

PLASTIC INJECTION MOLDING

Introduction: Injection molding is a manufacturing process for producing parts by injecting molten material into a mould. Injection moulding can be performed with a host of materials mainly including metals (for which the process is called die-casting), glasses, elastomers, confections, and most commonly the thermoplastic and thermo setting polymers. Injection molding is used to create many things such as wire spools, packaging, bottle caps, automotive parts and components, toys, pocket combs, some musical instruments (and parts of them), onepiece chairs and small tables, storage containers, mechanical parts (including gears), and most other plastic products available today. Injection moulding is the most common modern method of manufacturing plastic parts; it is ideal for producing high volumes of the same object. Injection molding machine molds can be fastened in either a horizontal or vertical position. The majority of machines are horizontally oriented, but vertical machines are used in some niche applications such as insert molding, allowing the machine to take advantage of gravity.



Types of Injection Molding Machine: These Machines are classified primarily by the type of driving systems they use: hydraulic, mechanical, electrical, or hybrid.

- **Hydraulic:** Hydraulic presses have historically been the only option available to molders until Nissei Plastic Industrial Co., LTD introduced the first allelectric injection molding machine in 1983. Hydraulic machines, although not nearly as precise, are the predominant type in most of the world, with the exception of Japan.
- **Mechanical:** Mechanical type machines use the toggle system for building up tonnage on the clamp side of the machine. Tonnage is required on all machines so that the clamp side of the machine does not open (i.e. tool half mounted on the platen) due to the injection pressure. If the tool half opens up it will create flash in the plastic product.
- **Electric:** The electric press, also known as Electric Machine Technology (EMT), reduces operation costs by cutting energy consumption and also addresses some of the environmental concerns surrounding the hydraulic press. Electric presses have been shown to be quieter, faster, and have a higher accuracy, however the machines are more expensive. Hybrid injection (sometimes referred to as "Servo-Hydraulic") molding machines claim to take advantage of the best features of both hydraulic and electric systems, but in actuality use almost the same amount of electricity to operate as an electric injection molding machine depending on the manufacturer.

Advantages of using Injection Molding Unit: Following are the advantages

- i. **Detailed Features and Complex Geometry:** The injection molds are subjected to extremely high pressure. As a result the plastic within the molds is pressed harder against the mold compared to any other molding process. Due to this excessively high pressure, it is possible to

add a large amount of details into the design of the part. Furthermore, due to high pressure during the molding process, complex and intricate shapes can easily be designed and manufactured which otherwise would have been too complicated and expensive to manufacture.

- ii. High Efficiency:** Once the injection molds have been designed to the customer's specifications and the presses pre-programmed, the actual molding process is very quick compared to other methods of molding. Plastic injection molding process hardly takes times and this allows more parts to be manufactured from a single mold. The high production output rate makes plastic injection molding more cost effective and efficient. Typically, hot-runner ejection mold systems produce parts with more consistent quality and do so with faster cycle times, but it's not as easy to change colours nor can hot runners accommodate some heatsensitive polymers. Learn more about the key differences between hotrunner and cold-runner systems.
- iii. Enhanced Strength:** In plastic injection molding, it is possible to use fillers in the injection molds. These filler reduce the density of the plastic while it being molded and also help in adding greater strength to the part after it has been molded. In fields where parts need to be strong and durable, plastic injection has an option that other molding processes do not offer.
- iv. Ability to Use Multiple Plastic Types Simultaneously:** One of the major advantages of using plastic injection molding for manufacturing parts is the ability to use different types of plastic simultaneously. This can be done with the help of co-injection molding, which takes away the worry about using a specific type of plastic.
- v. Automation to Save Manufacturing Costs:** Plastic injection molding is an automated process. A majority of the injection molding process is performed by machines and robotics which a sole operator can control and manage. Automation helps to reduce manufacturing costs, as the overheads are significantly reduced. Furthermore, with reduced labour force the overall cost of manufacturing the parts is reduced and this cost saving can easily be passed on to the customer. Furthermore, automation allows for making precise and accurate injection molds.

Computer aided design (CAD) and computer aided manufacturing (CAM) allow close tolerances during the making of the molds.

