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Critical Failure Analysis of Caustic Slurry Pump

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Abstract: This project is to design the impeller of the turbine for a centrifugal caustic slurry pump to increase its efficiency and showing the merits of designing parameters (six blade turbine, design (material) changes from impeller) comparing with the old material (stainless steel 2324) of a turbine. An investigation in to usage of new materials is required. In the present work impeller is designed with two different materials. An attempt has been made to investigate the effect of temperature on the impeller. By identifying the true design feature, the extended service life and long term stability is assured is defined. A thermal (transient) analysis has been carried out to investigate the maximum heat flux of the impeller is defined. An attempt is also made to suggest the best material for an impeller of a turbine by comparing the results obtained for two different materials Inconel alloy 783, Inconel alloy 740 for impeller is to made it. Based on the results best material is recommended for the impeller of a turbocharger.

Key words: Pump, Turbine, Material, FEM.

1.INTRODUCTION

Centrifugal pump are a class of machinery intended to increase the power of turbine. This is accomplished by increasing the pressure of intake air, allowing more fuel to be flow condition. In the late 19th century, Rudolf Diesel and Gottlieb Daimler experimented with pre-compressing air to increase the power output and fuel efficiency. The first exhaust gas turbocharger was completed in 1925 by the Swiss turbine Alfred Buchi who introduced a prototype to increase the power of a compressor by a reported 76%. The idea of salary condition at that time was not widely accepted. However, in the last few decades, it has become essential in almost all diesel compressors with the exception of very small diesel turbo charger.

Their limited use in gasoline compressors has also resulted in a substantial boost in power output and efficiency. Their total design, as in other turbo machines, involves several analyses including: mechanical, aerodynamic, thermal, and acoustic. Turbo chargers and researchers still seek ways to improve their designs while governed by rules of cost and manufacturing capabilities. At first, scientists simply attempted to develop the conceptual designs into reliable products for end users.

Englberger L, Streich M, Tevaearai HT, Carrel TP. Interact Cardiovasc Thorac Surg. 2008 Feb 26 (4) Researchers in Switzerland sought to determine consensus regarding anticoagulation strategies during OPCAB through a questionnaire survey of European cardiothoracic surgeons. Survey questions included volume of OPCAB procedures performed, use of antiplatelet therapy, heparinization during intra- and perioperative periods, and general management techniques (ACT limits, protamine reversal, and use of antifibrinolytics). Of 750 surveys distributed, researchers obtained a sample size of 325 (43.7% participation).

There was significant variation in anticoagulation strategies. While 78% of participants used low or high molecular weight heparin for thrombosis prophylaxis, strategies for heparin unit dosage ranged from 70 U/kg to 500 U/kg. Variation was also seen in target ACT, with 24% of respondents requiring a value of 200 s, 18% requiring 250 s, and 26% requiring 300 s. Whereas 91% of respondents used protamine for heparin reversal, 52% used full dose reversal (1 mg per 100 U) while others used less. Antifibrinolytics were used by 40% of respondents, and 70% reported using cell saving devices. Respondents also differed in opinions of bleeding and risk for early graft occlusion with OPCAB. Fifty

six percent of respondents thought average bleeding was not reduced in OPCAB compared to CPB, while 34% thought the OPCAB technique a risk factor for early graft occlusion.

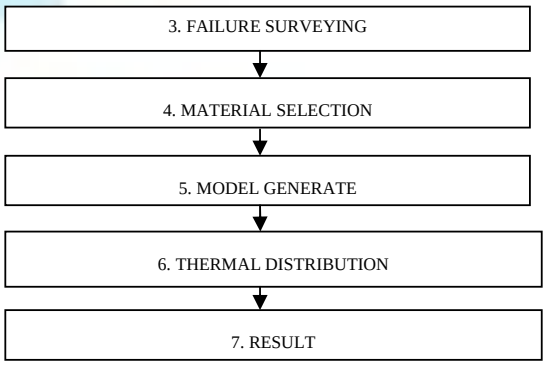
Sylvia Hurtado, Kevin Eagan, Bryce Hughes Higher Education Research Institute, UCLA (8) Establishes most of the growth in the new jobs will require science and technology skills "Those groups that are most underrepresented in S&E are also the fastest growing the general population" (National Academies, 2011, p. 3). In an effort to achieve long-term parity in a diverse workforce, they recommend a near term, reasonable goal of improving institutional efforts to double the number of underrepresented minorities receiving undergraduate STEM degrees.

