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Research Article

Mould Flow Analysis of Cooler Fan

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Abstract

Presently, Cooler fans are produced with 3 wings which produce low capacity of air. The material used for the wings is SS (Stainless Steel), which has more weight, consequently fan weight is more. The problem is rectified by designing fans with 5 wings by using ABS (Acrylonitrile butadiene styrene) Plastic material.The fan is manufactured by using injection moulding process. In this paper, Core and Cavity of cooler fan is extracted and total mould base is designed for the cooler fan using HASCO standards. Manufacturing processes for both core and cavity are also included. In this paper we are providing all the data required for doing Injection mould tool. Modelling and core-cavity extraction is done using Pro/Engineer software. CNC programming is also done using Pro/Engineer

Keywords: *ANSYS, Cooler Fan, CADD, pro –E.*

1. Introduction

A fan is a powered device used to create flow within a gas, usually air. A fan consists of a rotating arrangement of vanes or blades which act on the air. Fans produce air flows with high volume and low pressure. Fans are as varied in their construction as they are in their applications. These blades are primarily differentiated according the physical principle of the transfer of energy to the gas medium. Depending on the design, each fan is suitable for a number of different uses.

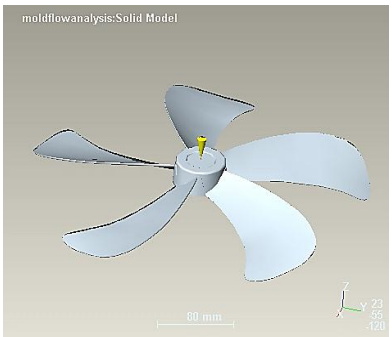

Fig.1 Cooler fan

2. Introduction to pro/engineer

Pro/Engineer wildfire is the standard in 3D product design, featuring industry-leading productivity tools that promote best practices in design while ensuring compliance with your industry and company standards. Integrated Pro/Engineer CAD/CAM/CAE solutions allow you to design faster than ever, while maximizing innovation and quality to ultimately create exceptional products. Customer requirements may change and time pressures may continue to mount, but your product design needs remain the same - regardless of your project's scope, you need the powerful, easy-to-use, affordable solution that Pro/Engineer provides

2.1 Pro/Engineer Wildfire Benefits

Pro/Engineer Wildfire is the standard in 3D product design, featuring industry-leading productivity tools that promote best practices in design while ensuring compliance with industry and company standards.

1) Unsurpassed geometry creation capabilities allow superior product differentiation and manufacturability
2) Fully integrated applications allow you to develop everything from concept to manufacturing within one application
3) Automatic propagation of design changes to all downstream deliverables allows you to design with confidence
4) Complete virtual simulation capabilities enable you to improve product performance and exceed product quality goals

3. Modules

Pro/ Engineer can be packaged in different versions to suit the needs, from Pro/Engineer Foundation XE, to Advanced XE Package and Enterprise XE Package,

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Pro/engineer Foundation XE Package brings together a broad base of functionality. From robust part modeling to advanced surfacing, powerful assembly modeling and simulation, the needs will be met with this scalable solution.

The main modules are

Part Design
Assembly
Drawing
Sheet Metal
Manufacturing

4. Mould flow analysis

Mould flow, 3D solids-based plastics flow simulation that allows plastics part designers to determine the manufacturability of their parts during the preliminary design stages and avoid potential downstream problems, which can lead to delays and cost overruns. Following are the benefits:

Optimize the part wall thickness to achieve uniform filling patterns, minimum cycle time and lowest part cost Identify and eliminate cosmetic issues such as sink marks, weld lines and air traps. Determine the best injection locations for a given part design.

Mould flow analysis gives you the ability to maintain the integrity of your product designs. It provides you the tools to quickly optimize part designs and check the impact of critical design decisions on the manufacturability and quality of the product early in the design process.

There is no need to:

1) Compromise the aesthetics of your design concept for manufacturability;
2) Go through a lengthy trial and error process to find the most suitable material to produce the part with the highest possible quality and the lowest possible cost
3) Find out during trial runs that the produced part has visual blemishes, such as sink marks, weld lines, air traps or burn marks.

5. Plastic advisor

Plastic advisor is an add on analysis package for Pro/E, specially for plastic injection moulding. For doing this analysis, after drawing the required object Select applications > plastic advisor > pick datum point for injection location > ok.

Fig.3 Icons

When we click on the moulding parameter icon a separate window opens and there we can select the required materials and we can specify the require injection conditions like mould temperature, injection pressure.

After specifying the materiel and processing conditions, click on the specify injection location icon and specify the required location point. Then click on the run analysis icon and select plastic flow analysis and click on start button.

