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ON

INDUSTRIAL V - BELTS

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INDUSTRIAL V-BELTS.

1. INTRODUCTION

"Rubber Industry" to many people means only one thing "rubber tyres" and not the countless industrial rubber products without which the economy of a country would cease to function. Consequently many people both in and out of the rubber business fail to realise either the size of this "non-tyre" industry or its immense contribution to the general welfare of the country. Falling with in this classification include such products as "Transmission Belts" which shows not only technological progress (1,2,3) but new market strength (4). Belting constitute a major sector of the non-tyre industry and has tremendous growth potential to meet both internal and export market. Power transmission belts in general are of two types, Flat transmission belts and V-belts. Flat transmission belts remained for a long time as a neglected power transmission medium, since it slipped on the flat pulleys they were trying to turn. Hence, V-belt now plays the dominent role in Industrial power transmission. It can grip the V-belt pulleys with a grip unknown to older flat rubber belts. It has certain specific advantageous when incorporated in a drive. These include:

a) Possibility of very short centre distance, the wedge action of the V-belt compensates to some extent for the small arc of contact.

b) Being compact, can be installed cheapely within a minimum of space, and guarded economically.

c) Replacement inexpensive, extremely quick and reduce down time of machines.

d) No lubrication worries.

e) Less vibration and noise and

f) Cushions the motor and bearings against load fluctuations both by elastic extensibility and slip under extreme over loads.

V-belts of various types like Automotive Fan Belts, Industrial V-belts and Fractional Horse Power belts are popular. Of these the first two types are more popular in the Indian market. V-belts were first introduced by Gates (5) Rubber Company of Denver, U.S.A. in 1917 and they arrived in U.K. by late 1930's and in India by 1950's. They are available in five basic sizes A,B,C,D, and E (Table 1), the top width of these belts being 13,17,22,32, and 38 mm. respectively.

TABLE.I. SIZES OF STANDARD INDUSTRIAL V-BELTS.

Section	Top width (mm)	Thickness (mm)	size range	Nominal inside length (mm)
A	13	8	23--174	584 - 4478
B	17	11	24--238	610 - 6045
C	22	14	43--418	1092 - 10617
D	32	19	75--598	1905 - 15189
E	38	25	180--598	4572 - 15189

As the power capacities of the belts rose due to development in tension members, the production of E section was dropped in most countries The fast moving sizes in the market are A and B. V-belts transmit power between V-shaped sheaves, and has the ability to accomodate a wide horse power range and operate singularly or in multiple. There is hardly a machine big or small sophisticated or simple where in one or more power transmission belts are not used.

The technology of this industry has grown to the point where belts are being engineered for every application (6). Banded V-belts, Poly V-bel and positive drive belts (7) are some of the newer developments in this area. The extensive development work on new designs with belts of smaller cross section and with higher unit strength has necessitated the use of stronger load bearing members in the belt and materials like rayon, steel wire, glass fibre and more recently polyster has been used with marked success, the rayon being more popular in India. The use of these stronger load bearing members, necessitated the use of special adhesive treatments to obtain proper cord rubber adhesion. Although wet RFL dip has been extensively used, a dry bonding system using resorcinol, formaldehyde donor (HMT) and silica in the rubber compound has reported (8) to give equivelent strength as wet RFL dip. This system does not require expensive fabric treatment equipment but its use is limited since most V-belts producers have costly dipping equipments and the dry in situ bonding system is no better than wet RFL dip. It is also difficult to obtain good finely divided silica filler in India. But since currently most of the cord manufacturers supply dipped cords at reasonable rates, it is possible to eleminate the costly dipping equipments and therefore the present project aims purchasing dipped cords from market.

2. MARKET SURVEY

2.1. USERS/CUSTOMERS ANALYSIS AND FUTURE DEMAND ASSESSMENT

There is a great built in demand for Industrial V-belts in our country. The item is used by all industries irrespective of the type and size of machines employed. There widespread applications include, compressors, conveyors, elevators, electric generators, liquid agitators and mixers, printing machinery, pumping machinery sifters and

separator screens, concete mixers, flour and feed mills, machine tools, pulp and paper making machinery, saw mill machinery, wood working machinery, ball and hammer mills, calenders, crushers, disintegrators, flaking mills, grinders, mining machinery, drilling machinery, presses extruders, stone breaking machinery etc. With a fairly developed industrial base, the demand for power transmission belt is very high in our country. As the phase of industrialisation gathers momentum, the demand for power transmission belts will increase rapidly. The industrial sector is very dynamic in India and the growth rate is very impressive with the result that our economy will reach the take off stage in the neap future. The above economic scene is very encouraging for a V-belt manufacture as the demand for this product is correlated with the pace of industrialisation (Fig.7.)

The production of Fan and Industrial V-belts for 1973 was 6 million pieces. The existing capacity is approximately 7 million pieces. The demand for Fan and V-belts for 1978 - 79 would be around 16 million pieces (9). Hence an additional capacity of 11 million is required to keep phase with demand. At present there is a heavy shortage for this item in the market and the production is nowhere near the demand. Even if the present production is doubled the product will enjoy a sellers market. The production of industrial V-belts for the last 18 years is shown (Table 2) (10). The growth rate is very promising, as the production has increased from 1.5 million in 1963 to 4 million by 1973 and the demand by 1978-79 would be around 9 million pieces. The present market condition of industrial V-belts is one of acute scarsity. The present manufacturers are unable to keep phase with demand. The scarsity condition will prevail for the next five to ten years despite the increase of capacities by various manufacturers and the establishment of new units.

TABLE 2. INDUSTRIAL V-BELTS, PRODUCTION STATISTICS.

Year	Production 'ooo s	Year	Production 'ooo s
1956	266.4	1965	2035.2
1957	451.2.	1966	2127.6
1958	546.0	1967	2647.2
1959	721.6	1968	3045.7
1960	952.8	1969	3240.0
1961	1014.0	1970	3443.9
1962	1312.8	1971	3282.8
1963	1519.2	1972	4006.6
1964	1779.6	1973	3880.2

Belting also shows good export potential. It constitute about 23.6 % of total non-tyre product exported. During 1973-74, India exported belting earning foreign exchange to the time of Rs. 26 million. Thus a new unit can aim both domestic and export market.

2.2. SALES CHANNELS AND METHODS.

The marketing of the above item can be handled in two divergent ways.

a) Entrusting to a sole distributor

b) Marketing by unit itself.

Both methods have merits and demerits. For a product like industrial V-belts, it is better to take up the marketing challenge by the unit itself. The pertinant reasons include:

a) It is unlikely to get a sole distributor whose loyalities can be counted in the long run.

b) Manufacturer will not have any direct effective link with dealers and consumers, preventing him to enter the market directly at a later stage if need arises.

c) The flexibility of the marketing operation will be very much limited; once a long term agreement is made the unit is obliged to follow the terms and condition, irrespective of price changes and demands.

d)Consumer loyalty to the product can be built up only in direct marketing.

e) There is no special saving in indirect marketing since the unit has to pass on to the sole distributor about 10% discount in the listed price, in addition to dealer commission.

f) Brand popularisation and image creation can effectively be done only in direct marketing.

Having selected direct marketing, the unit has to execute the following

a) Formation of sales departments.

b) Evolving an effective product promotion compaign.

c) Building an efficient dealer network.

The functions of the sales department include

a) Customer and dealer contacts.

b) Canvasing and processing orders.

c) Advising the production department on production planning

d) Product despatch

e) After sales service.

f) Sale accounting

g) Product promotion

2.3. GEOGRAPHICAL EXTENT OF MARKET.

2.3.1. Domestic Market.

The unit can aim an All India Market with Northern, Eastern, Western and Southern zone with head quarters at Calcutta, Delhi

Bombay and Madras respectively. The unit can appoint zonal representatives and sales representatives. Dealers can be appointed in all principal towns and cities of India. A survey showed that dealers of the present manufacturers are Mill store suppliers, spare part and general machinery dealers. Since V-belt is an item consumed by machines in Industries, it is the industrial buyer who ultimately makes the purchasing decision. They are well informed and usually make rational decisions based on quality, price, delivery time, payment terms, after sales service etc. Hence consistency of quality should be initially established for a destinction brand to be established in the market.

