimen shall be considered to have failed when it ~~is~~ develops a leak, weeps or ruptures.

Calculation:-

$$\text{Hoop stress} \quad S = \frac{P(D-t)}{2t}$$

where P = internal pressure in kg/cm^2

S = Hoop stress in kg/cm^2

D = Average outside diameter in cm.

t = Minimum wall thickness in cm.

3.3. Utilisation of scrap:-

When the extrusion commences till a time where conditions are balanced for uniform extrusion, the extrudates are treated as scraps and reused after grinding and drying in a oven for 3 hours at 70°C. This scrap is mixed with virgin plastics suitably.

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SECTION - IV

PRODUCTION REQUIREMENTS

The following given factors may be due consideration while starting a plastic pipe manufacturing unit.

4.1. Raw Materials:-

To produce polyethylene pipes the required raw materials are LDPE & HDPE. The chief source of indigeneous suppliers are IPCL & HOECHST. In addition to this the other manufacturers' name also given in Appendix - III. The current price of LDPE is Rs.21/= and HDPE is Rs.22/= including taxes transportation charges.

ANNUAL CONSUMPTION OF RAW MATERIALS

Item	Quantity required (kg)
LDPE	35,500
Scrap (LDPE)	9,000
HDPE	29,500

4.2. Machineries and its accessories:-

The total capacity of extruder in this proposed unit is 75 MT per year with 100% efficient on single shift basis. The technical assistance of machine suppliers can be made use of in the erection of machinery and its service. The following machinery and its accessories are required.

Extruder (Screw Dia - 75mm)		One
1" Die & sizing die	-	One
1½" Die "	-	One
2" Die "	-	One
2½" Die "	-	One
3" Die "	-	One
Haul-off unit	-	One
Water tank	-	One
½ HP Motor with pump	-	One
Grinder	-	One

The cost of machineries are given in Annexure-I-B

4.3. Man power requirements:- A fair estimation of the personnel requirement for the ~~pa~~ project is given below:-

Category	No. of persons
Technical manager	1
Sales manager	1
Clerk	1
Operators	2
Helpers	2

4.4. Land & Building:- Land of area at least 300 sq.m. is needed for this project. The work shed is 3 x 20 size, office and laboratory both shall have floor area of ~~each~~ 4m x 3m & 3 m x 3 m respectively. The required size for keeping raw materials and

finished products is 3 m x 3 m & 5 m x 3 m respectively. The estimated cost of land and building is Rs.40,000.00

4.5. Electric Power:- Connected load of 35 KW is required for the plant and machineraries, 4.5 KW for lighting purpose. The monthly power consumption is 212 KW. The detailed power consumption is given in Annexure II B-1.

4.6. Water:- Water storage system (4 x 4 x 2 m^3) along with one 0.37 KW water pump is provided along with plant and machinery. Water is also required for personnel consumption and several cleaning purposes.

4.7. Location:- While fixing a small scale unit location, the following factors to be considered.

1. Nearness to the market.
2. Nearness to Raw materials.
3. Cheaper labour wages.
4. Availability of Electric power.
5. Transport facilities.
6. Availability of water.

While locating a plant all the above factors should be given due consideration. This being as a small industry its requirements are meagre and so the most important consideration in choosing ~~the~~ a proper location should be nearness to the market. This product being a common item, the industry should thrive on local selling.

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SECTION - V

USERS AND MARKET SURVEY

5.1. Users:- PE Pipes have wide spread use in the following areas:-

1. Agricultural field: The farmers need mainly 2", 2½" & 3" pipes for their use in field. They prefer polyethylene pipes because of its advantages over the conventional pipe material like concrete and G.I. Pipes in its price and service.

2. Electrical field: Because of its good electrical resistance and ~~adk~~ oxidation resistance properties it is used in electrical field as electrical conduits.

3. Industrial field:- Polyethlene pipe have good chemical resistance property and smoother innersurface. It is used for water transportation and fluid transportation in different industries.

4. Construction field:- It is used for cold-water services, soil/rain water, underground drainage & electrical conduits.

5.2. Consumption pattern and estimates:-

The growth of PE pipes industry is directly related to the growth of agricultural, chemical industries and exports.

