



DESIGN & FABRICATION OF PORTABLE INJECTION MOULDING WORKING WITH SOLAR ENERGY

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Abstract: Injection molding is the most common process to produce a wide range of complex plastic parts for many different applications. By this molding technique we produce large to small range of components. Moulding conditions or process parameters play a decisive role that affects the quality and productivity of plastic products.

Present days, every 40% product made by plastic. But that plastic didn't decompose and it can't burn due to plastic causes air pollution. Plastic Pollution is one of the major contributors towards climate change. While the size of plastic pollutants can vary from big to microscopic, they are found everywhere. Human activity is the biggest cause of plastic pollution. Plastic items typically have a very short lifespan-think car tires, bike plastic products and water bottles. And because they're so cheap to make, we don't value them enough to hang on to individual items. By this plastic injection moulding machine, we convert waste plastic to design product with very less cost effective. By using solar energy we run the injection moulding machine by the solar panel. Here we convert heat energy into electrical energy.

IndexTerms - Waste plastic (pellets), Mold, Barrel, Reciprocating screw, Heater, Nozzle, Non-return valve, Solar panel, Charge controller, Battery.

1. INTRODUCTION

Injection moulding is one of the most common processes used to produce plastic parts. It is a cyclic process of rapid mould filling followed by cooling and ejection. A variety of materials both plastic and non-plastic can be used as feedstock. However, the machine must be configured for the type of material used. The material, which is generally available as grains or powder, is plasticized in an injection unit and injected into a clamped mould under high pressure (500-1500 bar). The main advantage of injection moldings is that it is a very economical method of mass production. Ready parts with tight tolerances can be produced in one step, often completely automatically. In general, after processing is not necessary. It is also possible to integrate different functions into one part to avoid the formation of different components that would be more expensive, e.g., the base of a typewriter with integrated guidance and fixing elements, the springy components of a printer element, a lens with integrated prism to stop down a beam of light. To guarantee a high quality in the injection moulded parts the following points have to be considered:

The material has to be plasticized and injected carefully to avoid negative effects on the material properties.

The process settings (such as pressures and temperatures) concerning the machine and mould have to remain constant with regard to time and space. Basic parts of an injection moulding machine.

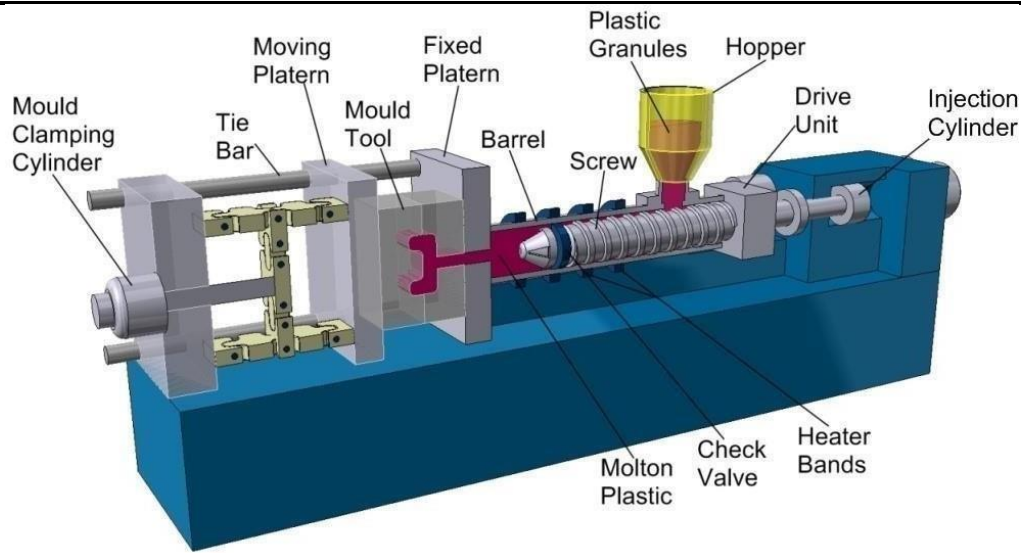


figure 1 injection moulding machine

2. LITERATURE REVIEW ON STATIONARY PLATEN OF INJECTION MOULDING MACHINE

Mr. P. Vinod, Mr. K. Vijaykumar [7] have designed multi-cavity injection mould with HRS and CRS. By comparing both designs, they researched the impact of runner systems, mould cooling and venting. Moulding analysis is carried out using ANSYS.