2.3.2. EXPORT MARKET.

The industrial V-belts are having a very good export potential in other countries since industries are expanding all over the world. India export belting to various countries like Philippines, Malaya, Kenya, Bengaledesh, Iraq, Burma, Kuwait, U.S.A. and U.K. India's export of belts for the last 12 years is shown in Table 3.

TABLE 3. VALUE OF BELTING EXPORTED.

Year	Value 'ooo s Rs.	Year	Value 'ooo s Rs.
1962-63	30	1968-69	690
1963-64	104	1969-70	1040
1964-65	315	1970-71	1637
1965-66	122	1971-72	752
1966-67	240	1972-73	911
1967-68	393	1973-74	2585

2.4. COMPETATIVE SITUATION

Since the demand out phase the supply, there is least chance for a competitive situation in the market. The major manufacturers of power transmission V-belts in India are Dunlop India Limited, Fenner Cockill Limited, National Rubber Manufacturers, Firestone Tyre and Rubber Company and Oriental Rubber Industries. Apart from these there are some eighteen small scale manufacturers producing industrial V-belts. The licensed capacity of the major manufacturers are given in Table 4.

TABLE 4.

Sl.No.	Name of Manufacturer	Licensed capacity
1	Fenner Cockill Ltd., Madurai	38,36,000 Nos
2	Dunlop India Limited, Calcutta	13,80,000 Nos
3	National Rubber Manufacturers Ltd., Calcutta	9,80,000 Nos.
4	Firestone,Tyre and Rubber Company Bombay	7,20,000 Nos.
5	Oriental Rubber Industries Ltd., Bombay	2,40,000 Nos.

Though some of the manufacturers are planning to increase the capacity and the commissioning of some new units inevitable, from judging the past experience in the field, the product is destined to enjoy a Sellers Market for years to come.

3. PRODUCTION REQUIREMENT

3.1. LOCATION

The decision of plant location is based on a comparative study of the facilities available which include, raw materials, skilled workers, water, electricity, transport convenience and nearness to market. The site should be selected to avoid industrially build areas and to accomodate a site 5 times the contemplated area considering the minimum future requirements including expansion. The size selection should be based on datas collected from different sources.

FACTORS	SOURCE OF INFORMATION
a. Community	Bankers, Chambers of Commerce
b. Construction cost	Architects, Contractors
c. Electricity	Electricity Board.
d. Housing availability	Civic officials
e. Industries in area	Industrial Associations
f. Labour situation	Other manufacturers
g. Markets	Salesmen, customers
h. Site	Municipal authorities, Brokers
i. Taxes	Government officials
j. Transportation	Carrier serving area
k. Water supply	Public Health Engineering Department

If the factory is located in an Industrial Estate, it offers the following advantages.

a. Well planned units of various types can be purchased or taken on rent thus eliminating the investing of money on land and building.

b. They provide factory accomodation at suitable sites with Common Facilities for water, electricity, steam, transport, banks, postoffices canteens, laboratories, libraries, and Toolrooms.

c. They bring a number of industries together and facilitate collective purchase of raw materials and sale of finished goods.

d. They help the dispersal of industries to comparatively under developed regions raising the living standard of the people living those areas and provide an ideal toolfor integrated development.

e. They help intertrading and interservicing.

f. Some of the other facilities include, marketing facilities, exemption from sales tax, priority for electric power connection and subsidised charges for consumption of power.

Location in an industrially back ward area also provide some special benefits like exemption from tax and rebate on fixed capital. Therefore the present project can be located in an Industrial Estate in Kerala where the facilities like raw materials, skilled workers, water, electricity and transport convenience are available.

3.2. RAW MATERIAL REQUIREMENTS

All the raw materials are indegenously available from well established sources. The raw material requirements for one year are shown in table 5. The sources of raw materials are given in Annexure 9 A part of the natural rubber can be replaced by SBR. For specialised applications Neoprene W types can be choosen which impart high heat flex, oxygen, ozone, and oil resistance. Since in Kerala where an uninterupted supply of Natural rubber is available, the project is worked out with 100% NR. A part of the raw polymer can be replaced with reclaim which reduce cost and improve processing.

3.2.1. TERMS OF PURCHASE.

All negotiations are done through banks. On a margin money of 30% the bank will spend 70% for the purchase of raw materials. The amount has to be paid in 70 days with interest. The materials will be pledged to the bank and small quantities are withdrawn whenever required, on payment of cash.

3.3. LAND AND BUILDING.

The total land area required is 10,000 sq.feet. Since the present project can be started in Industrial Estate, a well planned unit to house the layout should be choosen. An 'A' type special shed with an area of 7,200 sq.feet is most desireable.

3.4. PLANT LAYOUT

The plant layout, properly designed will cover all production and service facilities, and help to provide the most effective utilisation of men materials and machines in the process and also to co-ordinate all operations. The plant layout should ensure:

(a) Economic processing and low material handling cost.

(b) Effective utilisation of all space and should avoid floor congestion and bottlenecks in operation.

(c) Uniform flow of materials through the plant and

(d) Shop cleanliness, good working conditions, elimination of hazards and easy access to service facilities.

A typical layout for the project is shown in Fig.7.

3.5. PLANT AND MACHINERY.

All items of plant and machinery are indegenously available from well established sources. A portion of the equipments can be fabricated locally. The main items of machinery and equipment for the production of Industrial V-belts is given in Annexure 2. The total cost of plant, machinery and equipment is worked out to be Rs. 8,60,900/-

3.5.1. Capacities of Major Machines.

The capacities of major machines are shown in Box.1

Box.1

Machinery	Capacity per hour
Mixing Mill 14" x 36"	50 to 60 kgs.
Calender 42" 3 bowl	162 Metres
Extruder 2½"	50 kgs.
Boiler	200 kgs. steam

3.5.2. Terms of Purchase.

(a) Quotations are made and satisfactory quotations are confirmed

(b) One third of the total amount has to be paid in advance with the purchase order and balance against delivery documents through bank.

(c) Forwarding, packing, Taxes like G.S.T., C.S.T., Octroi are at extra cost.

(d) The purchaser has the right to inspect machinery.

(e) Delivery time will be within 6 to 8 months from the date of receipt of confirmatory order.

(f) Most machinery supplier give one year guarantee of good performance.

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

3.5.3. Source of supply

The source of supply of plant and machinery is given in Annexure 6.

3.6. MAN POWER REQUIREMENTS

The personnel required for the unit can be catagorised as operating and non-operating. The number of operating personnel is 66. Non-operating personnel will be 25. The Chief Executive of the unit is the General Manager. Since sales will be the most important function of an Industry, the unit proposes to have a very competant Sales Manager who is well versed in the marketing of V-belts.

3.6.1. Training programme.

For the efficient functioning of the firm, experienced and well trained technologists, supervisors, Millmen and other operators are required. Small Industries cannot afford to have elaborate training programmes, as it is a costly affair. However, the Government is giving training programmes in institutions like Common Facility Service Centres at affordable expenses. The manpower requirements of the unit is given in Annexure 7.

3.7. UTILITIES.

The utilities required are water, electricity and steam. The requirements of water, electricity and steam are shown below:

(a) Water.

Water is used in boilers and to cool mixing mill, Calender and extruder. The water can be re-circulated and fresh make up of water required is approximately 3000 litres per day. In Kerala water is available in all seasons.

