

Analysis and Optimization of Centrifugal Blower Material by using FEA & CFD

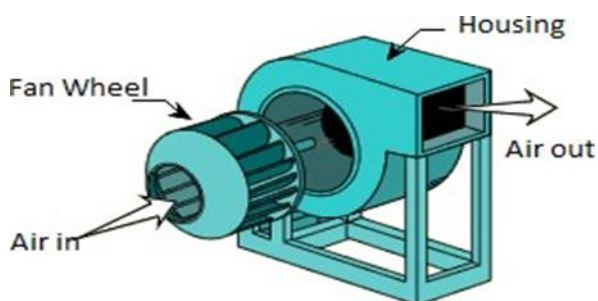
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Abstract - An in food production industries for air flow cause centrifugal blowers are used. These blowers preserve the meals cool earlier than packaging in order that the meals does not now no longer get spoiled. Due to non-stop use of blower at low temperature and at presence of humidity it begins of to corrosion. So that it different houses get disturbed i.e. performance, discharge, go with the drift fee, etc. and additionally because of corrosion a few debris get infected with meals and turns into dangerous. So to enhance boiler we've got accomplished this studies. We use CFD Analysis for fluid go with the drift situations and FEA Analysis for bodily phenomenon and element prototype layout.

Key Words: CFD Analysis, FEA Analysis, Centrifugal Pump, Applications, SS316L, Problem Identification Static Modal Analysis, Boundary Conditions.

1. INTRODUCTION:



Blowers are extensively utilized in business and business packages from store air flow to cloth handling, boiler packages to a number of the car cooling structures. The overall performance of the fan machine may also variety from unfastened air to numerous cfm (cubic toes according to min.). Blowers are one of the mechanisms used frequently in submarines. They are set up in air flow and air con structures in nearly all submarine compartments. Ventilation structures generally supplied with the aid of using primary structures consist of deliver and exhaust lovers, serve for air flow of lodging and apart from lodging regions with atmospheric air with simultaneous air flow of garage batteries and for air cooling and purification from dangerous and smelling impurities. Blowers are one of the styles of rapid equipment which might be used to transport air constantly with in mild boom in static stress. Selection of fan machine relies upon on diverse situations including airflow rates, temperature of air, pressures, airstream

houses, etc. Although, the fan is generally decided on for nontechnical motives like price, delivery, availability of space, packaging etc. The blower is usually analyzed with the aid of using its overall performance curves which might be described because the plot of evolved stress and strength required over more than a few fan generated air go with the drift. Also those fan function curves may be used to facts like fan bhp for choice of the motor being used. The centrifugal lovers with impellers having blades of Airfoil phase are taken into consideration because the excessive performance impellers many of the six kinds Airfoil blades, Backward Inclined unmarried thickness blades, Backward curved blades, ahead curved blades, radial tip blades and radial blades. The gift examine offers the layout technique for those excessive performance impellers which consist of the numerical layout system and the CFD evaluation of it. The CFD element is used for development the outcomes of Static Pressure generated on the access to the impeller, static performance. The CFD optimization additionally helped to enhance the go with the drift sample thru the centrifugal fan machine. Centrifugal rapid machines are usually used in lots of air-shifting gadgets because of their cap potential to reap noticeably excessive- stress ratios in a compact configuration in comparison with axial lovers. They are regularly observed in fueloline turbine engines, heating air flow and air con structures, and hydraulic pumps. Because in their extensive use, the noise generated with the aid of using those machines regularly reasons severe environmental problems. The rapid equipment noise is regularly ruled with the aid of using tones at blade passage frequency and its better harmonics. This is in particular because of robust interactions among the go with the drift discharged from the impeller and the cutoff of the casing. In addition to discrete tones, the broadband noise is likewise generated because of the separation, turbulence blending, and the vortex interplay technique.

1.1 PROJECT IDEA:

The meals enterprise dealing with corrosion troubles and getting infected evaluation to triumph over corrosion, stress, pace of go with the drift, performance, etc. with meals. The major purpose to clear up the cloth trouble. So this studies is accomplished with the aid of using FEA and CFD

1.2 MOTIVATION OF THE PROJECT:

We have organized a brand new machine after figuring out problems withinside the present blower cloth. By this machine works correctly and efficiently. Cold or moisturize weather industries can use this machine because of its resolved troubles, corrosion resistance and coffee maintenance. It may be very powerful in meals industries to now no longer get infected because of its houses.