G. Rajendra Prasad, Dr S. Chakradhar Goud [8] Studied dynamic characteristics like hot runner nozzle strain using analysis in FEA.

N. Divya, Dr. S. N. Malleswara Rao, Dr. V. S. Parameswara Rao, [9] concluded in their paper as the hot runner system accommodates the molten plastic. The runner method determines mould component consistency and productivity. They performed structural and thermal analysis of the mould 's original and updated designs concluding that the modified design produces the best performance.

Rashi A. Yadav, S. V. Joshi, N. K. Kamble [5], Recent studies to design and determine injection moulding method parameters. In parameter environment for injection moulding, several test works were performed focused on various approaches. In the plastic injection moulding (PIM) industry, optimum process parameter settings are critically affected by performance, consistency, and cost of output.

A. Demirer, Y. Soydan [3], Unlike the conventional runner approach, hot runner machine effects on injection moulding method and injection product properties were studied. They used data from method parameters experiments. Injection pressure and temperature change a broad variety. For the hot runner process, injection pressure was marginally lower for higher weight samples. If the temperature of the process increases, shrinkage and warpage increased, reducing with increased injection pressure and happening at a low level where the sample weight was high.

Gurjeet Singh, Ajay Verma [10] Studied primary moulding conditions from design creation to product manufacturing. They studied different factors based on processing parameters. It is concluded that efficiency declines when channelizing efforts to improve quality. Parameters must be optimised to ensure good quality and efficiency. Authors analysed different responses to injection moulding process quality based on output parameters and methods. Mehdi Moayyedean, Kazem Abhary [11], the injection moulding method implemented a new gate geometry. It was observed that current edge gates corners create turbulence of molten plastic leading to internal and external defects. New geometry was introduced to reduce injected parts' internal and external flaws. The study's goal was to make the final piece easier geometry, which eliminates the last part 's apparent blemish after de-gating.

V.Chandra Sekhar, N. Jaya Krishana [12] Suggested design for two circular flat plate 1 mm wide. Contribution of this research was to change the existing edge gate geometry by eliminating rectangular edge gate corners to minimise scrap occurrence of injected bits. Smooth plastic flow through cavities often prevents internal and exterior defects. The result reveals no shot-filling cavities. No weld lines, meld lines or sink marks were identified with new edge gate design. The experiment ends with an added portion of the initial edge gate step, less noticeable than the current edge gate.

2.1 STATEMENT OF PROBLEM

Plastics are cheap, lightweight and durable materials, which can readily be moulded into a variety of products that can be used in a wide range of application. As a consequence, the production of plastics and percentage of plastics used in vehicle has increased compare to last years. However, current levels of their usage and disposal generate several environmental problems. Plastics have substantial benefits in terms of their low weight, lower cost relative to many other material types. Recycling is one of the most

important actions currently available today to reduce these impacts and exhibits one of the most dynamic areas in the plastic industry. That plastic causes the different types of pollutants. So, more time are required to decompose that plastic we can use recycling process by injection moulding machine to over the waste plastic.

2.2 OBJECTIVES OF THE PROJECT

- To convert the waste plastic into design product with low cost effective and to produce quality product.
- To avoiding single usage plastic.
- To reduce amount of electricity charges.
- To convert heat energy into power by solar panel.