Injection Molded Plastics Market Analysis: The global injection molding machine market size accounted for USD 17.05 billion in 2017 and is estimated to expand at a CAGR of 3.5% by 2025. Growing demand for lightweight and durable products coupled with increasing adoption from the automotive and packaging industries is likely to drive this growth over the forecast period. The rising importance of lightweight materials in the automotive industry is expected to boost the use of plastic materials in automotive component manufacturing, which, in turn, will drive the market. Rapid growth in population, growing industrialization, along with technological advancements, have augmented the demand for automotive in emerging markets. It is used in applications such as interior and exterior trim components, electronic subassemblies, and under-hood applications.

Plastic Injection Molding Manufacturing Process: The Injection Moulding Process is one of the plastic based product manufacturing process, this process utilizes a specialized machine called injection moulding machine which is fundamentally divided into two parts mould and injector. Wide range of plastic product can be manufactured from this machine, for each differently shaped product a separate mould is required, thus multiple products of same or different material can be manufactured on same Injection Moulding Machine by simply changing its moulds. The raw material is plastic granules which are supplied to Injection Moulding Machine via Hooper & Feeder arrangement along with required additives, these raw material are mixed in a mixer usually integrated within the Machine followed by which these granules are converted to their semi-solid state utilizing heaters of the injection moulding machine followed by which this semi-solid plastic is injected into the mould using screw or plunger arrangement. The mould is then cooled down utilizing the chiller sub-system of machine and part is ejected out of mould by ejector pins at command of the operator, these parts are then

collected and placed in their respective bins, followed by appropriate packaging prior to sale.

Machinery & Equipment's required: Different Types of Injection Molding machine based upon capacity is known as Gram weight name like:

- 70 Gram Injection Molding Machine
- 300 Gram Injection Molding Machine
- 3 KG Injection Molding Machine
- 50 Tonne Injection Molding Machine
- 80 Tonne Injection Molding Machine
- 130 Tonne Injection Molding Machine etc.

Rate of the machine vary according to the capacity of the machine. In this project we have taken the machine with batch of 150 kg and the cost is 14.0 Lac Rs. Injection molding machine is also available in the market of 300 & 500 Kg batch production and price of machine varies accordingly.

Raw Material Requirement for Plastic Injection Molds:

Plastic Granules are required as raw material for injection molding parts manufacturing. These granules are available in market in different colours and types. For eg. Polyethylene(PE), Polypropylene(PP), Poly styrene(PS), Alkathene(AT).

However, Polypropylene held the largest market share of over 36.0% in terms of volume in 2019. This is attributed to its increasing consumption in automotive components, household goods, and packaging applications. Polypropylene is increasingly used for electrical connector bases and covers to provided mechanical and electrical protection on account of its electrical insulation properties. Other applications include battery housings and food packaging. Polypropylene is the preferred packaging material for food packaging as it is durable. Owing to these benefits, the segment is projected to

register a significant CAGR over the forecast period, thereby driving the overall demand for injection molded plastics.

On an average raw material cost per Kg: Rs. 75-100

Note: In this project plastic container is taken as plastic mold for manufacturing in Injection plastic molding machine.

Area:

The industrial setup requires space for Inventory, workshop or manufacturing area, space for power supply utilities and auxiliary like Generator setup. Also some of the area of building is required for office staff facilities, documentation, office furniture, etc. Thus, the approximate total area required for complete industrial setup is 1000 to 1400Sqft. Civil work will cost around 3 Lac (approx.)

Power Requirement –The power consumption required to run all the machinery could be approximated as 20 hp.

Manpower Requirement- There are requirement of skilled machine operators to run the machine set. Experience quality engineers are required for desired quality control. Some helpers are also required to transfer the material from one work station to other. Office staffs are required to maintain the documentation. The approximate manpower required is 8 including 1 Supervisor, 1 Plant operator, 1 unskilled worker, 1 Helper and 1 security Guard. 3 Skilled worker including Accountant, Manager and sales personal each.

Approvals & Registration Requirement:

Basic registration required in this project:

- GST Registration
- Udyog Aadhar Registration (Optional)
- Choice of a Brand Name of the product and secure the name with Trademark if require

Bank Term Loan: Rate of Interest is assumed to be at 11%

Depreciation: Depreciation has been calculated as per the Provisions of Income Tax Act, 1961

Implementation Schedule:

S No.	Activity	Time required
1.	Acquisition of premises	1-2 Months
2.	Procurement & installation of Plant & Machinery	1-2 Months
3.	Arrangement of Finance	1.5-2 Months
4.	Requirement of required Manpower	1 Month
5.	Commercial Trial Runs	1 Month
	Total time Required (some activities shall run concurrently)	5-6 Months