6. Results of mould flow analysis

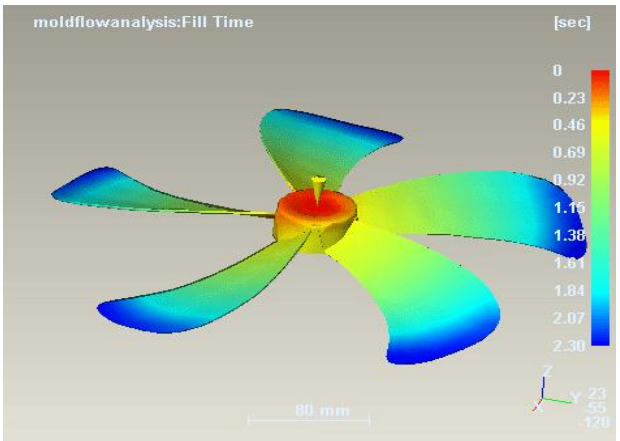

Fig.4 Fill time

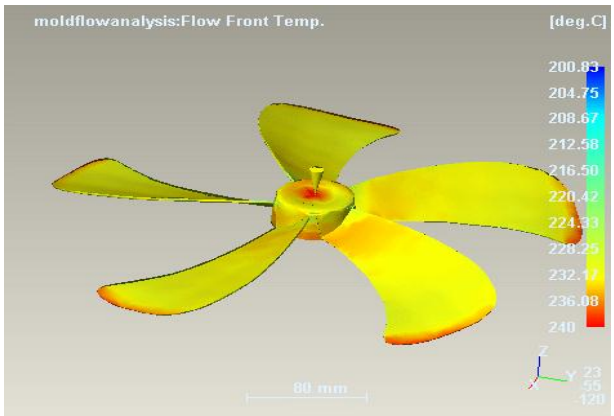

Fig.5 Flow Front Temperature

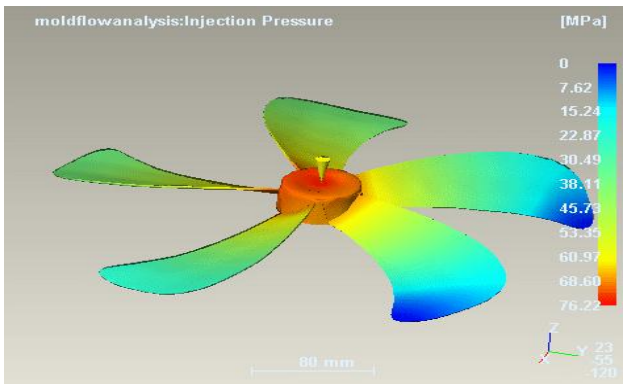

Fig .6 Injection pressure

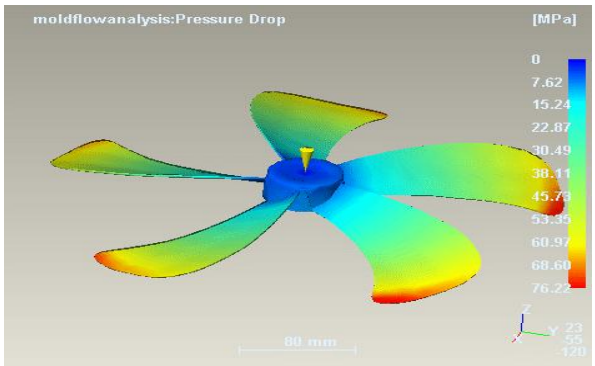

Fig.7 Pressure drop

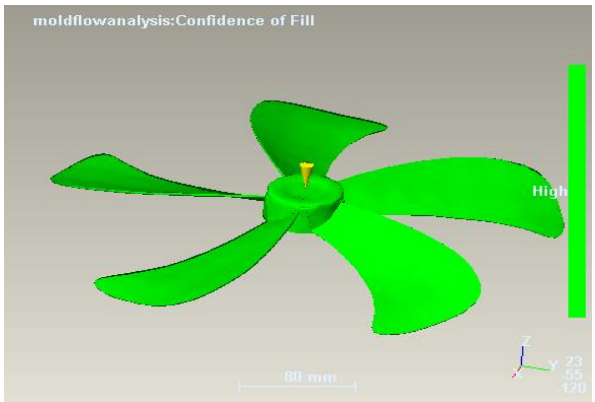

Fig.8 Confidence of fill

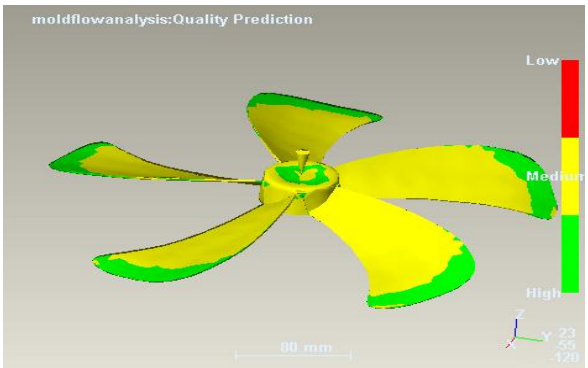

Fig.9 Quality prediction

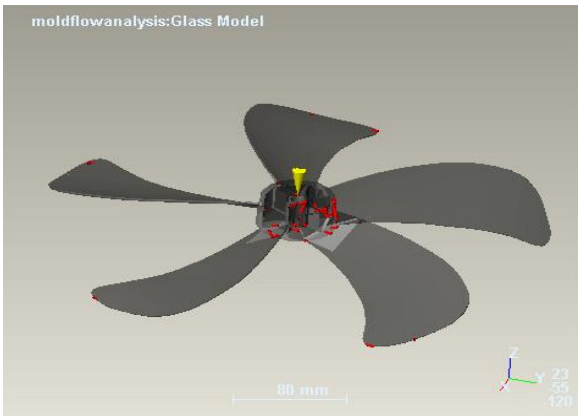

Fig.10 Weld lines

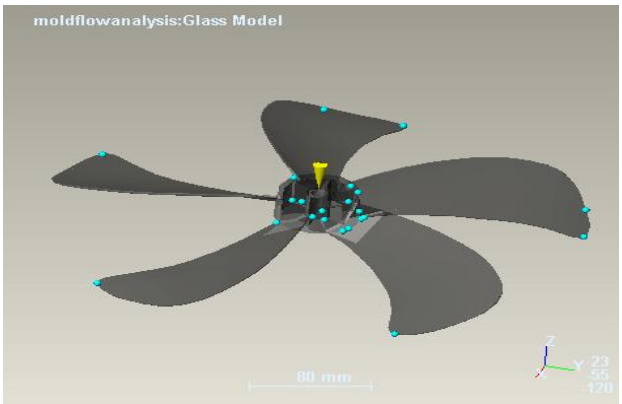

Fig.11 Air Traps

Confidences of fill results indicate that there is a low Confidence of fill due to the high pressure required to fill the cavity. The advice topic on pressure drop indicates that to fill the part you will need to change one of the following things:

1) material
2) injection location
3) injection pressure
4) part geometry
5) injection pressure

The Quality Prediction plot uses several results to give an indication of the overall quality of the part. When the Quality Prediction result indicates a problem the following things have to be checked and changed if necessary.

1) Shear stress is too high
2) Cooling time is too high
3) Pressure drop is too high
4) Flow front temperature is too high
5) Flow front temperature is too low

Weld lines are not all critical and do not always lead to visual or structural defects. Weld lines are often unavoidable but we can change the flow of the material to place them in areas that are less sensitive. Weld lines should only be in areas that are not visually or structurally sensitive.

Air traps appear when fronts meet, trapping pockets of air flow. Like weld lines these are also unavoidable so we should take care that air traps should only be in locations where the air can be vented