3. METHODOLOGY

3.0 MAIN COMPONENTS

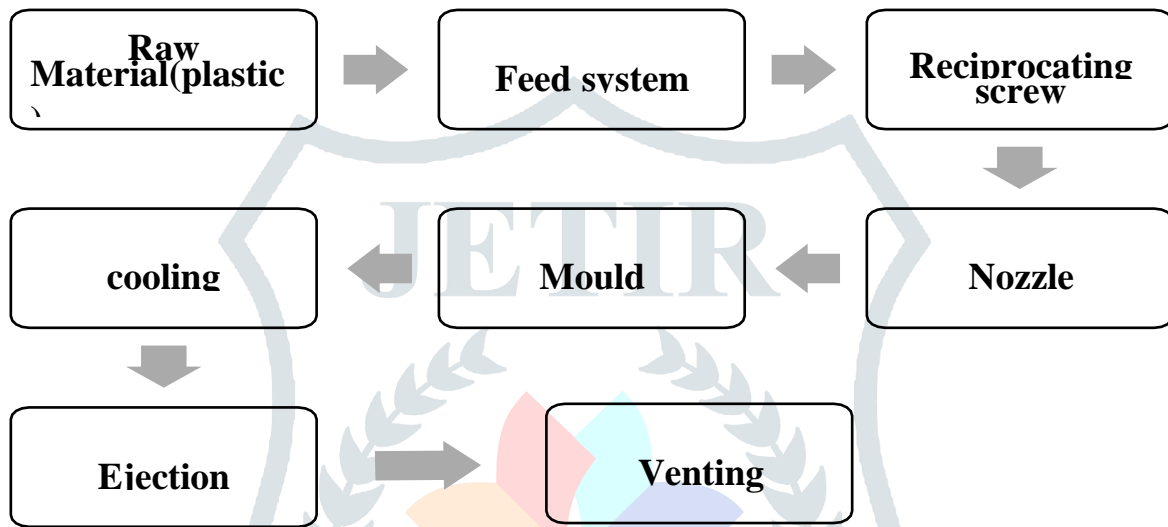


figure 2 main components

3.1 PLASTICS

Plastics are mouldable organic resins. They are either natural or synthetic and are processed by forming or moulded into different shapes. Plastics are important engineering materials for many reasons. They have wide range of properties, some of which are unattainable from any other materials, and in most cases, they are relatively low in cost. Some of the natural resins are Shellac, Wax and Amber etc. Synthetic resins are prepared by the recurring chemical reaction of simple organic compounds. These molecules combine to form a high molecular weight composite.

3.2 FEED SYSTEM

The feed system accommodates the molten polymer coming from the barrel and guides it into the mould cavity. Its configuration, dimensions and connection with the moulding greatly affect the mould filling process and subsequently, the quality of the product. A design that is based primarily on economic viewpoints, (rapid solidification and short cycles) is mostly incompatible with quality demands. Material is placed in the hopper prior to plastination. It must be designed to avoid material bridging in the throat and to let gravity feed the material. Material holds up spots must be avoided.

3.3 MOULD

A mould is a hollow metal block into which molten plastic is injected to form a certain fixed shape. Although they are not illustrated in the figure shown below, actually there are many holes drilled in the block for temperature control by means of hot water, oil or heaters.

Molten plastic flows into a mould through a sprue and fills cavities by way of runners and gates. Then, the mould is opened after cooling process and the ejector rod of the injection moulding machine pushes the ejector plate of the mould.

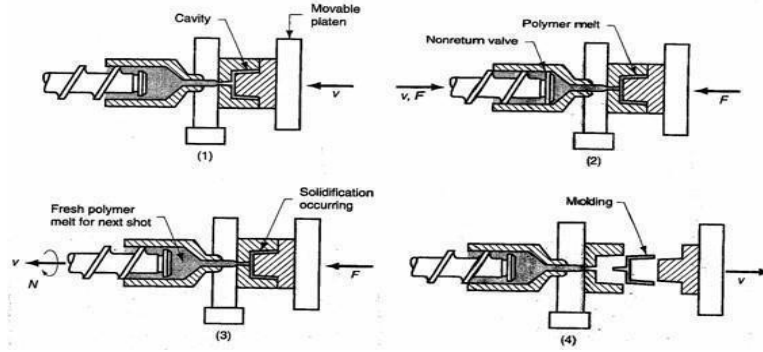


figure 3 various position of mould

3.4 COOLING SYSTEM

Cooling is very important to remove heat efficiently and dissipate the heat of the moulding quickly and uniformly. For efficient moulding, the temperature of the mould should be controlled and this is done by passing a fluid through a suitably arranged channel in the mould.

3.4.1 COOLING LAYOUT

There is no precise rule on which layout on the mould as long as the flow is uniform. But in many multicavity moulds the cooling channel layout are partly in parallel and partly series.