FINANCIALS

PROJECTED CASH FLOW STATEMENT					
PARTICULARS	I	II	III	IV	V
SOURCES OF FUND					
Own Contribution	2.29	-			
Reserve & Surplus	3.55	6.10	8.66	11.58	14.75
Depriciation & Exp. W/off	2.55	2.19	1.88	1.62	1.39
Increase In Cash Credit	4.00				
Increase In Term Loan	16.65	-	-	-	-
Increase in Creditors	0.51	0.08	0.08	0.09	0.09
TOTAL :	29.55	8.37	10.62	13.29	16.23
APPLICATION OF FUND					
Increase in Fixed Assets	18.50	-	-	-	-
Increase in Stock	0.86	0.14	0.15	0.16	0.16
Increase in Debtors	4.18	0.76	0.74	0.79	0.83
Repayment of Term Loan	1.85	3.70	3.70	3.70	3.70
Taxation	-	1.83	2.60	3.47	4.42
Drawings	1.00	1.50	3.00	4.00	6.00
TOTAL :	26.39	7.93	10.19	12.12	15.12
Opening Cash & Bank Balance	-	3.16	3.60	4.04	5.21
Add : Surplus	3.16	0.44	0.44	1.17	1.11
Closing Cash & Bank Balance	3.16	3.60	4.04	5.21	6.32

PROJECTED BALANCE SHEET					
PARTICULARS	I	II	III	IV	V
SOURCES OF FUND					
Capital Account					
Opening Balance	-	4.84	7.61	10.67	14.78
Add: Additions	2.29	-	-	-	-
Add: Net Profit	3.55	4.27	6.06	8.11	10.32
Less: Drawings	1.00	1.50	3.00	4.00	6.00
Closing Balance	4.84	7.61	10.67	14.78	19.10
CC Limit	4.00	4.00	4.00	4.00	4.00
Term Loan	14.80	11.10	7.40	3.70	0.00
Sundry Creditors	0.51	0.59	0.68	0.77	0.86
TOTAL :	24.15	23.30	22.75	23.24	23.96
APPLICATION OF FUND					
Fixed Assets (Gross)	18.50	18.50	18.50	18.50	18.50
Gross Dep.	2.55	4.74	6.62	8.24	9.63
Net Fixed Assets	15.95	13.76	11.88	10.26	8.87
Current Assets					
Sundry Debtors	4.18	4.94	5.68	6.47	7.30
Stock in Hand	0.86	1.00	1.14	1.30	1.46
Cash and Bank	3.16	3.60	4.04	5.21	6.32
TOTAL :	24.15	23.30	22.75	23.24	23.96

PROJECTED PROFITABILITY STATEMENT					
PARTICULARS	I	II	III	IV	V
A) SALES					
Gross Sale	41.82	49.42	56.84	64.71	73.03
Total (A)	41.82	49.42	56.84	64.71	73.03
B) COST OF SALES					
Raw Material Consumed	15.39	17.78	20.30	22.95	25.74
Electricity Expenses	1.45	1.61	1.77	1.93	2.10
Repair & Maintenance	4.18	4.94	5.68	6.47	7.30
Labour & Wages	7.18	7.90	8.77	9.73	10.71
Depreciation	2.55	2.19	1.88	1.62	1.39
Cost of Production	30.75	34.42	38.40	42.71	47.24
Add: Opening Stock /WIP	-	0.60	0.70	0.81	0.92
Less: Closing Stock /WIP	0.60	0.70	0.81	0.92	1.04
Cost of Sales (B)	30.15	34.32	38.30	42.60	47.12
C) GROSS PROFIT (A-B)	11.66	15.10	18.54	22.11	25.91
	27.89%	30.55%	32.62%	34.18%	35.48%
D) Bank Interest (Term Loan)	1.81	1.48	1.07	0.66	0.25
ii) Interest On Working Capital	0.44	0.44	0.44	0.44	0.44
E) Salary to Staff	3.78	4.61	5.53	6.20	6.82
F) Selling & Adm Expenses Exp.	2.09	2.47	2.84	3.24	3.65
TOTAL (D+E)	8.12	9.00	9.88	10.53	11.16
H) NET PROFIT	3.55	6.10	8.66	11.58	14.75
	8.5%	12.3%	15.2%	17.9%	20.2%
I) Taxation	-	1.83	2.60	3.47	4.42
J) PROFIT (After Tax)	3.55	4.27	6.06	8.11	10.32
Raw Material Consumed	Capacity	Cost per kg	Amount (Rs.)		
	Utilisation				
I	45%	76	15.39		
II	50%	79	17.78		
III	55%	82	20.30		
IV	60%	85	22.95		
V	65%	88	25.74		