Increasing the retention of STEM majors from 40% to 50% would, alone, generate three-quarters of the targeted 1 million additional STEM degrees over the next decade. Retaining more students in STEM majors is the lowest-cost, fastest policy option to providing the STEM professionals that the nation needs. Changing productivity levels means changing practices, and mindsets from priming the sieve to priming the pump, or talent development.

G. Agrati and A. Piva Weir Gabbioneta, Sesto S. Giovanni, Italy (3) Multistage horizontal boiler feed pumps are designed and built in two different configurations: with equidirectional or with opposite impellers. The study is carried out from hydraulic and structural point of view. A particular attention is addressed to the axial load balance and to the lateral dynamic analysis, with new and worn clearance conditions. A complete calculation of rotor dynamic behaviour in both configurations has been performed using the finite element method. The model of the shaft has been meshed using beam elements, while linearised coefficients have been evaluated in order to simulate stiffness and damping of sleeve bearings, impeller wear rings, balancing drums and interstage seals. Undamped critical speed map, damped mode shapes and Campbell diagrams are presented and discussed. Calculation results are confirmed by experimental measurements carried out on an opposite impeller multistage pump, where non contacting probes have been installed nearby sleeve bearings locations, and order tracking method has been applied during start-up and coast-down transients.

The modifications incorporated in the pump include enlargement of flow passages to accommodate bigger solid particles, robust impeller with smaller number of vanes, special seals and proper material of construction to ensure longer life. These have to be operated with relatively wide clearance at impeller-casing contacts to minimize choking and localized wear. These modifications increase the hydraulic losses in the pump and deteriorate the pump performance. The present study is concerned with the evaluation of the performance characteristics of a centrifugal slurry pump when handling bottom fly ash at 30% concentration of bottom fly ash slurry at different speeds1000, 1150, 1300 and 1450 rpm. From the experimental evolution it is concluded that the parameters defined for head and capacity of the conventional pumps are also applicable for the slurry pumps with water despite the constructional differences. From the bottom ash characteristics it is also observed that addition of the fly ash in the bottom ash developed head decreases with increases of the flow rate results decreases the power consumptions of the transportation of the bottom ash in pipelines.

II. METHODOLOGY



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III. FAILURE SURVEYING

(a)While analyzing the slurry pump equipment of impeller design. It consider more failure area is occurred. This failure is rectify or recovery of the process to problem solving the frontal solution.

(b) The failure occurs in three problem

(i)Wear plate material problem

(ii)Design changes

(iii)Material changes

This type of centrifugal pump is supporting to the impeller the flow rate efficiency is higher performed to actuating the force of the equipment is called as Wear plate. The sudden life time period is exist wear Plate is corrosion and wear.

3.1 Dimension Changes

IV. SELECTION OF MATERIAL

Material selected for this work is inconel alloy 740 and inconel alloy 783 has very good heat flux to Steel plate, Sheet, Coil, Flat bar, Round bar, Strip steel, wire, All kinds of forgings. It is high strength alloys with major alloying elements are Iron and silicon.

4.1 Properties of inconel alloy 740 &783

Inconel Alloy 740& 783 has a range of useful

V. MODEL GENERATE

There are most software packages are available for creating the 3D model of the slurry pump impeller design and some of the software's are

1. SOLID WORKS
2. PRO ENGINEER
3. CATIA
4. UNIGRAPHICS
5. INVENTOR

Here we have chosen the solid works as the modeling software because of following advantages.

1. It is the feature based modeling software

(a) While applying more capacity of the fuel applying system is highly temperature is maintained.

(b) While Occur the problem is noted impeller blade area. So in this type of blade design is perimeter in changes and also total impeller design calculating the function to creating the model by using the solid works software.

3.2 Material Changes

Nowadays SS2324 is using the impeller material and our project is considered of two cases of material one of the Inconel alloy 740 and Inconel Allo

783 is considering the analysis of FEA method transient temperature analysis.

