सत्यमेव जयते

Product	:	**PET bottles**
Quality Standards	:	**IS 14537: 1998**
Installed Capacity	:	**720000 numbers**
Net Profit Ratio	:	**34.00%**
Break Even Point	:	**54.33%**
Year of preparation	:	**June 2020**
Prepared by	:	**Chemical Division**

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1. INTRODUCTION

Plastic remains one of the most utilized packing materials than its equivalents like paper, glass, and metal. The low cost of packaging is encouraging its use in various industries. With environmental concerns arising in more and more countries, important players have boosted their investments in research and development to tackle environmental concerns and make plastic bottles safer for use. Plastic packaging has been witnessing an increasing inclination from consumers over other products, as plastic packages are light in weight and easier to handle. Similarly, even the major manufacturers prefer to use plastic packaging solutions, owing to their lower cost of production. The introduction of Polyethylene Terephthalate (PET) and High-Density Polyethylene (HDPE) polymers expanded plastic bottling applications. With PET bottles being the most widely used packaging for water, the consumption of PET is growing in various countries.

The beverage industry in India is primarily dominated by PET bottles, which hold a larger market share in beverage packaging in comparison to glass & plastic bottles. According to FICCI, Indians consume 11 kg of plastic per year in comparison to 109 kilograms by an average American, and this figure is further expected to rise in the coming years. Most of the PET bottles used in the country are manufactured locally, while a minority share of 2% is imported from other nations. On the other hand, new trends in food packaging, like PET bottled rice, are creating new potential for growth. Most of the PET bottles used in the country are manufactured locally, while a minority share of 2% is imported from other nations. Other packaging materials, such as PP and HDPE, are also finding growing adoption, with companies looking to attract consumers by offering different types of products.

2. PRODUCT USES & SPECIFICATIONS

Like glass, PET is hygienic, strong, and resistant to attack by micro-organisms, does not react with foods or beverages, and will not biologically degrade. Its safety for food and beverage use is recognized by health authorities around the world. But unlike glass, PET is extremely lightweight, simple to transport and won't break, which is why it's preferred for packaging many foods and beverages. PET bottles are cleared for both single and repeated use by the FDA and other world health-safety agencies. It's a common misconception that refilling or reusing a PET bottle will somehow cause the bottle to degrade or to release harmful substances. PET is a stable, inert material that doesn't biologically or chemically degrade with use, and is

resistant to attack by micro-organisms. Regulatory authorities have tested PET bottles and found no harmful substances in either new or re-used PET bottles.

3. BASIS AND ASSUMPTIONS:

1. The production of the unit is worked on the basis of three shifts of 24 hours working a day for 300 working days a year.
2. The salary and wages are taken on the local rates prevailing in Kerala at the time of preparation of the profile.
3. Interest rate for capital investment is taken as 18%.
4. Cost of plant machinery and equipment has been considered as per prevailing rates in the market.
5. Cost of installation and electrification of machinery and equipment has been taken at the rate of 5% of the cost of plant and machinery
6. Working efficiency is taken as 75%

4. PLANT CAPACITY PER ANNUM:

Annual production capacity 500000 PET bottles. Annual working days is assumed as 300.

5. MARKET POTENTIAL

The global PET bottle market reached a volume of more than 17 Million Tons in 2018, registering a CAGR of more than 2.3% during 2011-2018. The market is further projected to reach a volume of nearly 19 Million Tons by 2024, at a CAGR of nearly 2.1% during 2019-2024. Polyethylene terephthalate (PET) refers to a thermoplastic polymer resin of the polyester family which is widely used for manufacturing plastic bottles. In comparison with PP, HDPE and PVC bottles, PET bottles are more durable, transparent, lightweight, non-reactive, cost-effective and thermally stable. Moreover, they are environment-friendly and can be recycled repeatedly which further reduces their manufacturing cost. Primarily used in the packaging of drinking water and beverages, PET bottles are also gaining prominence as a packaging solution for salad dressings, household cleaners, medicines, dish detergents and mouthwashes. The rising trend of westernization, inflating disposable incomes and altering food patterns of consumers have increased the demand for bottled beverages, particularly in developing countries like India and China.