The demand and estimates for PE pipes for some future years are given below. For comparison the demand for other plastic pipes materials like PVC and PP is also included.

End-Use Demand Analysis

End-Uses	Production and consumption in 1974-75 (MT)	1978-79 (MT)	Expected Demand in 1983-84 (MT)
LDPE pipes & conduits	1160	4000	96,4000
HDPE "	5900	9900	13,260
PVC "	10,050	34,250	37,000
PP pipes & pipe fittings	--	500	1000

Export Performance

Commodity	Export performance Rs. (in crores) 1974-75	1975-76
Polyethylene Pipes	579.4	1745.3

Considering the above figures it is very clear that the demand for PE pipes will be more in the years to come.

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SECTION - VI

PRICING AND MARKETING

There are three strategies for pricing a product:-

1. Cost oriented pricing.
2. Competition oriented pricing.
3. Demand oriented pricing.

A compromise between the first two methods is considered in the present project. The selling price per kg. is Rs.26.26. The price list of the different sizes of the pipes if given in Appendix - II-D.

As can be clearly seen from the market estimation there is a high demand in South India especially in agricultural appliances. Distribution can be made directly and through distribution agency.

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SECTION - VII

CAPITAL REQUIREMENT

The financial aspects of the unit can be given in the following heads:-

1. Fixed capital requirement.
2. Working capital requirement.
3. Gross capital requirement.

7.1. Fixed capital:- This includes the cost of machinery, building, electrical goods, pre-operation expenses etc. The cost of each item is given in Annexure - I. The required amount is Rs.2,72,000.00

7.2. Working capital:- Working capital includes the cost of raw material, utilities and over head expenses. The requirements depends on the duration of involving in purchasing of raw material, manufacturing of the products and the products selling. A three months working capital should be always taken for the successful implementation of the project. The calculated amount of three months working capital is Rs.3,80,000.00

7.3. Gross capital requirement:-

Item		Amount Rs.
Total fixed capital requirement	-	2,72,000.00
Total working capital	-	3,80,000.00
Total	-	6,52,000.00

SECTION-VIII

FINANCING PLAN

8.1. Sources of fixed and working capital:-

8.1.1. National Small Industries Corporation:- On recommendation of the Director of Industries, machinery is supplied by the National Small Industries Corporation on the basis at very reasonable terms. Under this scheme the national small industries corporation supplies the machineries for the unit, on easy instalments on hire purchase basis.

The 90% loan is to be repayable in 13 half year instalments, first instalment being repayable after one year from the date of delivery of machineries.

8.1.2. Small Scale Industries development: It offers machinery on hire purchase on a margin money deposit of 20% . Repayment starts after two years and should be completed with in seven years. It offers special conscession to technically qualified persons. The rate of interest is 7.5%.

8.1.3. State Financial Corporation:- It offers financial assistance in cases to small and medium scale industries to provide for 85% of land, building, machinery, miscellaneous assets and contingency costs upto 10 lakhs.

Repayment should be started in the second year and should be completed with in 10 years in 17 half year instalments. The interest in the case of specified backward area is 10.25% and for other area is 11.85%.

8.1.4. Commercial & Co-operative Bank:- Nationalised banks provide cash loans for machinery. Loans are given on 25% margin money and 12 - 16% interest. The working capital can also be aquired as loan. Repay period is 3 years.

8.1.5. Industries Development Bank of India:- This bank offers financial assistance directly to industries upto 3/4th of the capital investment. So that the promotors contributes should not be less than 25%.

8.1.6. State Government Industries:- Departments under the rural industries project, it offers assistance for machinery purchase upto 90% of value at a rate of interest 6½%.

8.2. Financing of the Project:-

A gross capital of Rs.652,000.00 is proposed to be raised as follows:-

8.2.1. Loan:- 80% of the total fixed cost can be borrowed from State Small Scale industries development Corporation. 20% of the money has to be paid as margin money. Thus we can secure Rs.217,600.00 from SIDCO at an interest of 7.5%. A margin money of Rs.54,400 is required to secure this loan.