Total water required = 900 kilo litres per annum

Cost = Rs. 900/-

(b) Electricity

Electricity is the major driving power for all machines. The electrical requirements for the process operations are given below:

Box.2

Sl.No.	Machinery and Equipment.	H.P.	K.W.
1	Mixing Mill	40	29.84
2.	Calender	30	22.38
3	Extruder	5	3.73
4	Wrapping Machine	3	2.24
5	Boiler	5	3.73
6	Water pump	4	2.98
7	Testing equipments	14.5	10.81
8	Lighting		3.92

Total K.W.		= 79.63
Annual electrical requirement Cost at 15 paise per K.W. assuming 80% of total consum.	}	= Rs. 55,296/-

(c) Steam

Operating cost of boiler (125 litres of Furnace OIL per day, rate Rs.1.10 per litre	}	= Rs. 41,250/-
Total operating cost of utilities		= Rs. 97,406
Rounded off		= Rs. 97,400/-

3.8. INFRA STRUCTURE AND OTHER FACILITIES

Consideration should be given to the availability of basic Infra Structure and supporting facilities of the proper type and in needed amount. These include:

(a) Transportation for incoming raw materials and components and outgoing finished products.

(b) Adequate storage facilities.

(c) Power i.e. facilities for H.T. and L.T. power lines.

(d) Communication facilities like Telegraph, Telephone, Telex services.

(e) Fuel for heat, power and process requirement

(f) Water for process requirement

(g)Facilities for sewage and waste disposel

4. TECHNOLOGY OF V-BELT MANUFACTURE.

4.1. BASIC V-BELT CONSTRUCTION

V-Belts have typical constructions of:

(a) Tension members (b) Base rubber (c) Cushion rubber and (d) Fabric jacket.

(a) Tension members.

The most important component is the tension member or reinforcing cord, which is usually of single or multilayer situated at the neutral zone (1/3 from top of pitch line). The characteristics of the tension member determines, how great a load the V-belt will transmit, the type of pulleys to be used, the stretch of the belt in service, and the length of time the belt will function satisfactorily, Rayon, steel wire and polyester have been introduced with marked success, rayon being more popularly used in India since it is indegenously availab.e Table 5 list the properties of cord materials used in belts (12). The use of these higher load bearing members in the belt, necessitates the use of special adhesive treatments to obtain adequate adhesion. Wet RFL dip is extensively used for rayon. A dry bonding system using Resorcinol, Formaldehyde donor (HMT) and silica is a development to be carefully considered to eliminate the costly dipping equipments.

(b) Base Rubber

The chief function of the base rubber is to support the cord tension members in a uniform plane so that equal strain is placed on each cord during belt operation. This is usually a hard rubber compound (13)(80 IRHD) and should possess high modulus in the transverse direction of the belt to resist distortion and squashing when operating under high loads and good flexibility in the axial direction as it goes around the pulleys. The compound should therefore possess:

* Low dynamic heat build up

* resistance to flex cracking and heat hardening

* Adhesion to jacket and cord

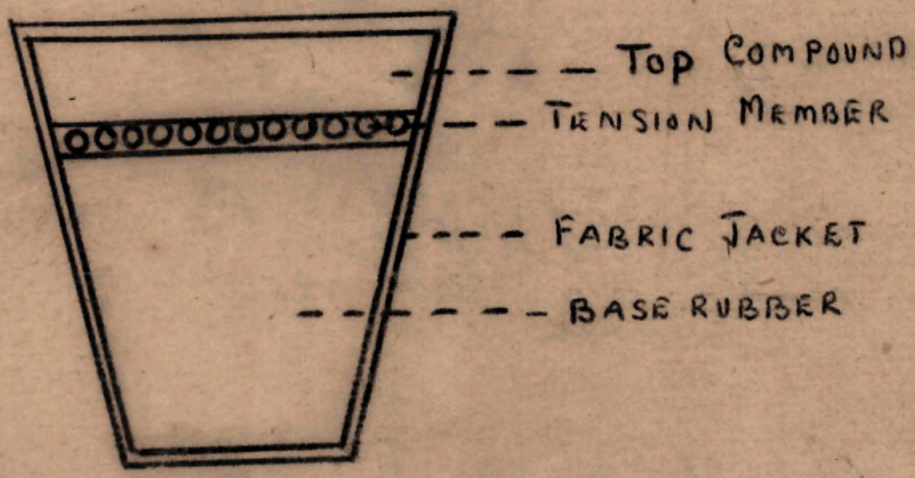
* Good Tensile strength and Modulus.

TABLE 5. PROPERTIES OF CORD MATERIALS USED IN BELTS.

PROPERTY	RAYON	NYLON	POLYESTER	GLASS FIBRE	WIRE
Tenacity (gms/denier)	4	7.5	7.5	8	3.8
Strength of typical dia (in.)	0.037	0.031	0.030	0.021	0.014
Slow loading (lbf)	61	67	67	75	54
Impact loading (lbf)	71	71	78	95	69
Elongation at break (%)	13	19	17	4	3
Modulus rating	100m	60	100	1000	1000
Dimensional stability					
Shrinkage (%)	0.9	6	3	0.1	0.1
Growth (%)	2	8	3	0.1	0.1
Moisture (%)	11	3.5	0.3	0.1	0.1
Heat Resistance rating	100	150	210	1000	1000
Wet strength	60	90	99	99	99
Flat spotting rating	100	25	100	300	300
Specific gravity	1.52	1.14	1.38	2.52	7.8

(c) Soft Cushion Rubber (Topping Compound)

The soft cushion rubber (60 IRHD) encases the cord tension members and it reduces deterioration which may occur by chafing the cord one against the other. The cushion compound should have:



TYPICAL V-BELT CONSTRUCTION

Fig-1

* Good extensibility when it goes around pulleys

* Low dynamic heat build up

* Reisistence to flex cracking and heat hardening

* Good flow characteristics in the uncured state.

* Ability to isolate and encase the tension members

* Good cured adhesion to cord and jacket.

(d) Jacket Fabric.

Frictioned fabric jacket consisting of one or more plies of rubberised cotton fabric prevents the ingress of moisture and function as a protecting envelope for the belt. The friction compound or jacket should possess:

* Good adhession and

* Resistance to heat hardening

4.2. PROCESS OF MANUFACTURE

There are various processes for the manufacture of V-belts. The shorter V-belts are manufactured on rotatable collapsible drums. The required number of layers of rubber are applied to the drum, the cord is wound on at touch pitch. The individual belts are then parted off by means of circular knives. They are then transfered to a skiving machine which roughly forms the V shapes. Finally one or two jackets are applied using a belt flipper. The belts are then vulcanised in multiring moulds in open steam.

The long length belts are made similarly, except that they are built on twin drums using weftless cord fabric instead of an individually wound cord. The belts are then vulcanised by moulding in a press under controlled stretch condition. The above process is suitable for a large scale manufacturer . Hence in the present project a separate process which uses indigenously machinery and equipments is preferred.

The various process steps in the manufacture include:

a) Mixing

b) Extruding the base rubber

c) Extruding top

d) Calendering rayon cord fabric and cotton jacket fabric

e) Assembling or Belt building

f) Wrapping

g) Vulcanising

h) Stripping

i) Finishing

j) Inspection and quality labelling

k) Packing and despatch

A process flow diagram is shown in Fig. 2.

a) Mixing

Mixing is carried out as per specified schedule. The batch weight for a 14" x 36" mill is approximately 25 - 30 kgs. batch and takes 20 - 30 minutes. The mill is run for 2 shift to produce 860 kg. of mixed compound. It is usual to run several batches of same compound to get uniformity in mixing. The same mill is used for warming up operation before feeding to extruder, for the base and top extrusion in the 3rd. shift.

b) Extruding base.

The base compound is broken down, warmed and fed to the extruder with uniform strips at uniform temperature. The mill bank should be kept 10 to 20 cm high. The extruder jacket should be cooled to maintain extrudate temperature at or below 95°C for safe processing. The base profile is then cooled and stacked. Extrusion speed is 50 kg. per hour.

c) Extruding top

The procedure is the same as above.

d) Calendering Rayon cord and Cotton jacket fabric.