MARKET TREND IN CURRENT PANDEMIC SCENARIO:

There are both advantages and disadvantages in all the sectors due to COVID–19. But the packaging sectors around the world have more significant benefits than other industries that are affected by the Corona Virus pandemic.

As many countries are under shut down due to this deadly virus, stock up on necessary supplies such as medicines, dairy products, food, sanitizers, face masks, disinfectants, and many more has been in high demand. All these products require packing, and their production has been higher than ever before. The consumers and customers around the world prefer packed products rather than initially available and sold lose products such as fruits, vegetables, etc. Hence, the demand for the packaging industry has increased due to the pandemic.

Apart from the above reasons, rise in e commerce and health issues has increased the demand on Plastic packaging industry. In the packaging industry, by material, the plastics sector has the highest demand. And a lot of producers and companies who initially used other types prefer plastic for apparent health care safety, as it is much safer, more affordable, long-lasting and for years the medical industry has been using plastic for packing the medicines. Plastic also helps in stopping the spread of the diseases and helps keep the products packed in it from reacting, getting spoiled and rotting. During the shutdown period, the products are supposed to have a longer shelf life and expiring soon would lead to starvation as the public would not be able to buy new replacements for the expired as most of the production units are closed. The employees are also asked to stay in quarantine and self-isolation.

China, no longer the market leader

China, which is the leader in the packaging sector, lost its clients, and its economy is likely to decrease up to 50% during and after the pandemic. This is because all the companies who were relying on China for packing are now shifting their businesses to other second world countries such as India. Also, after the control of coronavirus outbreak, many companies prefer to rely on other nations rather than China.

6. QUALITY STANDARDS

PET bottles for packaging alcoholic liquids, sanitizers etc is being tested according to IS 14537: 1998

7. RAW MATERIALS

Main raw material is Polyethylene Terephthalate (PET) confirming to IS: 12252. PET is supplied by the resin manufacturers in the form of small pellets, each about 0.05 grams. The advantages of PET are Crystal Clear; Pure; Safe; Good Barrier; Lightweight; No Leakage; Design Flexibility; Recyclable; Good Resistance; Long Shelf-life.

8. MANUFACTURING PROCESS

A remarkable transformation takes place when injection molded PET is stretched at the right temperatures and to the right extent. The long chains undergo strain-hardening and strain-induced crystallization, which gives the properly-made PET bottle exceptional clarity, resistance to internal pressure, uniform wall thickness, toughness, and a host of other features.

Manufacturing containers with PET can be divided into two categories:

- One-Stage "hot preform" method
- and Two-Stage "cold preform" method.

The One-Stage Method

This method goes from PET granule to finished bottle on one integrated machine. This means the injection-moulded preform is withdrawn from the injection cavity while still hot enough to be stretch blown to form the bottle. No extra heating is required, and since preforms are not stockpiled to be blown at a later date, but are freshly moulded every time, there is no risk of surface damage from preforms knocking together during storage or transportation. One-Stage method is suitable to small and medium scale production lines.

The Two-Stage Method
This method uses two separate machines. The Two-Stage system uses two separate machines: an injection molding machine for making the preforms, and a reheat blow moulding machine to reheat the preforms from a cold state and blow the bottles. The requirement for a preform heating system means the Two-Stage process has a lower thermal efficiency. This method is most suited to medium to large-scale production units. This project profile is prepared based on the of two stage method.

i) **Drying of PET**: PET absorbs moisture from the atmosphere. This must be removed by a dehumidifying drying process before processing.

ii) Plasticizing the PET : Dried PET pellets are compressed and melted by a rotating screw.

iii) Injection Molding the PET Preform : Molten PET is injected into the injection cavity and cooled rapidly to form a "preform" (The test-tube-like form from which bottles are blown is known as a preform).
Injection Moulding Process:

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┌─────────────────┐        ┌─────────────────┐
│  Raw Material   │        │  Master Batch   │
└────────┬────────┘        └────────┬────────┘
         │                          │
         └──────────┐    ┌──────────┘
                    ▼    ▼
              ┌──────────────┐
              │    Mixing    │
              └──────┬───────┘
                     ▼
        ┌─────────────────────────┐
        │ Raw Material Fed in to   │
        │         Hopper           │
        └────────────┬─────────────┘
                     ▼
        ┌─────────────────────────┐      ┌─────────────────────┐
        │ Material is plasticized  │      │ Clamp the mould at  │
        │      in the barrel       │      │ specified tonnage   │
        └────────────┬─────────────┘      └──────────┬──────────┘
                     ▼                               │
        ┌─────────────────────────┐                  │
        │ Inject the molten        │◄─────────────────┘
        │ material to mould at     │
        │ required speed and       │
        │ pressure                 │
        └────────────┬─────────────┘
                     ▼
        ┌─────────────────────────┐
        │ Allow the material to    │
        │ cool for solidification  │
        └────────────┬─────────────┘
                     ▼
        ┌─────────────────────────┐
        │ Open the mould to eject  │
        │    the component         │
        └─────────────────────────┘
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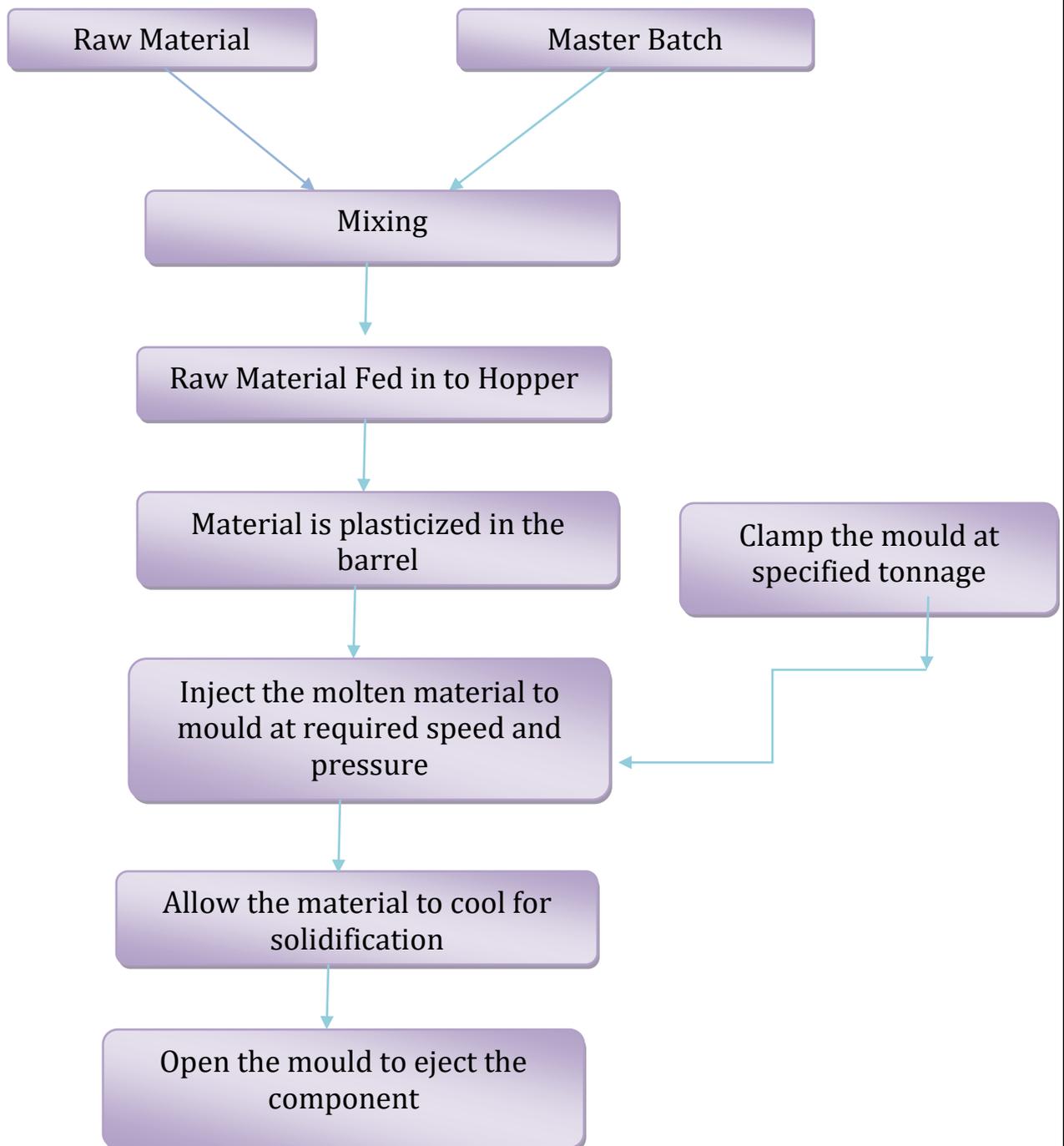
iv) Heating the PET Preform

