

## MODELING AND INJECTION ANALYSIS OF EXHAUST FAN

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**Abstract** An exhaust fan is a device that uses undesirable odors, particulate, dust moisture and other pollutants that may be present in the air to control to indoor environment. Exhaust fans can also be integrated into heating and cooling system. These fans are typically very easy to install, so they can also installed in many other location. Users need a few tool for installization and they have work easily with electricity.

This project involves modelling of exhaust fans, using solid works and analysed injection moulding procedure of exhaust fan using ansys software. Exhaust fan and casing material selected as ABS (Acrylonitrile Butadine Styrene) plastic material instead of stainless steel. It has been studied flow pattern, filling time, pressure and temperature of exhaust fan moulding.

**Keywords:** ABS (Acrylonitrile Butadine Styrene) plastic material, solidworks, Injection Modeling

### 1. INTRODUCTION

#### Plastic Moulding :

Plastic moulding is the method of acquiring a desired form of plastic using the system of moulding. In this procedure the molten plastic is poured in the die of desired form, corresponding to the shape of product we want after which allowed to solidify till it solidifies and obtains its form.

Plastic moulding is ideal for producing excessive volumes of the identical item. A few advantages of plastic moulding are high manufacturing prices, repeatable excessive tolerances, huge variety of substances used, low labour value, minimum scrap losses, and little need to finish parts after plastic moulding.

In vast phrases, the procedure of plastic moulding includes feeding uncooked fabric granules and components which include shade, right into a hopper situated on the moulding machine. The uncooked cloth enters a heated barrel with reciprocating screw and the molten plastic is then injected at good sized force into a component mildew tool for the item being produced.

The procedure of plastic moulding commonly starts off evolved with an industrial dressmaker or engineer who designs a product. That is followed up via the work of a toolmaker or mold maker who makes the mould to match the design created. Whilst molten, they could then be manipulated (injection moulded, extruded etc.) To a new form. Whilst fashioned to their new form they ought to then be cooled to solidify them.

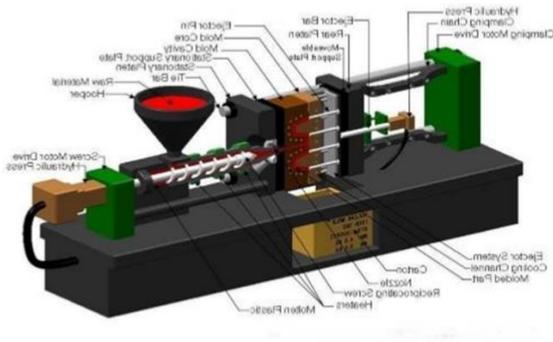


**Fig 1 Examples of Few Plastic Components**

#### Injection Moulding :

Injection moulding is a producing method for generating parts by injecting cloth into a mold. Injection moulding may be performed with a host of substances, along with metals, glasses, elastomers, confections, and maximum typically thermoplastic and thermo putting polymers. Cloth for the component is fed right into a heated barrel, mixed, and forced into a mildew hollow space, where it cools and hardens to the configuration of the hollow space. After a product is designed, normally with the aid of an industrial clothier or an engineer, moulds are made with the aid of a mould (or toolmaker) from steel, commonly either metallic or aluminum, and precision machined to shape the features of the favored component. Elements to be injection moulded should be very cautiously designed to facilitate the moulding procedure; the fabric used

for the part, the preferred shape and functions of the part, the cloth of the mildew, and the homes of the moulding device ought to all be taken under consideration. The versatility of injection moulding is facilitated via this breadth of design issues and possibilities.



**Fig 2 Injection Moulding Machine**

The injection moulding gadget consists of 3 most important additives; particularly,

1) **Clamping unit:** clamping designs are of three kinds: toggle, hydraulic and hydro mechanical. Toggle clamps offer each excessive pace and excessive force whilst they are desirable and are maximum suitable to exceedingly low-tonnage machines. In case of excessive-tonnage machine hydraulic clamping unit is used that's connected to the

shifting platen. It is used to apply the clamping force to maintain the mould closed at the same time as injecting.