1) The Confidence of Fill and the Quality Prediction results are good starting points when checking an analysis. They will show you where there may be problems with the part.
2) If flow front is too low in an area where weld lines are present, the weld lines may appear worse. In areas where the flow front temperature is too high, material degradation and surface defects may occur.

We must make sure that the flow front temperature is always within the recommended temperature range for the material used.

6.1 Results

Cycle time = 24.33 sec

Each shift time = 7 hours/420min/25200 sec (By reducing brake time)

No: of components produced for each shift = each shift time /Cycle time

= 25200/24.33
= 1035.75
= 1000 components for each shift

Table 1 Injection moulding vs. other process

Process	Max operating temperature	Max operating Pressure	General operating pressure is less than
Rotational molding	260°c	20 Mpa	1.5 Mpa
Transfer molding	320°c	76 Mpa	20 Mpa
Compressi on molding	260°c	55 Mpa	20 Mpa
Injection	371°c	250 Mpa	100Mpa

Conclusions

Presently cooler fans are made with metals. So fan weight is more and consequently high power is required for the fan rotation. In this paper we tried to rectify the problem by using ABS plastic material. We have modeled the fan using 3D parametric software Pro/Engineer. Mould calculations are done to calculate number of units per hour, clamping force, shot weight, mass of water to be circulated to cool and rate of heat to be extracted by water.

Mould flow analysis is done on the fan to determine the material fill rate, filling time, temperature distribution, weld lines, air traps before going to tool design.

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