783 is considering the analysis of FEA method transient temperature analysis.

properties:

- Corrosive resistance
- Elastic Modulus
- Tensile Strength

4. 2 Applications of Aluminium Alloys 740& 783

The applications for inconel Alloys 740& 783are:

Steel plate, Sheet, Coil, Flat bar, Round bar, Strip steel, wire, All kinds of forgings.

2. Associatively
3. Parametric based design
4. Design indent

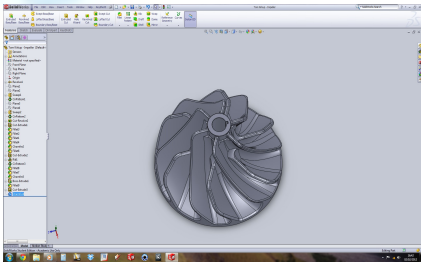

Figure 5.1 Flow Diagram for Impeller Design

VI. THERMAL DISTRIBUTION IN IMPELLER

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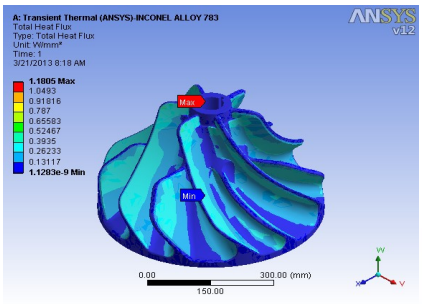

Fig6.1Heat Flux Distributions Inconel alloy 783

Type of analysis = Transient

Time taken = 60 seconds

Minimum Heat Flux= $1.1283x10^{-9}$ w/mm^2

Maximum Heat Flux= 1.805 w/mm^2

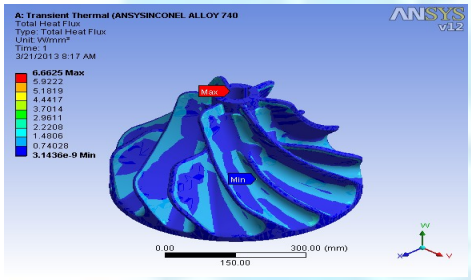

Fig 6.2 Heat Flux Distribution Inconel Alloy 740

Type of analysis = Transient

Time taken = 60 seconds

Minimum Heat Flux = $3.1436x10^{-9}$ w/mm^2

Maximum Heat Flux = 6.6625 w/mm^2

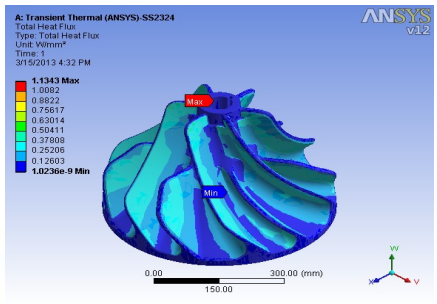

Fig 6.3 Heat Flux Distribution Stainless Steel 2324 (actual material)

Type of analysis = Transient

Time taken = 60 seconds

Minimum Heat Flux = $1.0236x10^{-9}$ w/mm^2

Maximum Heat Flux = 1.1343 w/mm^2

The graphical view is consider result

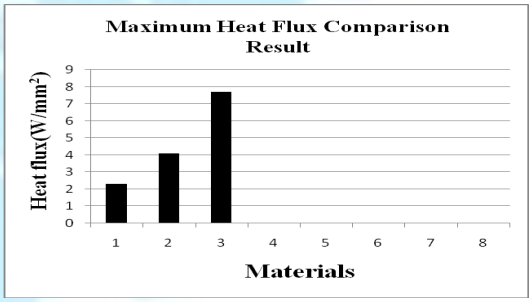

Fig 6.4Graphical View of Maximum Heat Flux

VII. CONCLUSION

We are doing the project in caustic slurry pump. In this company, stainless steel 2324 is used as impeller material in pump. It has tensile strength of 620-880 N/mm^2 and young's modulus of 194 KN/mm^2. Hence different studies were conducted to replace impeller material of the pump. The

different materials were put forward to increase the efficiency. So we analyse the Inconel alloy 740 having tensile strength of 1158 N/mm^2 and young's modulus of 218 KN/mm^2. Since inconel alloy 740 materials has considerably very high thermal conductivity and maximum heat flux, for our design analysis. we considered this as suitable material when compared to stainless steel 2324. By using inconel alloy 740, the corrosion rate will be reduced and also there is increase in efficiency.