75% working capital can be borrowed from a nationalised bank at a rate of 16% interest. This loan amount is Rs.285000/= The margin money required is Rs.95000/=

8.2.2. Own funds:- The margin money for fixed capital and working capital shall be ~~mad~~ met by the entrepreneur. Thus total amount of Rs.149,400.00

Particulars	Loan	Own money	Total
Fixed capital	2,17,600.00	54,400.00	2,72,000.00
Working capital	2,85,000.00	95,000.00	3,80,000.00
Total	5,02,600.00	1,49,400.00	6,52,000.00

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SECTION- IX

ECONOMIC VIABILITY & PROFITABILITY

Finahcial viability of the project can be gauged through profitability.

1. Sales income and profit:-

Items		Rs.
Total sales	-	1929000.00
Sales distribution @6%	-	115740.00
Cost of production	-	1625600.00
Gross profit	-	187660.00
Income tax	-	105565.00
Net profit/year	-	82095.00

2. Rate of return on own capital:

Items		Rs.
Total amount of own capital	-	149400.00
Net profit/year	-	82095.00
% Rate of return on own capital investment	-	54.29%

3. Rate of Return on capital employed:

Items		Rs.
Gross capital	-	652000.00
Net profit	-	82095.00
% of rate of return on capital employed	-	12.59%

4. Percentage of profit on sales turnover:

Items		Rs.
Annual sales turnover	-	1929000.00
Net profit/year	-	82095.00
% of profit on annual sales turn over.	-	4.25%

5. Breakeven Analysis:-

$$\text{Breakeven point} = \frac{F}{P-V}$$

where

F = Fixed cost

P = Price/kg.

V = Variable cost/kg.

a. Total variable cost:

Item		Rs.
Raw materials	-	1,440,250.00
Utility	-	49,000.00
Distribution cost	-	115,740.00
		1,604,990.00

Variable cost/kg =Rs.21.85

b. Fixed Cost = (Cost of production + Distribution cost) - Variable cost.

= (Rs.1625600 + Rs.115740) - Rs.1604990

= Rs.136350.00

C. Price per kg. = Rs.26.25

Breakeven point = $\frac{F}{P - V}$

= $\frac{136350}{26.25 - 21.85}$ = 30.98 MT

6. Ability of Repayment Borrowed funds:-

The term loan has to be paid back within the prescribed time. In the total profit approximately 33% is retained and 67% is used to pay back the term loan.

Net Profit	=	Rs.	82095.00
Depreciation	=	Rs.	30650.00
Available surplus	=	Rs.	112745.00
Less:- drawing 33%	=	Rs.	37745.00
		Rs.	75000.00

Repayment period on loan = 5½ years.

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SECTION - X

CONCLUSION

1.	Total fixed investment	=	Rs. 2,72,000.00
2.	Working capital (3 months)	=	Rs. 3,80,000.00
3.	Total investment	=	Rs. 6,52,000.00
4.	Working shift per day	=	1
5.	Personnel requirement	=	7
6.	Annual production	=	73.45 MT
7.	Annual sales	=	Rs. 19,29,000.00
8.	Break-even production	=	30.98 MT
9.	Net profit (per ~~day~~ year)	=	Rs. 82,100.00
10.	Rate of return on investment	=	12.59%

****

ANNEXURE - I

Fixed Assets:-

Items		Cost.Rs.
Land and Building	-	40,000.00
Machinery & its accessories	-	1,85,000.00
Electrical goods	-	5,000.00
Other assets	-	4,000.00
Pre-operation expenses	-	37,500.00
Total fixed cost	-	2,71,500.00
Rounded off	-	2,72,000.00

ANNEXURE - I-A

Land & Building:

Items		Cost Rs.
Cost of land	-	10,000.00
Cost of Building	-	30,000.00
Total	-	40,000.00

ANNEXURE - I-B

Plant & Machinery:-

Items		Cost. Rs.
One Extruder (including water tank, compressor, Haul-off etc.)		1,28,550.00
Dies	-	12,000.00
Pump	-	1,500.00
Grinder	-	8,000.00
Bursting pressure strength testing equipment	-	12,000.00
Packaging	-	2800 .00
Transport	-	800.00
Tax 10%	-	15,000.00
Total		1,80,000.00