The temperature of the preform is adjusted to the correct profile for blowing.
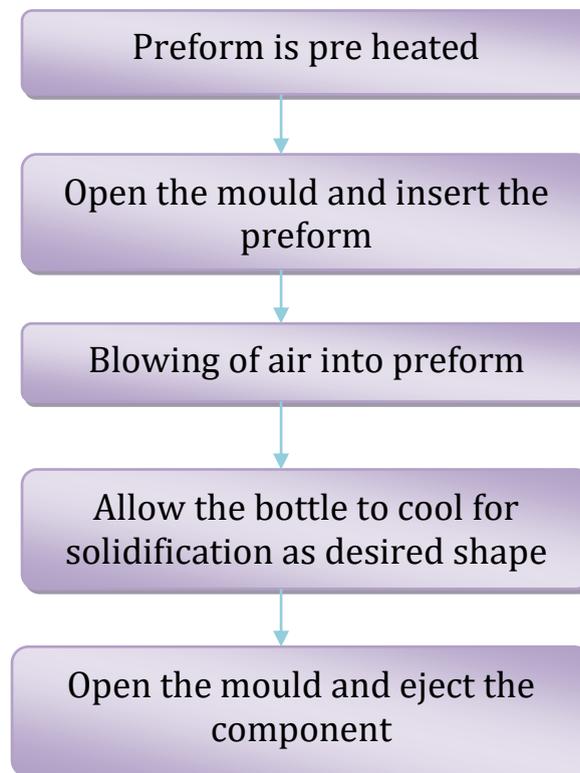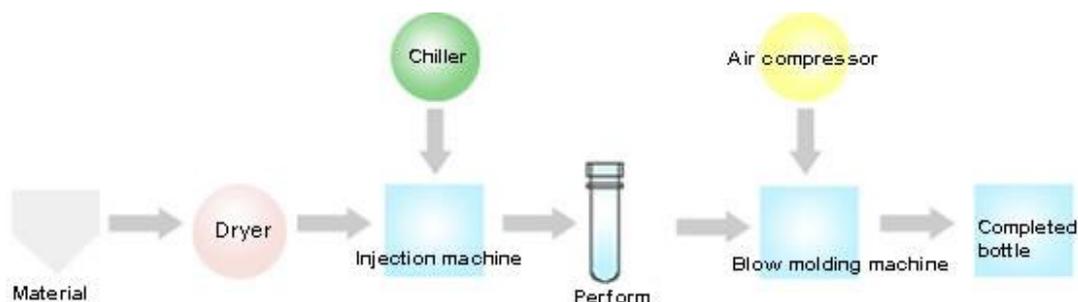
v) Stretch Blow Molding of PET Container

The hot preform is simultaneously stretched and blown (thereby orienting the crystals of and strengthening the PET) into a shaped blow mould to form a tough, lightweight container. PET that is heated to a temperature where its chain-like molecules are sufficiently mobile to uncoil instead of breaking when extended, can be oriented by stretching. Stretching applied from two directions at right angles, as in stretch blow molding, gives biaxial orientation. Oriented PET contains closely packed chains aligned in the directions of stretch. The material is stronger because the molecules act together instead of individually. The tensile strength of oriented PET is several times that of the un stretched material and the impact strength, barrier and chemical resistance are also significantly improved, so bottles can be lighter without sacrificing performance.