COMPUTATION OF SALE					
Particulars	I	II	III	IV	V
Op Stock	-	3,375.00	3,750.00	4,125.00	4,500.00
Production	2,02,500.00	2,25,000.00	2,47,500.00	2,70,000.00	2,92,500.00
	2,02,500.00	2,28,375.00	2,51,250.00	2,74,125.00	2,97,000.00
Less : Closing Stock(5 Days)	3,375.00	3,750.00	4,125.00	4,500.00	4,875.00
Net Sale	1,99,125.00	2,24,625.00	2,47,125.00	2,69,625.00	2,92,125.00
Sale Price per container	21.00	22.00	23.00	24.00	25.00
Sale (in Lacs)	41.82	49.42	56.84	64.71	73.03

COMPUTATION OF MAKING OF CONTAINERS			
Item to be Manufactured Containers			
Manufacturing Capacity per day	150	kg	
Manufacturing Capacity per annum	45,000	kg	
1 Kg final output	10	Containers	
No. of Working Day per annum	300		
Total Production per Annum	4,50,000	Containers	
Total Production per Annum	4,50,000	Containers	
Year		Capacity Utilisation	PLASTIC CONTAINER
I	45%	2,02,500.00	
II	50%	2,25,000.00	
III	55%	2,47,500.00	
IV	60%	2,70,000.00	
V	65%	2,92,500.00	

COMPUTATION OF CLOSING STOCK & WORKING CAPITAL					
PARTICULARS	I	II	III	IV	V
Finished Goods					
(5 Days requirement)	0.60	0.70	0.81	0.92	1.04
Raw Material					
(5 Days requirement)	0.26	0.30	0.34	0.38	0.43
Closing Stock	0.86	1.00	1.14	1.30	1.46

COMPUTATION OF WORKING CAPITAL REQUIREMENT			
Particulars	Amount	Margin(10%)	Net Amount
Stock in Hand	0.86		
Less:			
Sundry Creditors	0.51		
Paid Stock	0.35	0.03	0.31
Sundry Debtors	4.18	0.42	3.76
Working Capital Requirement			4.07
Margin			0.45
MPBF			4.07
Working Capital Demand			4.00

BREAK UP OF LABOUR				
Particulars		Wages Per Month	No of Employees	Total Salary
Supervisor		18,000.00	1	18,000.00
Plant Operator		15,000.00	1	15,000.00
Unskilled Worker		10,000.00	1	10,000.00
Helper		8,000.00	1	8,000.00
Security Guard		6,000.00	1	6,000.00
				57,000.00
Add: 5% Fringe Benefit				2,850.00
Total Labour Cost Per Month				59,850.00
Total Labour Cost for the year (In Rs. Lakhs)			5	7.18

BREAK UP OF SALARY				
Particulars		Salary Per Month	No of Employees	Total Salary
Manager		12,000.00	1	12,000.00
Accountant cum store keeper		10,000.00	1	10,000.00
Sales		8,000.00	1	8,000.00
Total Salary Per Month				30,000.00
Add: 5% Fringe Benefit				1,500.00
Total Salary for the month				31,500.00
Total Salary for the year (In Rs. Lakhs)			3	3.78

COMPUTATION OF DEPRECIATION					
Description	Land	Building/shed	Plant & Machinery	Furniture	TOTAL
Rate of Depreciation		10.00%	15.00%	10.00%	
Opening Balance	Leased		-	-	-
Addition	-	3.00	14.00	1.50	18.50
	-	3.00	14.00	1.50	18.50
		-	-	-	
TOTAL		3.00	14.00	1.50	18.50
Less : Depreciation	-	0.30	2.10	0.15	2.55
WDV at end of Ist year	-	2.70	11.90	1.35	15.95
Additions During The Year	-	-	-	-	-
	-	2.70	11.90	1.35	15.95
Less : Depreciation	-	0.27	1.79	0.14	2.19
WDV at end of IInd Year	-	2.43	10.12	1.22	13.76
Additions During The Year	-	-	-	-	-
	-	2.43	10.12	1.22	13.76
Less : Depreciation	-	0.24	1.52	0.12	1.88
WDV at end of IIIrd year	-	2.19	8.60	1.09	11.88
Additions During The Year	-	-	-	-	-
	-	2.19	8.60	1.09	11.88
Less : Depreciation	-	0.22	1.29	0.11	1.62
WDV at end of IV year	-	1.97	7.31	0.98	10.26
Additions During The Year	-	-	-	-	-
	-	1.97	7.31	0.98	10.26
Less : Depreciation	-	0.20	1.10	0.10	1.39
WDV at end of Vth year	-	1.77	6.21	0.89	8.87