Rayon cord and cotton jacket fabric are rubber frictioned on both sides using a 3 bowl calender, with the feed introduced between top and middle roll. Both sides are coated as two separate operations. A processflow for the calendering operation is shown separately. Temperature settings on roll are shown in box 1. Shop floor tests carried out on calendered rayon cord fabric include:

* Elongation
* Weight per meter
* Guage
* No of cords per inch.

e) Assemblihg or Belt building.

The belt is build or drums by applying the base, tension members, top compound and jacket.

f) Wrapping, Vulcanising, Stripping.

The assembled belts are wrapped, vulcanised in open steam for 40 minitues at 150°C, cooled and striped.

i) Finishing and Inspection.

The finished belts are trimed, inspected for defects and quality labelled.

k) Packing and Despatching.

The products are grouped according to sizes packed and despatched.

Box 1.

TEMPERATURE SETTINGS, CALENDER

Roll	Temperature.
Top roll	110°C
Middle roll	85°C
Bottom roll	65°C

4.3. TROUBLE SHOOTING AND REMEDIES.

Trouble shooting	Remedies.
1. Scorch during extrusion and calendering	Check extrusion temperature and calender bowl temperature.
2. Reduced jacket and cord adhesion	Use solvent during building
3. Under cure	Check steam pressure guage Check steam trap

4.4. PROCESS LOSS

Process loss may occur as:

(a) Scorched stocks

(b) Calendered fabric waste

(c) Flash and trimmings.

Scorched stocks can be reduced by good quality control before processing. Flash trimmings and calendered fabric waste can be reclaimed. The process loss can be controlled within 3%

4.5. QUALITY CONTROL

Quality cannot be inspected into a finished product. Quality has to be checked right from the raw material, processed compoi nds and in the finished product. Raw material checks one items from reputed manufacturers is not necessary. The following raw material tests are carried out for conventional chemicals:

Acceptance tests for Raw materials

(a) Reclaim

(1) Acetone extract (2) Residue on loss of ignition

(b) Zinc oxide

(1) Moisture (2) Sieve residue (3) Residue insoluble in 40% Acetic Acid

(c) Stearic acid

(1) Iodine value (2) Acid value (3) softening point

(d) Carbon Blacks

(1) Iodine value (2) DBP Absorption

(e) Accelerators.

(1) Melting point (2) Solubility

(f) Oils.

(1) Viscosity

(g) Sulphur

(1) Sieve residue (2) Acidity (3) Ash

(h) Rayon

(1) Tensile strength and elongation (2) moisture content

Process Control Tests.

These include tests on mixed stock prior to calendering and extrusion for each batch.

(a) Minimum viscosity (b) Scorch (c) maximum torque (d) specific gravity (e) Hardness (f) Tensile strength and elongation (g) modulus (h) Adhesion test on rayon cord and cotton jacket fabric.

Product testing

The following product tests are carried out as per ISI standards (14) for dimensions.

(a) Checking the angle of V-belts

A gauge as shown in Fig. 4 shall be used for checking the angle of V-belts. Along a straight portion of the belt kept under tension the cross section shall be such that the edges of the broader (top) side of the belt shall touch the sides of V-groove having an included angle of 38° and the edges of the narrower (bottom)side of the belt shall touch the sides of V-groove having an included angle of 42°. The flanks of the belt shall not touch the sides of the V-grooves.

(b) Section checking of V-belts.

A gauge as shown in Fig. 5 shall be used for checking the cross section of V-belts.

Along a straight portion of the belt kept under tension, the cross section of the belt shall be such that when placed in a gauge as shown in Fig. 5, it shall not touch the bottom of the gauge, the

edges of the top widths 's' and 't' shall not be higher than the points 'u' and 'v' at the top of template and the guiding mark 'mn' on the template shall cut the whole width of the belt in its upper half.

(c) Measuring the pitch length of V-belts.

The belt shall be mounted on two similar pulleys and a tension shall be applied to the belt. Before applying the tension, the belts shall be rotated a few times so that the belt is seated squarely into the grooves of the pulleys. The dimensions of the pulleys and tensions to be applied are specified in Fig. 6. The pitch lengths of the belt shall be calculated as given below:

$l_p = 2E + c_p$

Where

l_p = pitch length of the belt

E = centre distance between the two pulleys, and

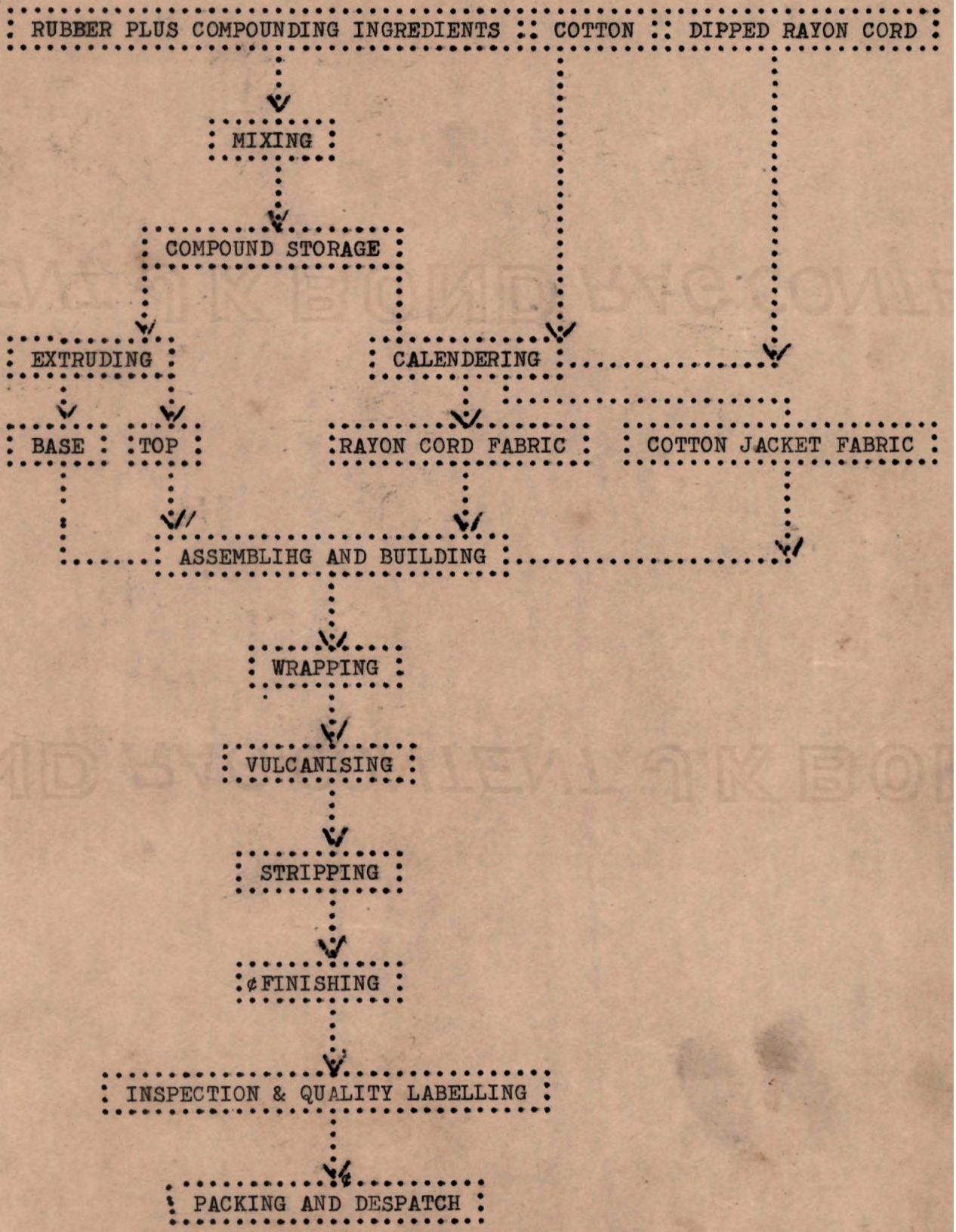
c_p = pitch circumference of the pulleys.