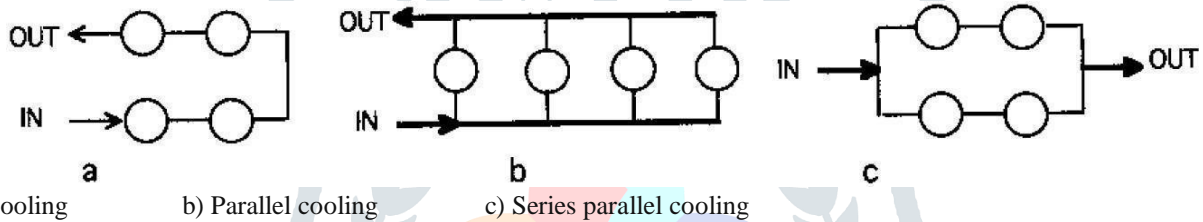


figure 4 different types of cooling layouts

3.5 EJECTION SYSTEMS

After a component has solidified and cooled down, it needs to be removed from the mould cavity. Ideally, this is done by gravity and the part falls to the floor as shown in Figure 3.21 However, some components with design features such as undercuts, adhesion or internal stresses may have to be removed from the mould manually or by robots.

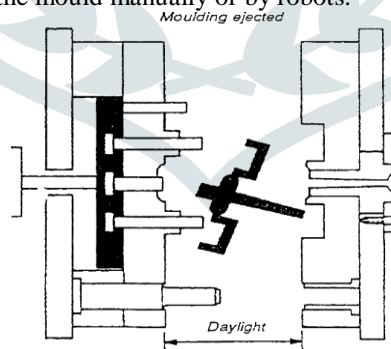


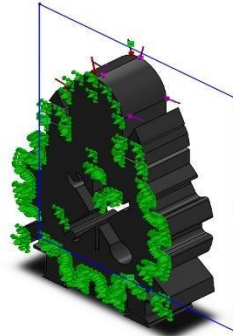
figure 5 moulding ejection

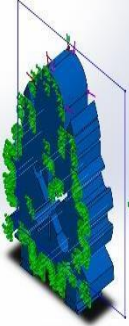
3.6 VENTING

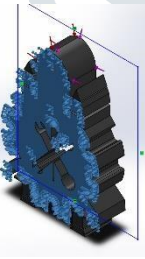
It is the process of removing trapped air from the closed mould and volatile gases from the processed molten plastic.

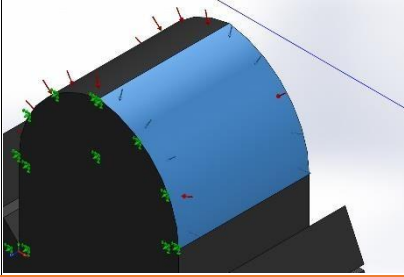
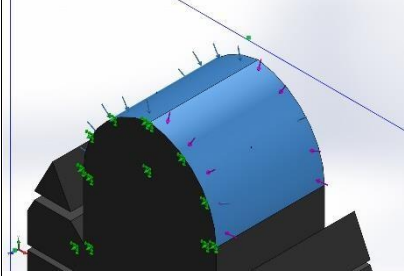
4. DESIGN OF DIE SHAPE