ANNEXURE - I-C

Pre-operation Expenses for six months:-

Item	Cost Rs.
Interest on loan for 6 months @ 7.5%	- 7250.00
Establishment	- 1500.00
Property taxes	- 1000.00
Postage	- 1500.00
Travelling Expenses	- 1000.00
Advertising,& Printing	- 1000.00
Indurance on Building and machineries	- 20205.00
Provision for meeting unexpected increasing in cost of any item	- 4000.00
	- 37500.00

ANNEXURE - II

Working Capital:-

Items	Cost Rs.
Raw material	- 1440250.00
Utilities	- 49000.00
Over head	- 24500.00
Total	- 1513750.00
Working capital required for 3 months operation	- 380000.00

ANNEXURE - II - A

Annual requirement of raw material

Item	Price Rs.	Quantity required kg.	Cost Rs.
LDPE	21	35500	745500.00
Scrap LDPE	10	9000	90000.00
HDPE	20.5	29500	604750.00
	Total		1440250.00

ANNEXURE -II-B

Manufacturing Cost:-

Item		Cost Rs.
Utilities	-	10500.00
Salary & wages	-	38500.00
Total		49000.00

ANNEXURE II B-1

Cost of Utilities:-

Electric Power consumption per day:

		KW
Extruder motor (15 KW)	-	120
Heater (1.5x6x8 KW)	-	72
Pump	-	2.75
Grinder (2 x 8)	-	16
Light	-	0.5
		212.22

Annual consumption of Electric power = 63666 KW

Annual Electric charge (Rs.0.165/unit) = 10500.00

ANNEXURE - II-B-2

Salaray and wages:-

Category	No.of person	Salary Rs.	Total amount Rs.
Technical	1	700	700
Sales man	1	600	600
Clerk	1	500	500
Operator	2	400	800
Helper	2	300	600
		Total	3200/=

Total amount of salary/year Rs.38000.00

ANNEXURE - II-C

Other over heads:-

Item	Cost.Rs.
Building maintenance @1%	- 400.00
Machine repairs @ 5%	- 9500.00
Travelling & advertising	- 3500.00
Postage	- 2000.00
2% insurance on fixed cost	- 5440.00
&m Property taxes	- 2000.00
Miscellaneous	- 1500.00
	- 24340.00
Rounded off	- 24500.00

ANNEXURE - III

Gross capital requirement:

Items	Rs.
Fixed capital	- 272000.00
Working capital	- 380000.00
Total	- 652000.00

ANNEXURE-IV

Other fixed cost & interest on loan:-

Item		Cost Rs.
a. **Depreciation:-**		
Depreciation on machineries @ 15%	-	27750.00
Depreciation on Building @ 5%	-	2000.00
Depreciation on other fixed assets. @ 10%	-	900.00
b. **Interest:-**		
Interest on Fixed capital @ 7.5%	-	20400.00
Interest on working capital @ 16%	-	60800.00
Total		111850.00

ANNEXURE - V

Total cost of Production:-

Item		Cost Rs.
Raw material	-	14,40,250.00
Electric charge	-	10,500.00
Salary	-	38,500.00
Other Over heads	-	24,500.00
Other fixed cost	-	1,11,850.00
		16,25,600.00

APPENDIX-I

ISI STANDARD SPECIFICATION

HDPE PIPE

A Subtitute for GI Pipe:

I S -1239-1968

Size mm (inch)	OD Max mm	OD Min mm	WT Max mm	WT Min mm	Working Pressure kgf/cm^2
50 (2)	60.8	59.7	4.15	3.85	6
65 (2½)	76.6	75.3	4.9	4.6	6
80 (3)	89.5	88.0	4.6	4.2	4

LDPE PIPE

I.S. 3076-1968

Nominal bore (mm)	(inch)	Nominal OD (mm)	WT Max mm	WT Min mm	Working pressure (lbs/sq.in.)
26	(1)	31.2	3.1	3.5	90
40	(1½)	43.8	3.4	3.8	70
50	(2)	60.0	4.6	5.2	70
65	(2½)	74.4	6.2	7.1	60
75	(3)	87.3	6.2	7.1	50

APPENDIX - II

The required dimensions of die, sizing die and mandrel for different sizes of PE Pipes production according to ISI Specification