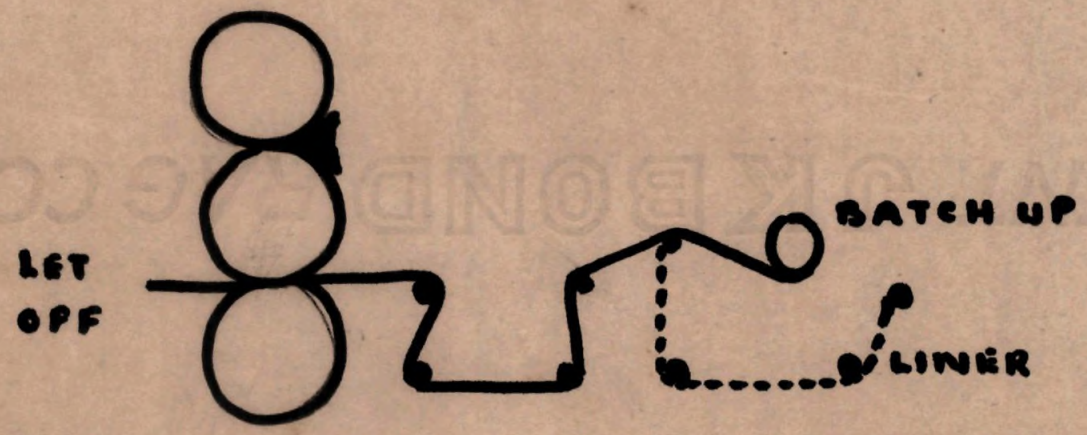
Apart from these ISI tests the hardness and cut belt examination can be carried out to ensure cure completion. The performance characteristics can be checked on a V-belt test running machine.

The sampling procedure can be as per ISI standards and any V-belt failing in one or more of the dimensional requirements shall be considered as a defective.

FIGURE.2

V-BELT MANUFACTURE





CALENDER LINE FIG 3

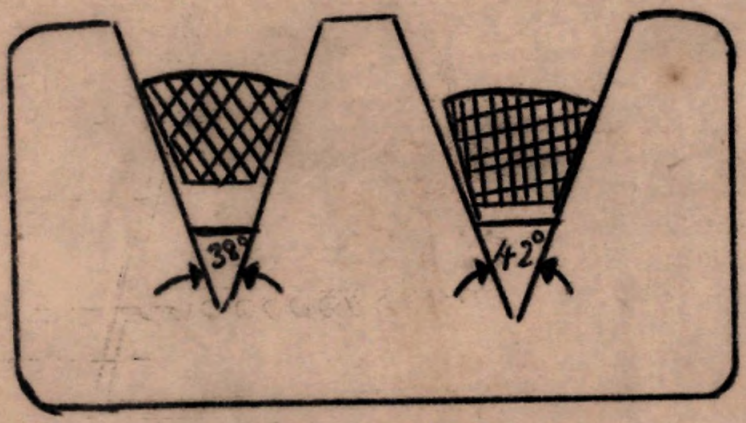


FIGURE - 4

CHECKING THE ANGLE OF V-BELT

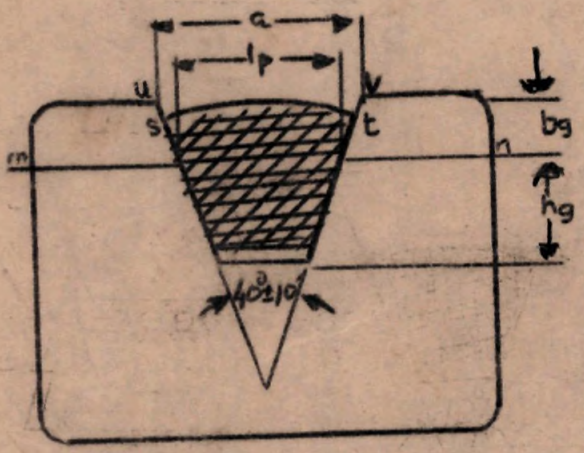
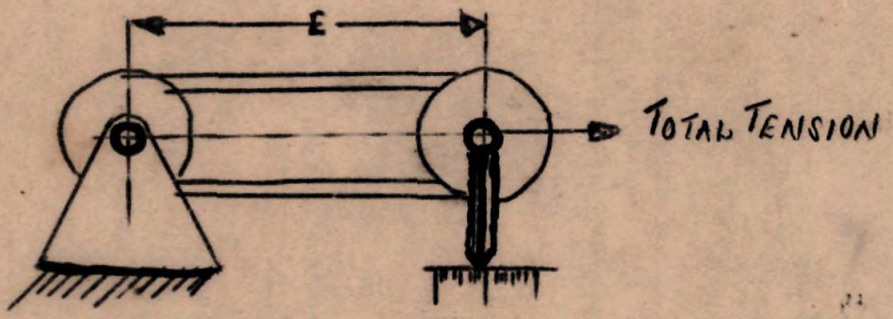


FIGURE - 5

GUAGE FOR CHECKING THE SECTION



MEASURING PITCH LENGTH OF V-BELTS

FIG. 6

5. SELLING AND DISTRIBUTION ARRANGEMENTS

The selling and distribution arrangements can be catogorised us.

a) Direct sales by opening sales depots

b) Through agents on commission basis.

For a V-belt manufacturer it is better to take up the marketing challenge by the unit itself due to reasons discussed in section 2.2. The goods can be despatched through rail or lorry. There is no credit for the product and documents are usually drawn through bank.

6. CAPITAL REQUIREMENTS

6.1. FIXED ASSESTS

The total fixed capital requirement is the summation of the expenses incured for land and building, plant and machinery, other fixed assests and prepperative expenses. The estimated fixed capital requirement is given in Annexure 4.

6.2. WORKING CAPITAL

Working Capital is the expenses incurred during a definite period of time towards the working of the plant. There are several methods of computing working capital. It depends upon the credit facilities made available by banks, raw material suppliers and the salaries and wages, utilities and other overheads. The estimated working capital requirement is given in Annexure 5.

6.3. TOTAL FINANCIAL REQUIREMENT.

This is the summation of the total fixed capital and working capital. The total financial requirement is estimated in Annexure 6. Rs. 19,61,800/-

7. FINANCING PLAN

In India, an entrepreneur need contribute only a minor portion of the total capital for starting a Small Scale Industry. The Government has launched several financing programmes for helping Small Scale Industrial entrepreneures. This include:

(a) State Financial Corporation

They provide long term credit for purchase of fixed assets and working capital loans to the extend of 50 to 75% of the value of the assets, at 6½ to 9% interest. They repayment generally has to be completed in 10 to 12 years time.

(b) State Director of Industries.

They provide loans under State Aid to Industries Act.

(c) State Bank of India and its subsidiaries.

They sanction medium and instalment credit loans for purchase of machinery and construction of factory buildings. Also provide working capital for purchase of raw materials. The rate of interest usually 14% per annum.

(d) Commercial Banks.

They sanction loans for meeting working capital needs.

(e) National Small Industries Corporation

They give machinery on Hire purchase at 7% interest, repayable in 7 years time

The financing plan for the present project is as follows:

(a)	Own Fund	Rs. 3,03,200/-
(b)	Block loan from Financial Institutions	Rs. 7,54,320/-
(c)	Cash loan from Banks	Rs. 9,04,300/-
	Total	Rs. 19,61,800/-

8. PRICING POLICY

With regard to price, the unit can market the product at the prevalant prices in the market. Most of the leading manufactures have only one price. There is no difficulty in sale at current prices since there is an acute shortage for the item in the market. The manufactures have recently increased the product prices, due to increased raw material costs. The present project is worked out with an average retail price of Rs. 14.42 for cost calculations.