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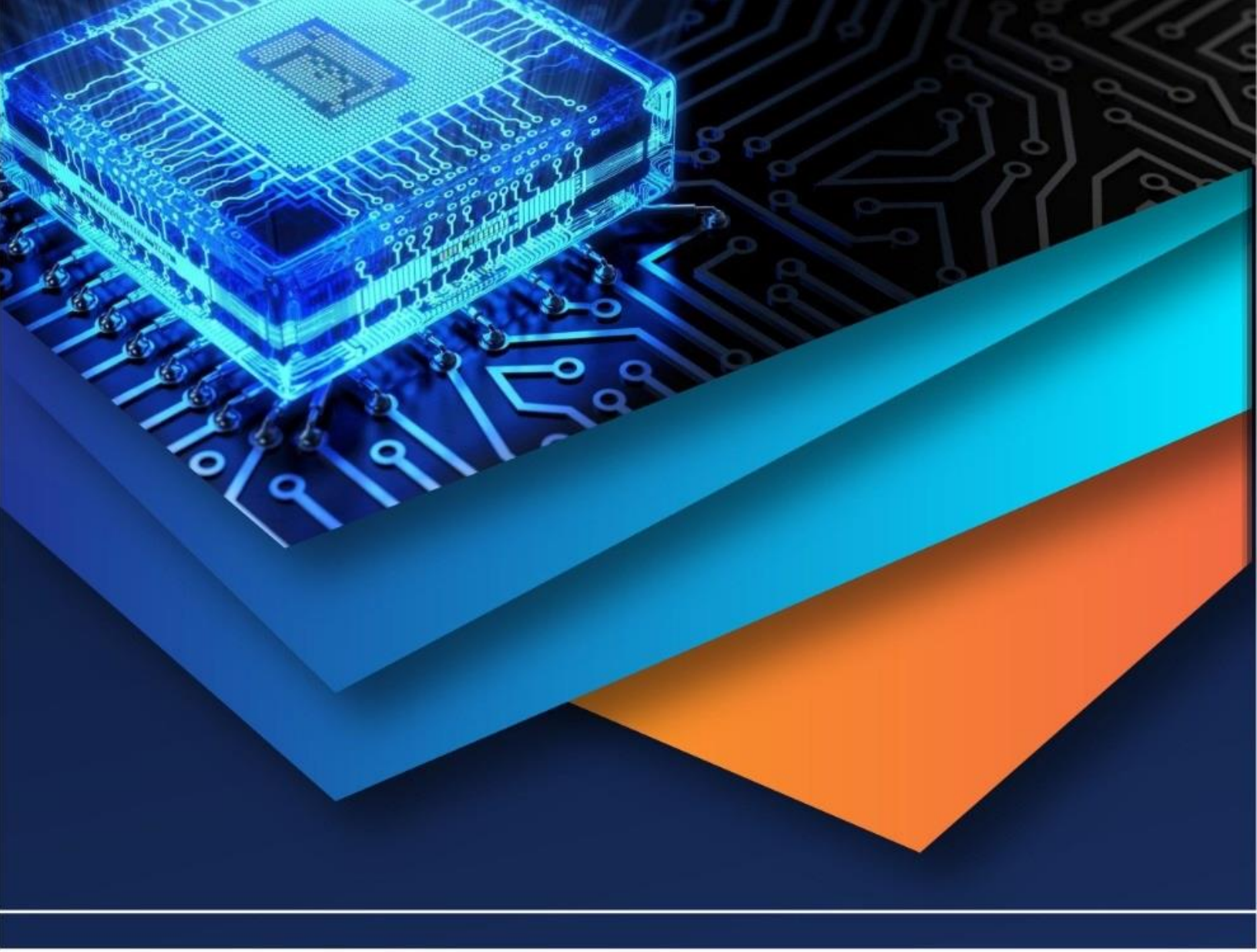

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