2. LITERATURE SURVEY:

Atre Pranav C. and Thundil Karuppa Raj R. looked into how Numerical Design and Parametric Optimization of Centrifugal Fans with Airfoil Blade Impellers would help to increase blade efficiency and weight.

Acoustic Characteristics of a Centrifugal Impeller with a Splitter are examined by Wan- Ho Jeon Thanks to their ability to achieve relatively high pressure ratios in a compact configuration compared to axial fans, centrifugal turbo machines are widely used in many air-moving devices.

Veeranjaneyulu Itha and T.B.S.Rao The aim of this paper is to investigate the static and dynamic analysis of a blower in order to minimise vibrations and effects.

Mohd Jubair Nizami, Ramavath Sunman to investigate the static and dynamic analysis of a blower in order to minimise vibrations and effects.

Jia Bing Wang Huazhong Numerical Analysis of Internal Flow Field of Multi-Blade Centrifugal Fan for Floor Standing Air-Conditioner is explained in order to boost the blower's discharge.

C. Cuevas Arteaga 1, J. Porcayo Calderón they investigated the Corrosion Resistance of Carbon Steel and Stainless Steels

3. PROBLEM DEFINATION AND SCOPE

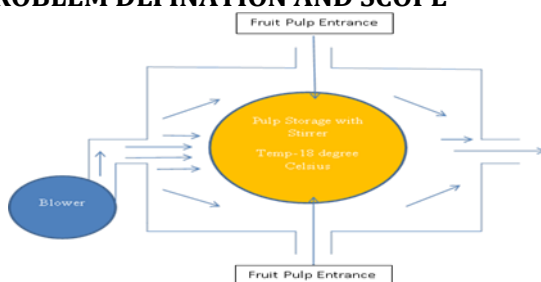


Fig. PLANT LAYOUT

3.1 PROBLEM STATEMENT:

In Fruit pulps input the box withinside the compartment's centre thru the channels given throughout the entrance, as proven in figure. Pulps are transformed to juice withinside the box with the useful resource of a stirrer, and juice flows thru the channels from the lowest of the box to the packaging department. A centrifugal blower is used on this plant for air flow and to manipulate the temperature of the

meals garage (pulp garage). According to a communique with a corporation representative, they may be having quite a few problems with centrifugal blowers. The cutting-edge centrifugal blower is fabricated from M.S. cloth, and corrosion is a vast issue. The identical materials are contaminating meals, that's dangerous. Additionally, the cutting-edge blower's weight is excessive, and the vibrations as a result of the given centrifugal blower are excessive. The cutting-edge blower's discharge is 12000 cfm (cubic toes according to metre), that's incredibly much less whilst in comparison to the pulp vicinity of the enterprise.

3.1.1 GOALS AND OBJECTIVES:

GOALS:

1. Study of Present blower layout
2. Take realistic enter from enterprise
3. Literature Survey
4. Design of Blower
5. Analysis of blower impeller for unique cloth like MS, SS, SS316L, etc.
6. Design Modification for weight optimization

OBJECTIVE:

1. To lessen corrosion trouble of centrifugal blower.
2. To optimize the load of the centrifugal blower impeller with the aid of using checking diverse substances like MS, SS, and SS316L.
3. To blower energy of centrifugal blower with the aid of using doing static and modal evaluation the usage of FEA.
4. To take a look at fluid go with the drift sample with the aid of using CFD evaluation to decide herbal frequency of the impeller of MS, SS, SS316L (Food Grade Steel) cloth.
5. To take a look at returned go with the drift of fluid at casing with the aid of using CFD evaluation
6. To take a look at discharge of blower with the aid of using CFD evaluation

3.2 STATEMENT OF SCOPE:

1. Study of Present blower design
2. Take practical input from industry
3. Literature Survey
4. Design of Blower
5. Analysis of blower impeller for different material like MS, SS, SS316L, etc.
6. Design Modification for weight optimization

3.3 METHODOLOGIES OF PROBLEM-SOLVING AND EFFICIENCY ISSUES

To Reduce Corrosion Problem Of Centrifugal Blower:

The gift centrifugal blower is made of from M.S. cloth right here corrosion is a primary trouble. The elements of the

identical are blending with meals, that's dangerous. In this task paintings to keep away from corrosion trouble of centrifugal blower SS316L (Food Grade Steel) cloth is used rather than MS cloth because of its corrosion resistance houses and this cloth is meals grade metallic. Stainless metallic gives top notch resistance to corrosion. There are, however, environments that could motive everlasting breakdown of the protecting chromium oxide passive layer at the metallic, main to corrosion at the unprotected surface. Adding alloying factors like molybdenum and nitrogen creates excessive-alloyed or excessive-overall performance stainless steels with advanced resistance to corrosion. The Outokumpu Corrosion Handbook addresses the overall scale of corrosion associated problems with good sized articles and technical descriptions protecting unique business sectors. The currently up to date guide carries a wealth of facts approximately the noticeably new duplex own circle of relatives of low-nickel stainless steels and the wealthy range of latest merchandise and packages. Also protected is unique consciousness on industries with disturbing packages including desalination, pulp and paper and oil and fueloline enterprise. The statistics have to be are available accessible for all and sundry looking for solutions to corrosion problems: designers, engineers, metallurgists and different specialists. Similar research of numerous chrome steel had been made and suggested elsewhere (10-17).

Comparison of corrosion kinetics of carbon steel and some stainless steels:

Fig: Comparison of the corrosion rate of some stainless steel materials and carbon steel exposed to LiBr-H₂O (50% wt) at 25°C.

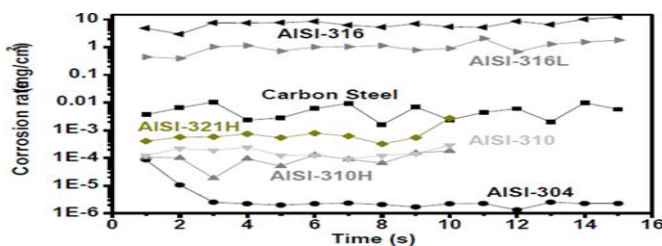


Fig : Comparison of the corrosion rate of some stainless steel materials and carbon steel exposed to LiBr-H₂O (50% wt) at 60°C.

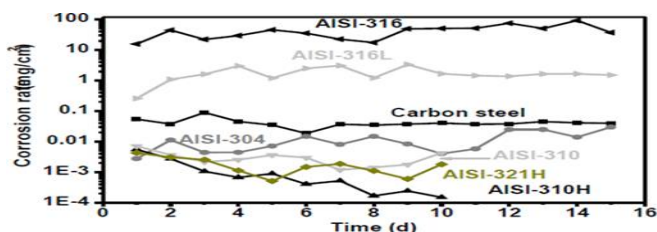


Fig: Comparison of the corrosion rate of some stainless steel materials and carbon steel exposed to LiBr-H₂O (50% wt) at 80°C.

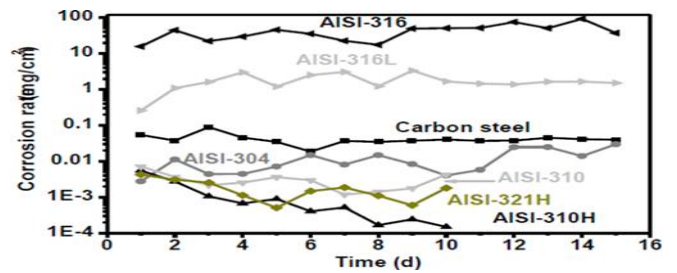


Table: Nominal composition of some studied materials under Li-Br conditions (wt. %).

Materials	Fe	C	Cr	Ni	Si	Mn	P(max)	S(max)	Mo	Other
Carbon Steel	98.02	0.1714	0.22	0.2064	0.1777	0.657	0.0154	0.0575	0.0733	See Exp. Procedure
AISI-316	70.595	0.08 max	17	12	0.75	2.0	0.045	0.03	2.5	N 0.1 max
AISI-316L	70.544	0.03 max	17	12	0.75	2.0	0.045	0.03	2.5	N 0.1 max
AISI-304	69.34	0.08 max	19	8.75	0.75	2.0	0.045	0.03		
AISI-310	50.67	0.25 max	25	20.5	1.5	2.0	0.045	0.03		
AISI-310H	50.85	0.07	25	20.5	1.5	2.0	0.045	0.03		
AISI-321H	68.6	0.07	18	10.5	0.075	2.0	0.045	0.03		Ti 0.7 max N 0.1 max