9. PROFITABILITY ANALYSIS.

9.1. COST OF PRODUCTION

The annual manufacturing expense for the manufacture of 6 lakh pieces of industrial V-belts is estimated below:

a) Raw material	=	Rs.	25,03,000
b) Salaries and wages	=	Rs.	7,04,950
c) Utilities	=	Rs.	97,400
d) Other overheads	=	Rs.	3,12,000
e) Interest on working capital	=	Rs.	5,14,000
f) Depreciation on			
i) Machinery	=	Rs.	86,090
ii) Fixed Assests and pre-operative expenses	=	Rs.	19,660
Total cost of production	=	Rs.	42,37,100

9.2. SALES AND MARKETING EXPENSES.

a) Distribution cost (freight, storage and packing)	=	Rs.	1,40,000
b) Indirect marketing expenses (travel, show room)	=	Rs.	30,000
Total	=	Rs.	1,70,000

9.3. COST ESTIMATION

a) Cost of production	=	Rs. 42,37,100
b) Sales and marketing expenses	=	Rs. 1,70,000
TOTAL	=	Rs. 44,07,100

9.4. REALISATION FROM SALES

List Price	=	Rs. 14. 42
Less: 15% discount	=	Rs. 2. 16
Price enclusive of Central excise	=	Rs. 12. 26
Central excise duty	=	Rs. 2. 04
Sales realisation	=	Rs. 10. 22

For calculation purpose, this is rounded off to Rs.10. 00

* This is based on the price of B. 60 size which is taken to be the standard for calculation purpose.

** The product prices have been increased recently by major manufactures due to increased raw material prices. However, this has not been taken into account.

9.5. NET PROFIT

Total income from sales	=	Rs. 60,00,000
Less: cost of production, sales and marketing expenses	=	Rs. 44,07,100
Profit before tax	=	Rs. 15,92,900
Less: Tax incidence	=	Rs. 7,96,450
Net: profit after taxation	=	Rs. 7,96,450

9.6. RATE OF RETURN ON OWN CAPITAL.

Own capital	=	Rs. 3,03,200
Net profit	=	Rs. 7,96,450
Rate of return on own capital	=	262.6 %

9.7. RATE OF RETURN ON CAPITAL EMPLOYED

Capital employed	=	Rs. 19,61,800
Net profit	=	Rs. 7,96,450
Rate of return on capital employed	=	40.5 %

9.8. PERCENTAGE OF PROFIT ON SALES TURNOVER

Annutal return from sales	=	Rs. 60,00,000
Annual profit	=	Rs. 7,96,450
% profit on sales turnover	=	13.2 %

9.9. PAY BACK PERIOD IF BORROWED FUNDS

Annual profit	=	Rs. 7,96,450
Plus depreciation	=	Rs. 1,05,750
Available surplus	=	Rs. 9,02,200
Less: drawings	=	Rs. 2,25,550
Amount available for paying back loan	=	Rs. 6,76,650
Term loan to be paid back	=	Rs. 7,54,300
Pay back period	=	14 months

9.10 BREAK EVEN ANALYSIS

Break even quantity is that quantity which if produced and sold will give neither a profit nor a loss.

$$B.E. = \frac{F}{P-V}$$

Where F = Annual fixed costs.

P = Unit price of product.

V = Variable cost per unit

Total sale of product	=	60,00,000
Average price per unit	=	10

Total variable cost

a) Raw materials	=	Rs. 25,03,000
b) Utilities	=	Rs. 97,400
c) Direct labour	=	Rs. 2,14,600
d) Distribution cost	=	Rs. 1,40,000
TOTAL	=	Rs. 29,55,000

Variable cost per unit	=	Rs. 4.92
Fixed cost per unit -	=	Rs. Total cost per unit - variable cost per unit.
Total cost	=	Rs. 42,37,100
Cost per unit	=	Rs. 7. 06
Fixed cost per unit	=	Rs. 2. 14

$\therefore$ B.E. $= \frac{F}{P-V}$ = 42 %

$\therefore$ Break even unit per year = 2,52,000 Nos.

11. CONCLUSION

Industrial V-belts can be started as a Small Scale Industry with indegenous raw materials and machinery. It gives the entrepreneur profits, independence and satisfaction, opertunity to use once ideas and opportunity for growth. To the nation it provides larger employmant with less investment, earns foreign exch through export and supports as a backbone of Indias economy. It produces goods with lesser time lag, mobilises local resources, skills and savings and develops entrepreneurship and entrepreneurial skills.

ACKNOWLEDGEMENT

I would like to express my thanks to Mr. V. Bhaskara Pehla Secretary, Rubber Board, Mr. C.M. George, Deputy Director, Agronomy Division, Mr. E.V. Thomas, Deputy Director, Rubber Chemistry and Technology Division, and Mr. R.G. Unny, Statistician, Rubber Board, for their guidance in preparing the report. I also wish to thank Mr. R. Lakshminarayanan, Technical Director, Fenner Cockill Ltd. for his helpful suggestions.

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ANNEXURE 1.

TABLE 5. RAW MATERIAL REQUIREMENTS.

Sl. No.	Item	Price per.kg. Rs.Ps.	Annual requirement * Kgs. Base	Top	Friction	Total	Value
1	Natural Rubber R.M.A. 1 grade	9.00	60,000	15,000	30,000	1,05,000	9,45,000
2	Zinc oxide	14.56	3,000	750	1,500	5,250	76,440
3	Stearic acid	12.00	1,500	375	600	2,475	29,700
4	F.E.F.	5.37	24,000	4,500	..	28,500	1,53,045
5	G.P.F.	4.77	36,000	3,000	6,000	45,000	2,14,650
6	Whiting	0.30	..	..	18,000	18,000	5,400
7	Vulcacit CZ	41.20	600	150	300	1,050	43,260
8	Sulphur	2.00	1,500	375	750	2,625	5,250
9	Nonox BL	32.00	600	150	300	1,050	33,600
10	Nonox HFN	33.10	600	150	300	1,050	34,755
11	Pine tar	4.00	2,400	600	1,350	4,350	17,400
12	Process oil	9.00	4,200	750	1,200	6,150	55,350
13	Rayon(1650 denier)	30.00	..	..	..	12,000	3,60,000
14	Cotton (12 oz.)	20.00	..	..	..	24,000	4,80,000
					Total Rs.		24,53,850
					Add 2% for wastage.		49,077
					Total Rs.		25,02,927

Rounded of Rs. 25,03,000/-

ANNEXURE 2.