HDPE PIPE

Size	OD		WT		Die	Mandrel	Sizing die	Wt / 100Mts	Pressure group
	Max.	Min	Max	Min.					
inch	mm	mm	mm	mm	mm	mm	mm	kg.	kgf/cm^2
2	60.8	59.7	4.75	3.85	60.0	57	60.5	70.5	6
2½	76.6	75.3	4.9	4.6	74.5	60	75.5	105.2	6
3	89.5	88	4.6	4.2	91	78	91	117.2	4

LDPE PIPE

1	31.2	-	3.5	3.1	32	25	32	29	8
1½	43.5	--	3.8	3.4	44	34.2	44	45	8
2	60	-	5.2	4.6	60	57	60.5	80	
2½	74.5	-	7.1	6.2	74.5	60	75.5	122	
3	87.3	-	7.1	6.2	91	78	91	166	

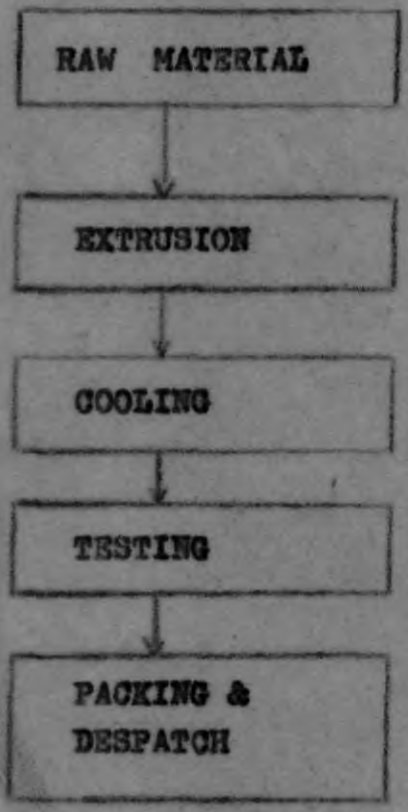
APPENDIX - II-A

TOTAL SALES:

Material	Sizes inch	Total Wt. (MT)	Total length of product (Metre)	Price/metre Rs.	Total price Rs.
LDPE	1	2.9	10,000	4.2	42000/=
	1½	4.5	10,000	8.5	85000/=
	2	8.0	10,000	16.7	167000/=
	2½	12.2	10,000	29.0	290000/=
	3	16.6	10,000	37.0	370000/=
HDPE	2	7.05	10,000	24.3	243000/=
	2½	10.5	10,000	32.1	321000/=
	3	11.7	10,000	41.1	411000/=