4.1 MODEL INFORMATION

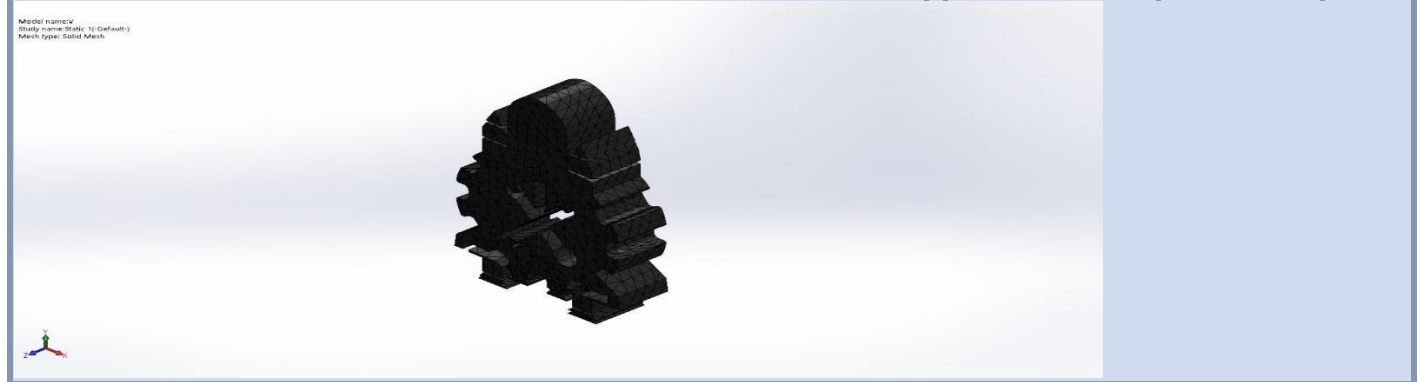


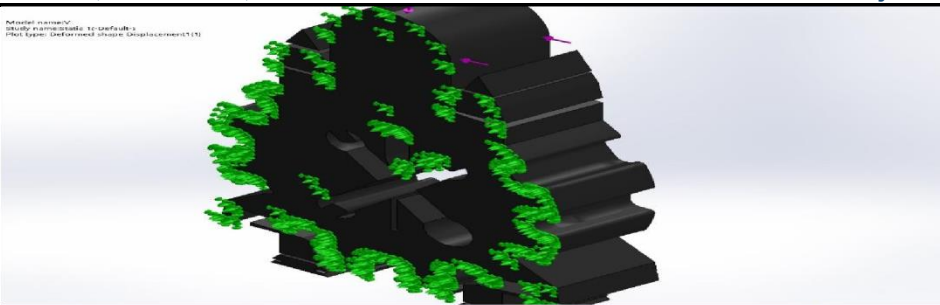
Model Reference	Properties	Components
	Name: Gray Cast Iron (SN) Model type: Linear Elastic Isotropic Default failure criterion: Mohr-Coulomb Stress Tensile strength: 1.51658e+008 N/m² Compressive strength: 5.72165e+008 N/m² Elastic modulus: 6.61781e+010 N/m² Poisson's ratio: 0.27 Mass density: 7200 kg/m³ Shear modulus: 5e+010 N/m² Thermal expansion coefficient: 1.2e-005 /Kelvin	SolidBody 1(Boss-Extrude5[7])(V), SolidBody 2(Boss-Extrude5[2])(V), SolidBody 3(Boss-Extrude5[5])(V), SolidBody 4(Boss-Extrude5[4])(V), SolidBody 5(Boss-Extrude5[1])(V), SolidBody 6(Boss-Extrude5[3])(V), SolidBody 7(Boss-Extrude6)(V)

Fixture name	Fixture Image	Fixture Details															
Fixed-1		Entities: 1 face(s) Type: Fixed Geometry															
Resultant Forces																	
<table border="1"> <thead> <tr> <th>Components</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>Reaction force(N)</td> <td>68.8007</td> </tr> <tr> <td>Reaction Moment(N.m)</td> <td>0</td> </tr> </tbody> </table>		Components	X	Reaction force(N)	68.8007	Reaction Moment(N.m)	0	<table border="1"> <thead> <tr> <th>Y</th> <th>Z</th> <th>Resultant</th> </tr> </thead> <tbody> <tr> <td>60.6863</td> <td>0.000467078</td> <td>91.7407</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table>	Y	Z	Resultant	60.6863	0.000467078	91.7407	0	0	0
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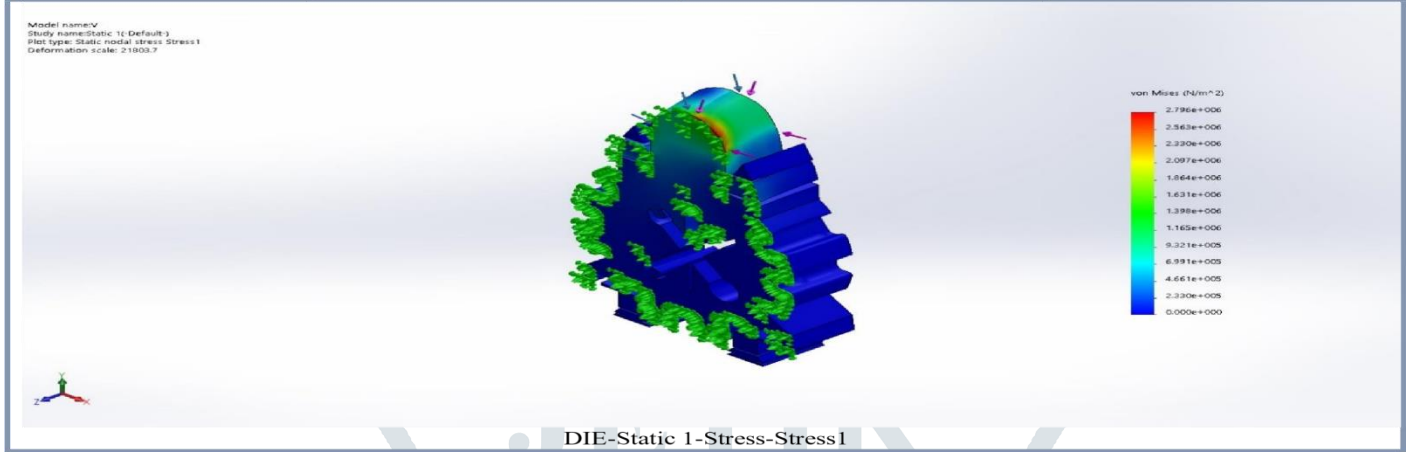
Load name	Load Image	Load Details
Force-1		Entities:Type:1 Value: face(s) Apply normal force 100 N
Pressure-1		Entities:Type:2 Value: face(s) Units: Normal Phase Angle: to selected face 100 N/m ² 0 deg Units: deg