PLANT AND MACHINERY REQUIREMENTS

Sl. No.	Description of item	Nos	Price per item	Value Rs.
1	14" x 36" Mixing Mill with chilled cast iron rolls complete with TEFC Motor 40 H.P.	1	80,000/-	80,000/-
2	42", 3 bowl Calender, chilled Cast iron rolls, 30 H.P. Motor with let off and widup devices	1	2,50,000/-	2,50,000/-
3	60 mm. extruder with a reduction geared 5 H.P. Motor	1	30,000/-	30,000/-
4	Building Machine	3	3,000/-	9,000/-
5	Wrapping Machine, 5 H.P. Motor	1	10,000/-	10,000/-
6	Vulcaniser 3' x 5'	1	15,000/-	15,000/-
7	V-belts Moulds	50	3,000/-	1,50000/-
8	Boiler 200 kgs. steam per hour	1	50,000/-	50,000/-
9	Weigh Scales			
	(a) 100kg dial type	1	5,000/-	5,000/-
	(b) 20 kg.	1	2,500/-	2,500/-
10	Hardness meter	1	800/-	800/-
11	Tensile Testing equipment (0.5 H.P.)	1	18,000/-	18,000/-
12	Curo meter	1	30,000/-	30,000/-
13	V-belt test running machine(10 HP)	1	15,000/-	15,000/-
14	Compression Test Rig	1	1,000/-	1,000/-
15	Laboratory press	1	4,000/-	4,000/-
16	Pellet Moulds	1	500/-	500/-

Sl. No.	Description of item	Nos.	Price per item	Value Rs.
17	Gauge for length and angle measure and pitch length measuring device	3		5,000/-
18	Analytical Balance Conditioning cabinet Soxhelet Extraction and other chemical Lab. Equipments.			25,000/-
	Installation 5%			35,000/-
	Total			7,35,800/-
	Provision for price escalation appox. 5%			36,800/-
	Sales tax and other expenses	7%		51,500/-
	Freight and transportation 5%			36,800/-
	TOTAL			8,60,900/-

ANNEXURE 3

MAN POWER REQUIREMENTS

a) Operating

S. No.		Nos.	Monthly salary	Value (annu
1.	Technical Manager	1	2500Θ	30,000
2.	Production Manager	1	2000Θ	24,000
3.	Factory Engineer	1	2000	24,000
4.	Laboratory Assistance	2	700	16,800
5.	Production Supervisors	6	1000	72,000
6.	Maintenance Engineer	1	1000	12,000
7.	Labours a) Skilled	33	400	1,32,600
	b) Semi-skilled	15	300	54,000
	c) unskilled	6	250	28,000
				3,93,400

b) Non-operating

1.	General Manager	1	3000	36,000
2.	Accounts Officer	1	1000	12,000
3.	Accounts Assistance	2	500	12,000
4.	Purchase Officer	1	1000	12,000
5.	Sales Manager	1	2000	24,000
6.	Zonal representative	4	1000	48,000
7.	Sales representative	8	500	48,000
8.	Steno-typist	2	500	12,000
9.	Peons	2	400	4,800
10.	Security guards	3	300	10,800
				2,19,600
	Total Wages and Salaries			6,13,000
	Fringe benefits (add 15%)	=	Rs.	7,04,950

ANNEXURE 4

FIXED ASSESTS

a) Plant and Machinery	=	Rs. 8,60,900
b) Other fixed assests	=	Rs. 82,000
c) Pre-operative expenses	=	Rs. 1,14,564
Total fixed capital	=	Rs. 10,57,464
Rounded off	=	Rs. 10,57,500

ANNEXURE 5

WORKING CAPITAL

a) Raw material cost	=	Rs. 25,03,000
b) Wages and salaries	=	Rs. 7,04,950
c) Utilities	=	Rs. 97,400
d) Other overheads	=	Rs. 3,12,000
		Rs. 36,17,350
Working capital for three months	=	Rs. 9,04,337
Rounded off	=	Rs. 9,04,300

ANNEXURE 6

OTHER FIXED ASSESTS

Item		Value
a) Pumps and piping	=	Rs. 15,000
b) Water tank 10,000 ltr capacity	=	Rs. 10,000
c) Office furniture	=	Rs. 26,000
d) Firefighting equipments	=	Rs. 6,000
e) Miscellaneous tools	=	Rs. 25,000
TOTAL	=	Rs. 82,000

ANNEXURE 7

PREOPERATIVE EXPENSES

Item		Value
a) Travelling expenses	= Rs.	10,000
b) Postage, telegram and telephone	= Rs.	2,000
c) Printing and stationery	= Rs.	6,000
d) Advertisement	= Rs.	15,000
e) Establishment	= Rs.	10,000
f) Miscellaneous expenses	= Rs.	15,000
g) Interest on block loan 7½%	= Rs.	56,564
TOTAL	= Rs.	1,14,564

ANNEXURE 8

OTHER OVERHEADS

a) Factory rent	= Rs.	12,000
b) Maintenance and repairs	= Rs.	43,000
c) Postage and stationery	= Rs.	5,000
d) Advertisement & Publicity	= Rs.	35,000
e) Taxes and Insurance	= Rs.	1,30,000
f) Miscellaneous	= Rs.	7,000
TOTAL	= Rs.	3,12,000

ANNEXURE 9

RAW MATERIALS SUPPLIERS

CARBON BLACK

1. Philips Carbon Black Limited, 31, Netaji Subhash Road, Calcutta-1.

2. United Carbon India Limited, Thana Belapur Road, Thana (Maharashtra)

MINERAL FILLERS

1. Hindustan China Clay Works, Pappinisseri, Cannanore Kerala.

ZINC OXIDE

1. Waldies Zinc Pigments Limited, Gillander House, Netaji Subhash Road, Calcutta-1.

STEARIC ACID

1. Goderej Soaps (Pvt.) Limited, Eastern Express Highway, Vikhrali, Bombay-79.

2. Bombay Oil Industries Private Limite, Kanmoor House, 281/287, NarinahaStreet, Bombay-9.

SULPHUR.

1. I.A. & I.C. (Pvt.) Limited, 86, Dr. Annie Besant Road, Worli Naka, Bomaby-18.

2. Sulphur Mills (Pvt,) Limited, 23, Kailash Darshan, (6th Floor), Nava Chowk, Bombay-60.

Acce
ACCELERATORS & ANTIDEGRADANTS RETARDERS, PEPTASERS

1. Bayer India Ltd. Bombay.

2. Alkali & Chemical Corporation of India Limited, Calcutta.

3. MINDIA Chemicals Of India Pvt. Limited, Bombay.

COTTON

1. Madura Mills Company Limited, Post Box No. 35, Madurai.

RAYON

Madura Mills Company Limited, Post Box No. 35, Madurai.

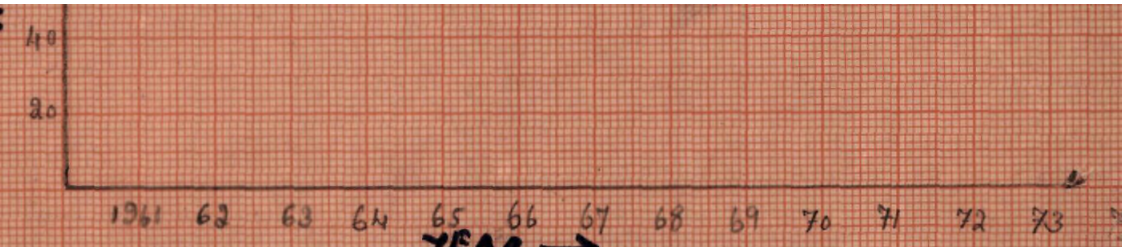
ANNEXURE 10

MACHINERY & EUQIPMENT SUPPLIERS

1. Sohal Engineering Works, Agra Road, Bhandup, Bombay.
2. Indian Expeller Works, 4/4 Naroda Industrial Estate, Ahmedabad.
3. Richardson & Cruddas Ltd., Byculla Iron Works, Post Box No. 4503 Bombay.
4. S.C.A. (Pvt.) Ltd., Mahalaxmi Chambers, Bhulabhai Desai Road, BOMBAY-26
5. Polymer Products Corporation, 808 Mahalaxmi Chambers, Bombay-26.
6. Indian Engineering Company, Worli Naka, P.B.No. 16551 Bombay-18
7. Kaybee & Co., Calcutta.
8. Giriraj & Co. 47, Syed Amir Ali Avenue, Calcutta.
9. Kamal Metal Industries, Gajjar's Bungalow, Ahmedabad-1.