PET Bottle Ejector

The finished container is ejected.

Blow Molding Process :

Preform is pre heated

Open the mould and insert the preform

Blowing of air into preform

Allow the bottle to cool for solidification as desired shape

Open the mould and eject the component

FINANCIAL ASPECTS

The unit may preferably be located in such a place where all infrastructural facilities viz. transportation, power, communication etc. are available. An area of 5000 sq.ft for is required for production; storage of raw material, storing finished product, laboratory and office is required. It is assumed to take the place on rental basis.

A. PLANT & MACHINERY

Sl.No	Description	Quantity	Value in lakhs
1.	Injection Molding machine (including excise duty, CST, transport, insurance) Capacity 200 to 250 ton per day Phase Three Phase Frequency 50 - 60 Hz Machine Structure Horizontal Power Source Electric Power 15-20 kW Voltage 220 - 340 V Plastic Type PP, PET, ABS etc	1	8
2.	2 Cavity Fully Automatic Stretch Blow Molding Machine with Air Recovery System Neck Dia: 28mm Blowing Capacity: 200ml to 1500ml (Water 2000ml) Connecting Load: 5 KW, 3 Phase only Pre - form Loading: Pre- form Storage Hopper & Auto Feeder Bottle Carrying Conveyor for Bottle Collection Air Recovery System Very Low Power Infrared Conveyorised Preheating System for Power Saving Blowing Toggle System for Easy and	1	10

	Lesser Mould Changing Time Incremental Heater Settings By 1% to 199% for Accurate Pre-form Heat Setting (including excise duty, CST, transport, insurance)		
	Ancillary equipment's		
3.	Moulds for injection moulding-16 cavity mold of (200 ml, 500 ml, 1000 ml, 1500 ml, 2000 ml each 1 number for preform)	5	18.00
4.	Blow Moulds of (200 ml, 500 ml, 1000 ml, 1500 ml, 2000 ml each 1 number for preform)	5	2.50
5.	Cooling tower- 40 TR with Pump	1	1.00
6.	Dehumidifying Capacity (Litre/Day) 17 - 500 Ltrs Body Material Stainless Steel Air Flow 20 - 280 cub m/hr	1	6.5
7.	Chiller for mould cooling-12 liter	1	7.20
8.	Blending unit	1	4.00
9.	Grinder	1	1.75
10.	High Pressure Air Compressor 20HP, FAD: 54 CFM (IR Model) Three cylinder, Two stage, Water cooler inner cooler and Water Cooler after cooler with Moisture Separator and Auto Drain Valves	1	2.35
11.	Compressor 20HP (Low Pressure)	1	1.75
12.	High Pressure Refrigerator Air Dryer 60CFM / 40 Bar	1	0.70
13.	Refrigerator Air Dryer (Low Pressure)	1	0.60
14.	Water chiller air cooled-2TR	1	1.00
15.	2TR cooling tower	1	1.00
16.	Testing Equipment's	-	6.00
17.	Erection & Electrification 10% of cost of machinery		5.28
18.	Office equipment & furniture	LS	3.00
	Total		80.63

	TOTAL FIXED CAPITAL (LAND, BUILDINGS, PROCESS PLANT & MACHINERY ETC.)	
		Project Cost (Rs.)
1	Process Plant & Equipment	80.63
2	Preliminary & Pre-operative Expenses (12%) (Company Formation, Interest during construction, Pre-production expenses, etc.)	10.15
	Total	90.78