2) **Injection unit:** it consists of the injector system and associated mechanism which melts the uncooked material and injects it into the die at high pressure and within the stipulated time. This device confines and transports the plastic because it progresses thru the feeding, compressing, degassing, melting, injection, and packing levels. It consists of the following elements:

3) **Hopper:** thermoplastic fabric is furnished to moulders inside the shape of small pallets. The hopper on injection gadget holds these pallets which can be gravity fed from the hopper via the hopper throat into the barrel and screw assembly.

4) **Barrel:** the barrel of the injection moulding system supports the reciprocating plasticizing screw. It's miles heated by means of electric powered heater bands

5) **Reciprocating screw:** the reciprocating screw is used to compress, melt and convey the material. The reciprocating screw consists of three zones, (1) feed quarter, (2) compressing region (transition quarter) & (three) melting zone

6) **Nozzle:** it connects the barrel to the sprue bushing of the mildew and forms a seal between the barrel and the mildew. The temperature of the nozzle must be set to the

substances soften temperature or just below it, depending on the advice of the material provider. Whilst the barrel is in its complete forward processing function, radius of the nozzle must nest and seal in the concave radius within the sprue bushing with a locating ring. For the duration of purging of the barrel, the barrel backs out from the sprue, so the purging compounds can loose fall from the nozzle.

7) **Mold unit:** it includes core and hollow space that bureaucracy the impression for the part to be moulded in conjunction with all of the other mechanism and element associated with mold base and ejector device. The mildew system consists of tie bars, stationary and transferring platens, as well as moulding plates (bases) that house the hollow space, sprue and runner systems, ejector pins, and cooling channels. The mould is largely a heat exchanger wherein the molten thermoplastic solidifies to the desired shape and dimensional information defined by way of the hollow space.

8) **Impact:** the injection mildew is an meeting of part of containing inside it an 'impact' into which plastic material is injected and cooled. It's miles the impression which offers the molding its shape the affect may additionally, therefore, be defined as that part of

the mildew which imparts form to the molding. The impact is shaped of two mould individuals:

1) The 'hollow space' that's the girl part of the mould. Gives the molding is external shape

2) The 'center' that is the male portion of the mold, forms the internal shape of the molding.

9). **Cavity and middle plates:** the basic mildew includes plates. Into one plate is sunk the hollow space which shape is outside of molding and is consequently referred to as the cavity plate. Similarly, the center that's venture form the 'core plate' shape the interior shape of molding. While the mould closed, the two plates come together forming a space among the hollow space and cowl that is the 'impression'

## 2. PROBLEM STATEMENT

The design and production of exhaust fans require meticulous attention to detail to ensure optimal performance, durability, and cost-effectiveness. One of the critical aspects influencing the quality and efficiency of exhaust fan manufacturing is the mould tool design and injection molding process. However, existing methodologies for mould tool design and injection analysis may lack comprehensive optimization strategies tailored specifically for exhaust fan production. Challenges such as inefficient cooling systems, suboptimal material selection, and inadequate flow analysis techniques can lead to defects, increased production costs, and compromised product quality. Therefore, there is a pressing need to conduct a thorough investigation into the modeling and analysis of

mould tool design and injection molding processes for exhaust fans. By addressing this gap, we aim to develop advanced techniques and methodologies that enhance the efficiency, reliability, and cost-effectiveness of exhaust fan production. This study seeks to identify key challenges and opportunities in mould tool design and injection analysis for exhaust fans and propose innovative solutions to overcome them. Through systematic research and experimentation, we aim to optimize the manufacturing process, improve product quality, and drive innovation in the exhaust fan industry.

### 3. EXPERIMENTAL PROCEDURE

#### Modeling procedure of Exhaust Fan Blade and Casing

You start this lesson through developing a brand new element.