Similar studies of several stainless steel have been made and reported elsewhere (10-17). The study of these materials was in an analogous way than the presented here for carbon steel. Kinetics corrosion at 15 days for stainless steel AISI-316 (UNS-S31600), AISI-316L (UNS-S31603), AISI-304 (UNS-S30400) and Carbon Steel; and corrosion kinetics at 10 days for stainless steel AISI-310 (UNS-S31000), AISI-310H (UNS-S31009), and AISI-321H (UNS-S32109) obtained after exposing to LiBr-H₂O solution (50% wt.) at 25, 60 and 80°C is presented in Figures from 16 to 18. The material which presented the lowest corrosion rate at 25°C was AISI-304, followed by AISI-310H, AISI-310, AISI-321H, carbon steel, AISI-316L, and the highest corrosion rate was for AISI-316. At 60 and 80°C, AISI-310H presented the lowest corrosion rate, and AISI-304 incremented its corrosion rate with temperature in a significant way, nevertheless, carbon steel always had the major corrosion rate with respect to that obtained for AISI-304, AISI-310, AISI-310H and AISI-321H, but lower corrosion with respect to AISI-316 and AISI-316L. The lower corrosion rate obtained for AISI-310H related to AISI-310 is due to the lesser contain of carbon presented for AISI-310H.

Static analysis of centrifugal blower to optimize the weight and enhance the strength:

In this paper CFD model is prepared by using above mentioned software with the help of following blower specifications:

Type of blower: Flanged Mounted type Centrifugal Blower (HBI-BL-076)

Volume flow rate: 12000 cfm (cubic feet per min)

Operating temperature: 16 degree centigrade

Static pressure at operating temperature: 130 mm of Hg

Size of blower/Wheel diameter: 735 mm

Fan RPM: 1440

BHP at operating temperature: 13.91 HP

Efficiency: 85%

Motor Power1: 12 Horse Power

Torque1: 6.90 kg-m1

Gas density at operating temperature: 1.21 kg/m3

Static Load: 25 kg, Dynamic Load: 375 kg

Noise Level1 at Site: 88 db1

3.4 APPLICATION:

1. Centrifugal blower is extensively utilized in business packages in which there may be a demand of consistent go with the drift of huge extent of air.
2. It is utilized in meals production industries for air flow cause.
3. It is likewise utilized in combustion, transporting cloth, cooling and heating machine, dirt control, air conveyer machine, business vacuum packages, etc.
4. As changed blower is utilized in chemical processing, corrosive fuel line handling, dirt collection, dryers, fume control, technique cooling and technique heating.

4. DETAILED DESIGN:

Fig: CFD model

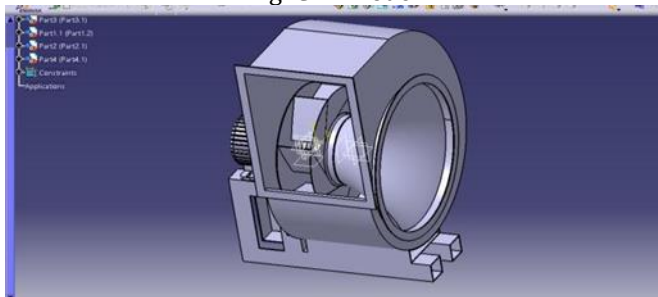


Fig. Blower Impeller

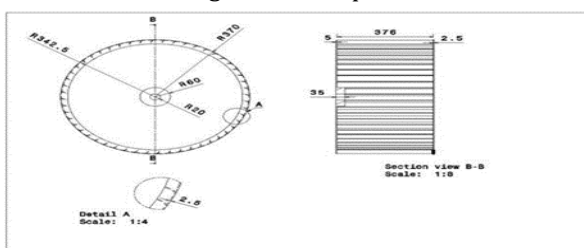


Fig. Blower Casing

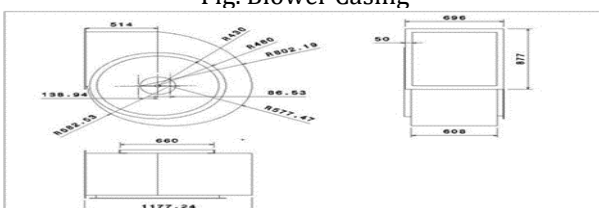
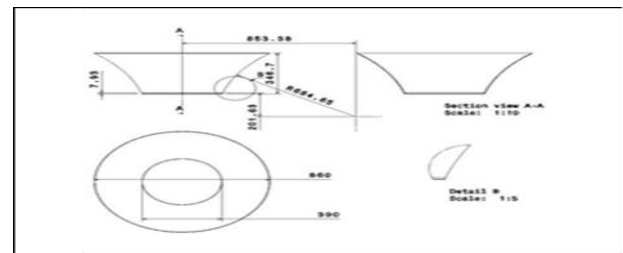