REPAYMENT SCHEDULE OF TERM LOAN						11.0%	
Year	Particulars	Amount	Addition	Total	Interest	Repayment	CI Balance
I	Opening Balance						
	Ist Quarter	16.65	-	16.65	0.46	-	16.65
	IInd Quarter	16.65	-	16.65	0.46	-	16.65
	IIIrd Quarter	16.65	-	16.65	0.46	0.93	15.73
	Ivth Quarter	15.73	-	15.73	0.43	0.93	14.80
					1.81	1.85	
II	Opening Balance						
	Ist Quarter	14.80	-	14.80	0.41	0.93	13.88
	IInd Quarter	13.88	-	13.88	0.38	0.93	12.95
	IIIrd Quarter	12.95	-	12.95	0.36	0.93	12.03
	Ivth Quarter	12.03		12.03	0.33	0.93	11.10
					1.48	3.70	
III	Opening Balance						
	Ist Quarter	11.10	-	11.10	0.31	0.93	10.18
	IInd Quarter	10.18	-	10.18	0.28	0.93	9.25
	IIIrd Quarter	9.25	-	9.25	0.25	0.93	8.32
	Ivth Quarter	8.32		8.32	0.23	0.93	7.40
					1.07	3.70	
IV	Opening Balance						
	Ist Quarter	7.40	-	7.40	0.20	0.93	6.47
	IInd Quarter	6.47	-	6.47	0.18	0.93	5.55
	IIIrd Quarter	5.55	-	5.55	0.15	0.93	4.62
	Ivth Quarter	4.62		4.62	0.13	0.93	3.70
					0.66	3.70	
V	Opening Balance						
	Ist Quarter	3.70	-	3.70	0.10	0.93	2.77
	IInd Quarter	2.77	-	2.77	0.08	0.93	1.85
	IIIrd Quarter	1.85	-	1.85	0.05	0.93	0.92
	Ivth Quarter	0.92		0.92	0.03	0.93	0.00
					0.25	3.70	

Door to Door Period 60 Months
Moratorium Period 6 Months
Repayment Period 54 Months

CALCULATION OF D.S.C.R					
PARTICULARS	I	II	III	IV	V
<u>CASH ACCRUALS</u>	6.10	6.46	7.94	9.72	11.72
Interest on Term Loan	1.81	1.48	1.07	0.66	0.25
Total	7.90	7.94	9.01	10.38	11.97
<u>REPAYMENT</u>					
Repayment of Term Loan	1.85	3.70	3.70	3.70	3.70
Interest on Term Loan	1.81	1.48	1.07	0.66	0.25
Total	3.66	5.18	4.77	4.36	3.95
DEBT SERVICE COVERAGE RATIO	2.16	1.53	1.89	2.38	3.03
AVERAGE D.S.C.R.			2.15		

COMPUTATION OF ELECTRICITY			
(A) POWER CONNECTION			
Total Working Hour per day	Hours	8	
Electric Load Required	HP	20	
Load Factor		0.7460	
Electricity Charges	per unit	7.50	
Total Working Days		300	
Electricity Charges			2,68,560.00
Add : Minimim Charges (@ 10%)			
(B) DG set			
No. of Working Days		300	days
No of Working Hours		0.3	Hour per day
Total no of Hour		90	
Diesel Consumption per Hour		8	
Total Consumption of Diesel		720	
Cost of Diesel		65.00	Rs. /Ltr
Total cost of Diesel		0.47	
Add : Lube Cost @15%		0.07	
Total		0.54	
Total cost of Power & Fuel at 100%			3.22
Year	Capacity		Amount
			(in Lacs)
I	45%		1.45
II	50%		1.61
III	55%		1.77
IV	60%		1.93
V	65%		2.10

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