1. Click on new on the usual toolbar. If that is the primary record you have got created, the devices and size standard dialog container seems. For units, select mmgs (millimeter, gram, second). For size general, choose ansi. Click ok.
2. The new Solidworks report dialog field seems.
3. Click part. Click ok.
4. Click on extruded boss/base on the functions toolbar. The the front, pinnacle, and right planes seem within the photos area.
5. Flow the pointer over the pinnacle aircraft to highlight it, then click to select it. The show adjustments so that the pinnacle aircraft is going through you. A sketch opens on the pinnacle aircraft.
6. Click on circle on the comic strip toolbar. The circle property manager opens in the left pane.
7. Pass the pointer over the origin. The pointer adjustments to region. This shows a coincident relation among the center of the circle and the beginning.
8. Click to vicinity the center point on the starting place.
9. Move the mouse and word a preview of the circle dynamically follows the pointer.
10. Click on to finish the circle and click on go out comic strip within the property supervisor.
11. Click on view > cover /display > brief axes.
12. This shows all of the device-generated axes in the component. You choose one as the primary axis of the pattern.
13. At the features toolbar, expand the linear sample fly out toolbar and click circular sample
14. In the belongings supervisor, under parameters:
15. Pick the brief axis in the center of the element for sample axis.
16. Select identical spacing to sample the wide variety of times uniformly around the axis inside 360°.
17. Set variety of instances
18. Click on in features to sample .
19. Inside the flyout function manager layout tree inside the pictures location, pick the final three functions (fillet2, reduce-extrude2, and boss-extrude3).
20. Click on proper .

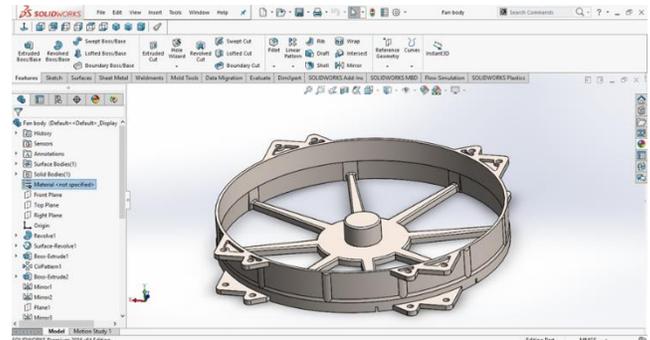


Fig 3 Fan Casing

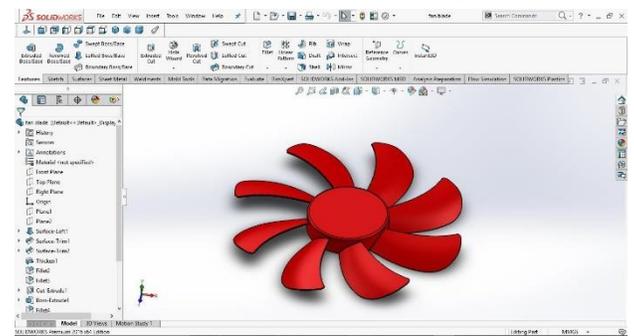


Fig 4 Fan Blade

#### Injection Analysis :

- Go to select on flow/PACK
- Filling Time = 4.3828 sec
- Main Material Melt Temperature = 290 °C
- Mold Wall Temperature = 80 °C
- Injection Pressure Limit = 100 mpa
- Max. Inject(Machine) Flow Rate = 194 cc/s
- Flow/Pack Switch Point in Filled Volume = 100 %
- Pressure Holding Time = 1.94 sec
- Total Time in Pack Stage = 3.17 sec
- Auto Filling Time(1: Exist, 0: Not) = 1
- Auto Packing Time(1: Exist, 0: Not) = 1
- Venting Analysis(1: Exist, 0: Not) = 0
- Cavity Initial Air Pressure = 0.1 mpa
- Cavity Initial Air Temperature = 25 °C
- Gold Wire Analysis(1: Exist, 0: Not) = 0 COOL
- Inlet melt temperature = 280 °C
- Min. Coolant temperature = 25 °C