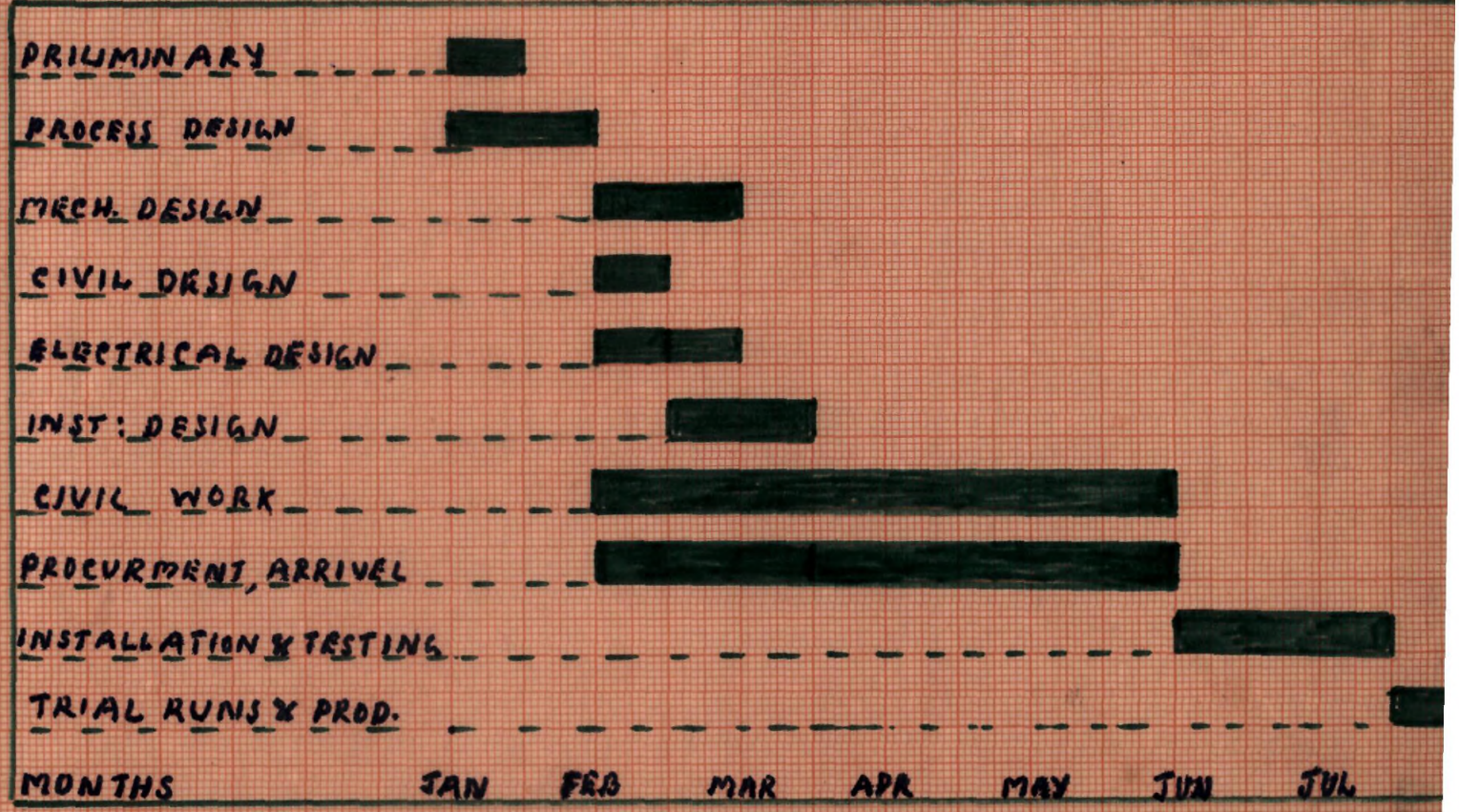
ECONOMIC DATA ON THE PROJECT

1. Capacity	:	2000 Numbers of V-Belts per day of three shifts
2. Total Financial Requirement	:	Rs. 19,61,800/-
3. Unit Cost	:	Rs. 7. 06
4. Net operating profit after providing interest charges depreciation tax etc.	:	Rs. 7,96,450/-
5. Rate of Return on Capital employed	:	40.5 %
6. Break-even unit per year	:	2,52,000 Nos.
7. Break-even point	:	42 %



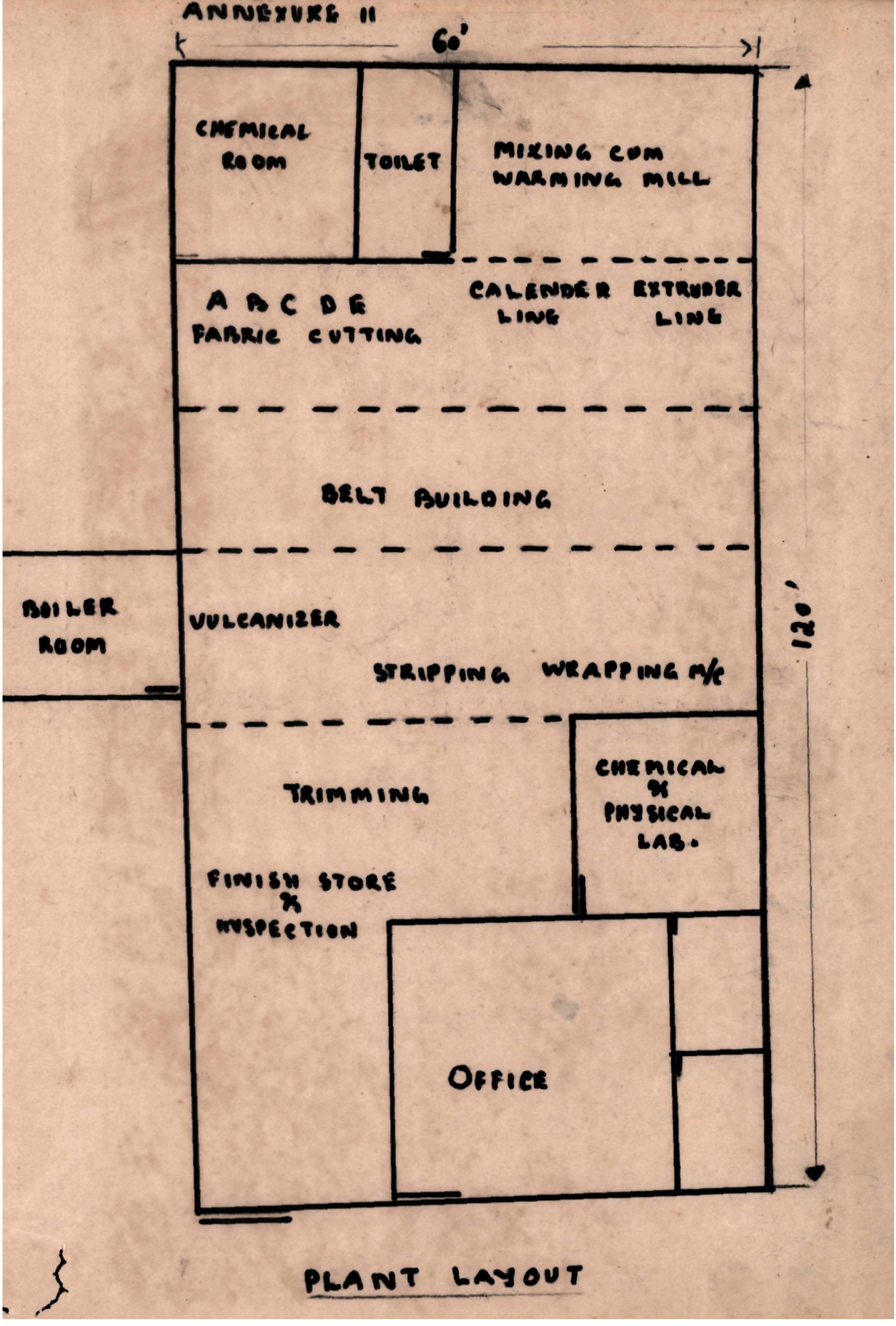
INDEX OF INDUSTIAL PRODUCTION . FIG-7

TENTATIVE TIME SCHEDULE



ANNEXURE-12

ANNEXURE II



PLANT LAYOUT