Fig. Blower Inlet Nozzle



5. STATIC ANALYSIS OF CENTRIFUGAL BLOWER FAN:

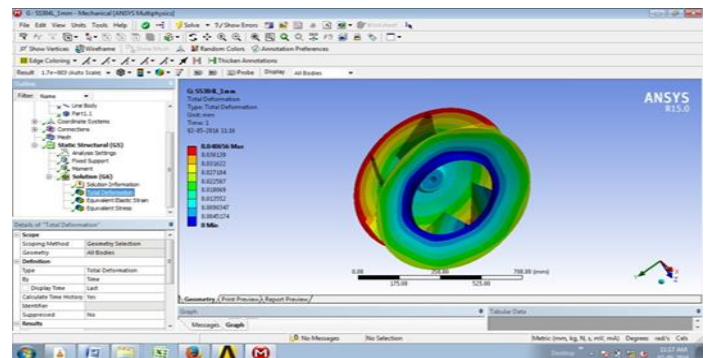
Procedure for Static Analysis In CFD:

1. Build the FEA model as explained.
2. Define the material properties such as young's modulus and density etc.,
3. Apply boundary condition and pressures.
4. Solve the problem using current LS command from the tool bar.

CFD:

The Computational Fluid Dynamics (CFD) technique is an effective manner to clear up non-linear partial differential equations that alter fluid go with the drift, warmness transport, and go with the drift turbulence. A CFD evaluation may also reduce down on checking out time and prices even as additionally making sure that the fan's inner go with the drift area isn't disturbed. Furthermore, designated statistics at the go with the drift area can be collected, and the go with the drift sample thru the impeller can be viewed, increasing our know-how of the fan's complex go with the drift mechanics and imparting impeller layout assistance. CFD FLUENT is applied on this paintings to clear up the go with the drift inside centrifugal blowers. The Moving Reference Frame (MRF) method may be utilized in conditions in which the fluid rotates. For the MRF method, a unique mobileular sector have to be indicated; in our investigation, the second one mobileular sector circumstance changed into detailed because the MRF sector.

Fig. Total Deformation of SS316L blower Fan



Static Analysis For Equivalent (Von-Misses) Stress:

Static evaluation of vital a part of centrifugal blower i.e. static evaluation of fan is accomplished with the aid of using the usage of FEA. Fan is center a part of centrifugal blower and all of the overall performance of blower is completely relies upon upon fan, so fan is selected vital a part of centrifugal blower for the static evaluation. Analysis is accomplished for the cloth MS, SS, and SS316L (Food Grade Steel) respectively, so as to test Equivalent stresses and its corresponding deformations prompted in every cloth.

6. RESULT AND COMPARISON TABLE:

	Existing 7 Blade Blower	5 Blade Blower
Material	Mild steel	Stainless steel ss316L
Weight(kg)	28.95	27.492
Total deformation	0.00041962	0.00038791
Stress	1.2962	1.264
Natural frequency	45.032	42.91
Max. Velocity	66.91	54.58
Velocity at outlet	16.41	13.73
Max. Pressure in blower	1.499	1.38
Pressure at outlet	48.19	31.38
Volume flow rate	12833.36	12250.39

7. SUMMARY AND CONCLUSION

7.1 SUMMARY:

1. So, the primary purpose of this studies is to enhance the blower cloth and layout in order that it is able to ultimate lengthy existence with its all houses without getting dislocated. So industries can manufacture in huge quantity.
2. We've organized a brand new layout after figuring out problems in an present blower. So blower cloth does now no longer get corroded and now no longer get contaminate with meals. Also ventilate it as required. Å
3. Thus, we've got modified preceding cloth with new one to address blower houses i.e. performance, corrosion, go with the drift fee, discharge, etc.

7.2. CONCLUSIONS:

1. According to the outcomes of the task, a chrome steel SS316L 5 blade impeller can be applied rather than a moderate metallic seven blade impeller to keep away from the corrosion of the blower.
2. When SS316L impeller is in comparison with the prevailing impeller, the stresses created with the SS316L 5 blade impeller are decrease, as is the deformation.
3. Although the SS316 5 blade impeller's first herbal frequency is incredibly decrease than the preceding impeller however it's far above the running frequency.
4. Using SS316L 5 blade rather than MS seven blade impeller leads in a weight financial savings of approximately 1.5 kg.

5. From CFD evaluation we are able to say that the stress and pace distribution are higher with the 5-blade blower than with the seven-blade blower and there may be additionally no signal of backflow within side the casing.

6. The extent go with the drift fee of a 5-blade impeller is incredibly decrease than that of a seven-blade blower. Presently in operation, consistent with the CFD studies this may be advanced with the aid of using growing the motor's pace.

8. REFERENCES

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