Total Nodes	20019
Total Elements	11536
Maximum Aspect Ratio	14.042
% of elements with Aspect Ratio < 3	89.1
% of elements with Aspect Ratio > 10	0.173
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:00:30
Computer name:	

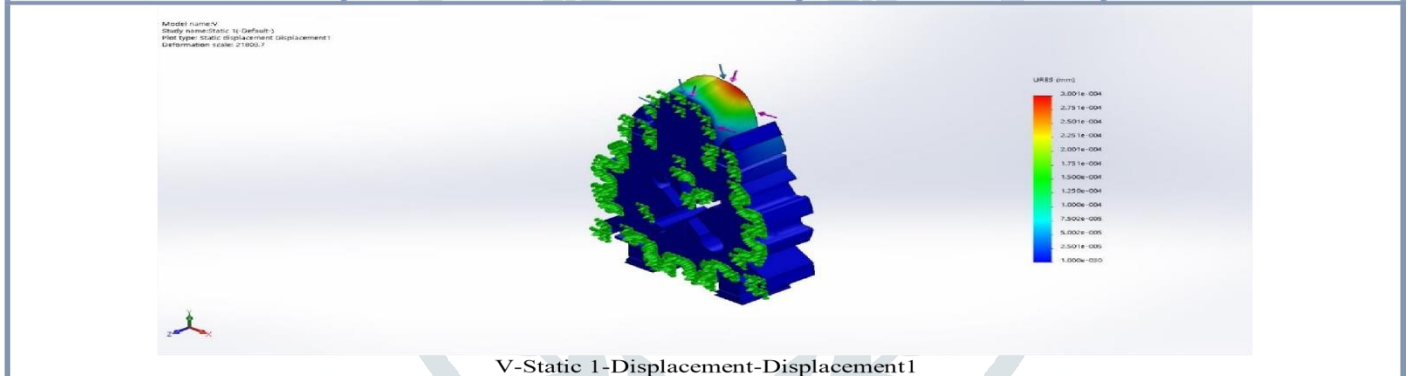




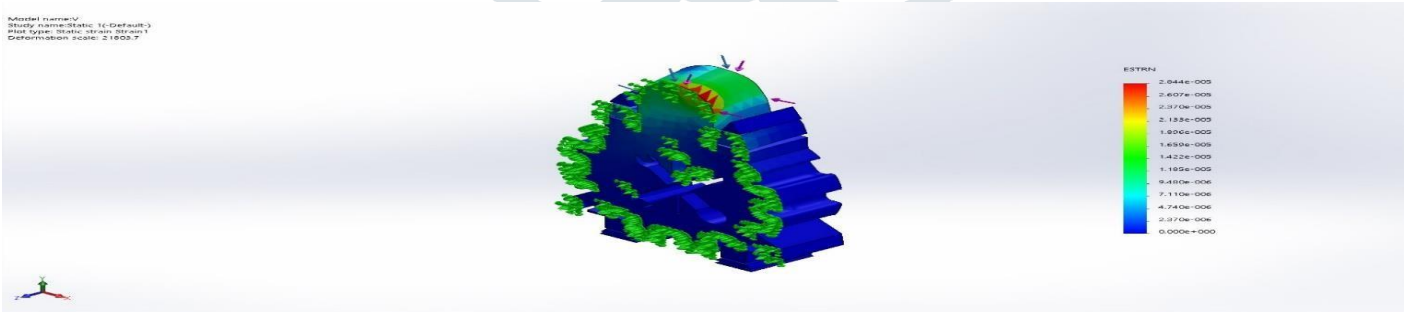
Name	Type	Min	Max
Stress1	VON: von Mises Stress	0.000e+000N/m ² Node: 1	2.796e+006N/m ² Node: 2880



Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 1	3.001e-004mm Node: 2870



Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	0.000e+000	2.844e-005



5. SOLAR INSTALLATION

5.1 COMPONENTS USED

The table 3.1 illustrates the various components that are used in the solar installation . A detailed description of these components is provided in this section

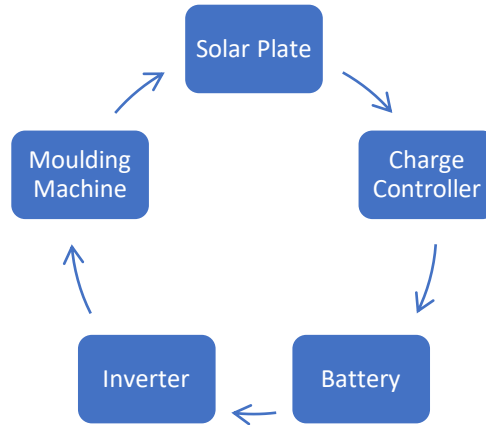


figure 6 various components used in the project

5.2 SOLAR PANEL

A Photovoltaic (PV) panel another name is solar panel consists of so many PV cells wired in parallel to increase current and in series to produce a higher voltage. The module is encapsulated with tempered glass on the front surface, and with a protective and waterproof material on the back surface. The edges are sealed for weatherproofing, and there is often an aluminum frame holding everything together in a mountable unit.

5.3 SOLAR CHARGE CONTROLLER

A solar charge controller is used to charge the battery by regulating and controlling the output from the solar PV array; it also protects the battery from being overcharged or over discharged.

5.4 INVERTER

An inverter (or power inverter) is a power electronics device which used to convert DC voltage into AC voltage. Although DC power is used in small electrical gadgets, most household equipment runs on AC power. Hence, we need an efficient way to convert DC power into AC power

5.5 BATTERY