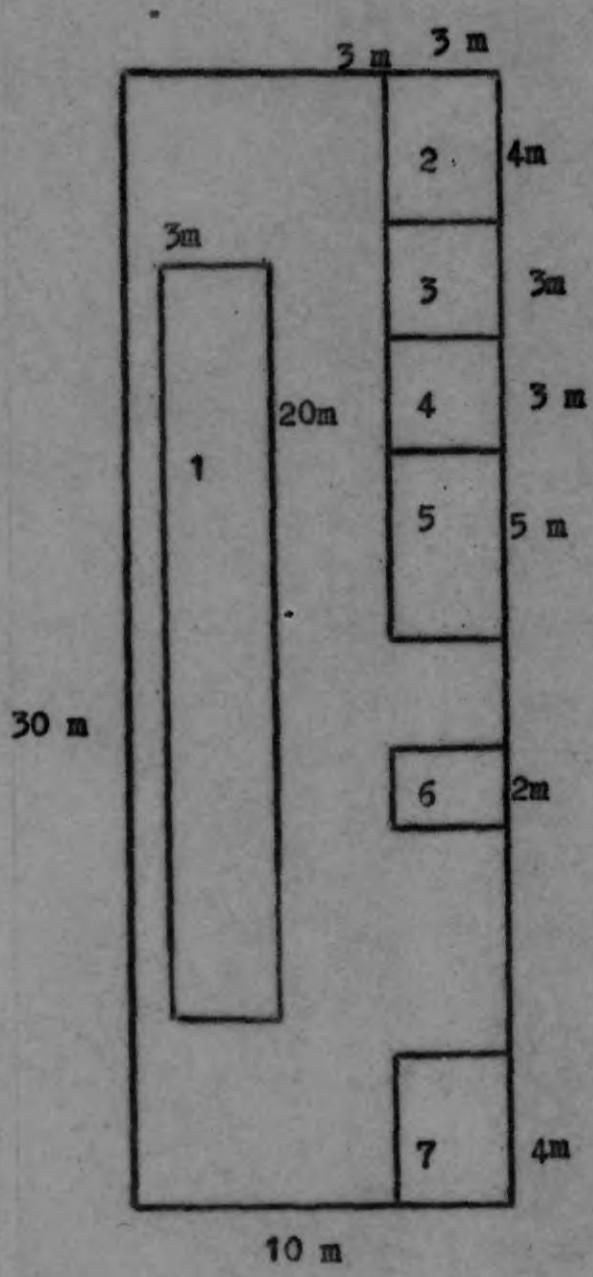
APPENDIX - II B

PROCESS FLOW DIAGRAM



APPENDIX - II - C

PLANT LAYOUT



1. Extruder & Accessories
2. Office:
3. Laboratory
4. Raw Material storage roo
5. Product storage room.
6. Grinder
7. Toilet

APPENDIX-II-B

PRICE LIST

HDPE PIPES

A substitute for G.I. Pipe conforming to I.S.Specification IS 1239-1968

Size mm(inch)	O D Max. mm	O D Min mm	Working pressure kgs/cm^2	Price/metre Rs.
50 (2)	60.8	59.7	6	24.30
65 (2½)	76.6	75.3	6	32.10
80 (3)	89.5	88.0	4	41.10

LDPE

Manufactured as per Indian Standard Specification IS 3076-1968

Nominal Bore (on ID basis) mm (inch)	Nominal Outside mm	Working pressure lbs/sq.in	Price per metre rs.
NORMAL GAUGE			
25 (1)	31.2	90	4.2
40 (1½)	43.8	70	8.2
50 (2)	60.0	70	16.7
MEDIUM GAUGE			
65 (2½)	74.5	60	29.0
75 (3)	87.3	50	37.0

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APPENDIX - III

Suppliers of Raw materials:

LDPE

1. Indian petrochemicals Corporation Ltd.,
   P.O. Petrochemicals,
   Dist. Vadodara 391346.

2. Indian Pertochemicals Corporation Ltd.,
   Ralla Ram Building,
   70, Mission Road,
   Bangalore-560027.

3. Union Carbide India Ltd.,
   Kasturi Building,
   Jamshedjim Tata Road,
   P.O. Box No. 610,
   Bombay-400001.

4. ICI Ltd.,
   P.O. Box No.310,
   Crescent House,
   Ballard estate,
   Bomaby - 400001.

5. Sidco Ltd.,
   Raw material Depot,
   Kadavanthara,
   Cochin-6820020.

HDPE

Manufacturer:

Polyolefins Industries Ltd.,
Bombay.

Suppliers:-

Hoechst Dyes & Chemicals Ltd.,
14, Pattle Road,
Madras - 600002.

APPENDIX - IV

List of Extruder Manufacturers and Suppliers:-

Extruder and its accessories:-

1. R.H. Windsor (India) Ltd.,
   E-6, U Road,
   Thana Industrial Estate,
   Thana- 400607.

2. Kolsite Industries,
   312, Kalbadevi Road,
   Bombay - 400002.

3. Brimco Plastics Pvt. Ltd.,
   55, Govt. Industrial Estate,
   Kandivli (west),
   Bombay - 499969.

4. Boolani Engineering Corporation,
   Prabhadevi Industrial Estate,
   402, Veer Savarkar Road,
   Bomaby-400025.

5. Neptune Plastic & Metal Industries,
   16, India Exchange Place,
   Calcutta.

6. Eliat,
   Vidya nagar,
   Kasargod,
   Kerala - 670123.

7. Polycare machineries,
   Surmount Enterprises,
   6 Dr. Nair Road,
   Madras-600017.

Grinder Suppliers:-

Pioneer Manufacturing Corporation,
41, Veena Dalvai Industrial Estate,
S.V. Road, Oshiwara,
Sogeshwari (W),
Bombay - 400060.

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