- Air temperature = 30 °C
- Mold open time = 5 sec
- Average coolant flow rate = 150 cc/s
- Control type(1:Eject temp., 2:Cooling time) = 1
- Eject temperature(If control type is "1") = 120 °C
- Cooling time(If control type is "2") = 3.16 sec
- WARP Ambient Temperature = 30 °C
- X-dir. Clamping Force= 6.5100 Tonne (7.1700 Ton U.S)
- Y-dir. Clamping Force= 4.4100 Tonne (4.8600 Ton U.S)
- Z-dir. Clamping Force= 6.7100 Tonne (7.4000 Ton U.S)
- Requiring injection pressure= 63.8400 Mpa (9261.5100 psi)
- Max. Central temperature= 282.4500 oc (540.4100 of)
- Max. Average temperature= 256.2600 oc (493.2600 of)
- Max. Bulk temperature= 288.7600 oc (551.7700 of)
- Max. Shear stress= 0.9600 Mpa (139.5200 psi)
- Max. Shear rate= 35319.7200 1/sec
- Averaged perfect cooling time= 1.8600 sec
- CPU Time= 101.80 sec
- Cycle Time: = 7.24 sec

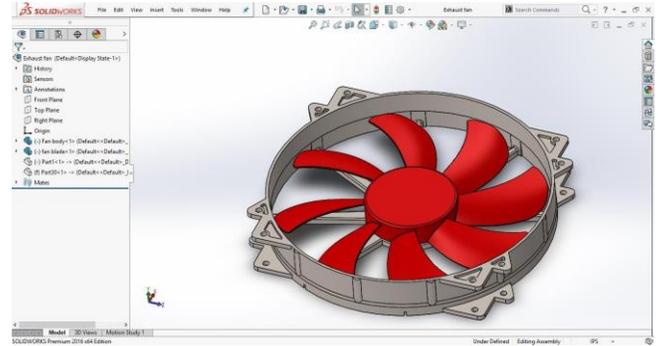


Fig 7 Exhaust fan Assembly

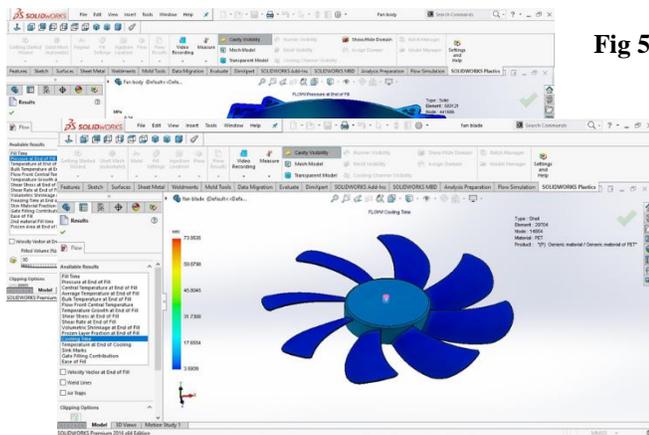


Fig 5

Fig 6

#### 4 RESULTS AND DETAILS :

##### Exhaust fan blade and casing assembly:

Exhaust fan blade and casing constructed by using solid works software and also done the model of the assembly as shown in the fig.

##### Injection analysis result:

Filling Time : 0.98 Sec  
 Injected Flow Rate :194 Cubic Centimeters/second Mold Wall  
 Temperature :50'  
 Melting Temperature :280' Total Time :3.18 Second  
 Total Mold Process :3.20 Seconds  
 Hence these are the resulting parameters for the best exhaust fan.

#### 5 CONCLUSION

In this project Modeling of exhaust fan and casing was done successfully by using a software solidworks by considering various design parameter.

After modeling export the exhaust fan model in injection analysis software and done analysis various injection analysis parameters like i.e; filling time , injected flow rate , mold temperature , melting temperature ,total time , total mold process are analysed

## 6 REFERENCES

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