B. WORKING CAPITAL

A. RAW MATERIALS:

Size	Weight	Cost	Numbers	Weight of PET required for producing 50 numbers / hr
200 ml	7 gm			350 gm
500 ml	17.5 gm			875 gm
1000 ml	35 gm	Rs.80/kg	50/ hr	1750 gm
1500 ml	52.5 gm			2625 gm
2000 ml	70 gm			3500 gm

Thus total 100 kg PET is required per day. For a month (25 working days) 2500 kg PET is required. Therefore, total cost of raw material is approx. Rs. 2,00,000/-. Production capacity is assumed as 75%

b) SALARIES & WAGES

Sl. No	Designation	No	Monthly	Total
1	General Manager	1	30000	30000
2	Production Manager	1	25000	25000
3	Machine Operator / Helper	2	10000	20000
4	R&D, Testing	1	12000	12000
5	Marketing Manager & Sales Manager	1	25000	25000
6	Clerical Staff	1	10000	10000

7	Other Staff	2	5000	10000
8	Maintenance (Elec. & Mech.)	1	10000	10000
	Total	10		142000
9	Fringe Benefits (20 % of the above)			28400
	Total		170400 rounded to 170000	

B. UTILITIES

Electricity: Load of Injection Molding Machine per hour is 20 KW Load of Stretch Blow Molding Machine and ancillaries per hour is 5 KW Hence total load is 25 KW/H Total load for month is 15000 KW	Unit costing is Rs.5.50 Hence total amount is around Rs.82,500/-
Water: 2000 liter for chiller and other works	1250/-
Total	**83750/-**

C. OTHER EXPENSES

1.	Postage and Stationery	2000
2.	Telephone	5000
3.	Transport and Traveling	10000
4.	Insurance for Machinery & Raw Materials	10000
5.	Miscellaneous	5000
6.	Advertisement & Publicity	5000
7.	Rent	15000
	Total	52000

TOTAL RECURRING EXPENDITURE PER MONTH:

Description	Value (Rs.)
Personnel	170000
Raw materials	150000
Utilities	83750
Other contingent expenses	52000
Total	455750
Working capital (Approximately working capital is estimated as 3 months recurring expenditure)	**1367250/-**

D. TOTAL CAPITAL INVESTMENT

1.	Plant and Machinery	9078000
2.	Working Capital (for 3 months)	1367250
	Total	**10445250**

E. COST OF PRODUCTION PER ANNUM

1.	Working capital	1367250
3.	Depreciation of dies, jigs, fixtures, furniture, Office equipment @ 20%	60000
4.	Interest on investment @ 18%	1880145
	Total	3307395
	Rounded to	**3300000/-**

TURN-OVER PER YEAR:

Items	Average Selling Price Unit (Rs.)
PET bottle 200 ml	Rs.3
PET bottle 500 ml	Rs.5
PET bottle 1000 ml	Rs.10
PET bottle 1500 ml	Rs.15
PET bottle 2000 ml	Rs.20
Total	Rs.5000000/- @ rate of average price of Rs.10/ for a production capacity of 500000 bottles / annum

10. PROFIT PER YEAR

Sales per year – Cost of production per year   = 5000000-3300000

=   **Rs. 1700000/-**

11. NET PROFIT RATIO ON SALES

Profit (per year)/ Sales (per year) *100

$$=1700000/5000000 *100$$

$$= \quad \textbf{34\%}$$

12. Rate of return

Profit (per year)/ Total Capital Investment *100

$$=1700000/ 10445250*100$$

$$= \quad \textbf{16.3 \%}$$

13. BREAK EVEN ANALYSIS

	Fixed Cost per annum	
a	Interest on investment @ 18%	1880145
b	Depreciation of dies, jigs, fixtures, furniture, Office equipment @ 20%	60000
c	40% of wages & salaries	68000
d	40% of other expenses (except rent)	14800
	Total	**2022945**

BEP $\quad$ = Fixed Cost/ Fixed Cost + Profit $\quad$ * 100

$\quad$ = 2022945/ 2022945+ 1700000 *100

$\quad$ = 2022945/3722945 * 100

$\quad$ = **54.33%**

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