A solar battery is a type of battery that stores energy generated by a solar PV system. The panels of the system capture solar energy and convert it to electricity, which is then routed through the inverter and used by your home.

6. RESULTS & CONCLUSION

Here we produce the plastic product with less amount of electricity usage by using solar panels produce power to the injection moulding machine. By this project we analysis the amount of power consumes from the solar panel & plastic specification after produce the product.

After observations

Voltage of each solar panel is usually around 17.0 Volts.

Voltage(V) = 17.0V

This voltage is reduced to around 13 to 15 Volts as required for battery charging.

Battery usage = 12.0 V

Time taken to completely charged battery is around 4 hrs

Time taken(T) = 4hrs

Current produced by each panel is around 10amp, it's depended on the sun.

Current(I) = 10 amp.

Power (P) = VIT

= (17)(10)(4) = 680 watts.

Current would vary when we connect in both series and parallel connection



figure 7 producing the product

CONCLUSION

The proposed plastic injection moulding is successful fabricated, conclusion of the equipment that we have fabricated, is as follows:

- Therecycled waste plastic is environmentally friendly and cost efficient.
- This plastic injection moulding machine largely used for plastic product effectively
- It is easy to operate
- It can use for small amount of plastic products
- The cooling time is very less in this moulding due to small number of plastic products only can use.

The fabrication of plastic injection moulding is used for converting waste plastic to design product. Here we can use any type of plastic and metals, polymers also. At the same time, it can decrease the amount of waste plastic in our surroundings & with less amount of electricity.

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