International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 7 Issue 2 Ver. V || February 2018 || PP. 61-65

Design of Conical Strainer and Analysis Using FEA

M. Umashankar [1], G. S. Santhosh [2]
[1]*Associate Professor, Department of MechanicalEngineering, KSIT, Bengaluru, India.*
[2]*PG Student, Department of MechanicalEngineering, KSIT, Bengaluru, India.*
Corresponding Author: M. Umashankar

ABSTRACT: *Strainer is a Mechanical element, which is used to separate the debris particles from the flowing fluid to downstream equipment. The fluid flow without filtration in to the downstream equipment causes damage, due to the initial and maintenance cost of downstream equipment is high, it is necessary to avoid the equipment from the failure. Generally the design, maintenance and service are done by keeping the cost as its main factor. Hence the possible methods should be adopted to avoid this type of failure. The Temporary Strainer is used when the debris rate is more in fluid flow. The pressure exerted into the normal temporary strainer could not withstand the fluid flow exerted to the downstream process and collect the debris properly. Hence Conical strainer is the type of Temporary strainer proposed for large debris collection capacity. So design is carried out to make more stiffer to collect large rate of debris and withstand more pressure with less deformation. Finally validated the results of FEA solution with the Theoretical solution. From the derived formulae, the deformation is more than the expected level, obtained better result for conical Strainer with Stiffener.*
KEYWORDS*-Conical Strainer, Stiffener, Deformation, Von Mises, Burst Pressure.*

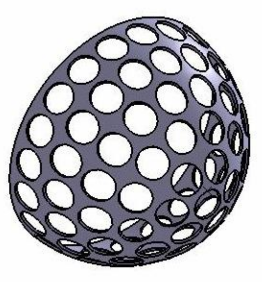
Date of Submission: 14-02-2018 Date of acceptance: 03-03-2018

I. Introduction

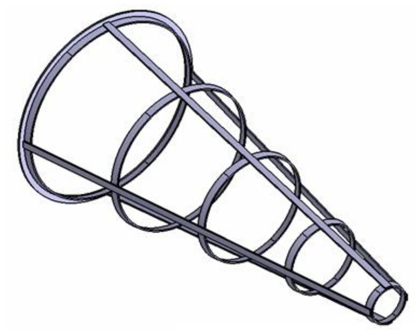
During and after the installation of pipeline and tank systems in industries, it is necessary to clean thoroughly. The cleaning procedure may often detach of weld. The scaling and other impurities are to be separate from the flowing fluid. If the impurities from the flowing fluid are not separate before entering into the system it may cause damage to the whole system of plants like Sewage Treatment industries, Chemical plant, Food processing facilities, Mining operation, Cement manufacturing, Petrochemical etc.

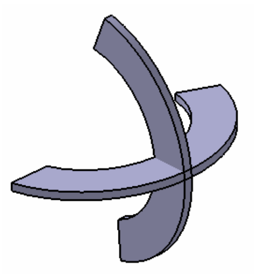
In order to control the damage for the system in the plant, it is necessary to install the separator in the inlet of pump. The separator must monitor the degree of contamination. The industries have experienced the need of filtering device for the protection of pump, compressor, turbine, meters, automatic valves, Steam traps etc., Filtering device is the mechanical element used to remove or separate the debris or solid particles and other impurities form the fluid which is flowing into the system, it is also called as Strainer [1].

The application of strainer in mechanical equipment's like centrifugal pump, Centrifugal compressor, Turbine etc., operates on small clearance between rotating and static part. Also spray, nozzle and trap have small opening to the flow [2].

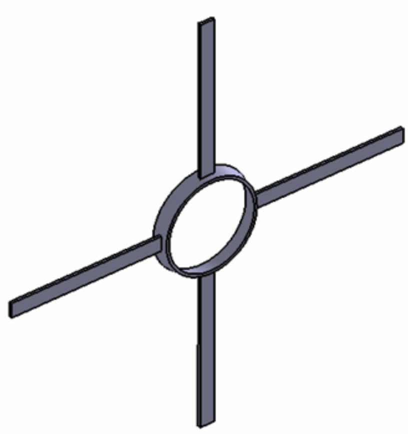


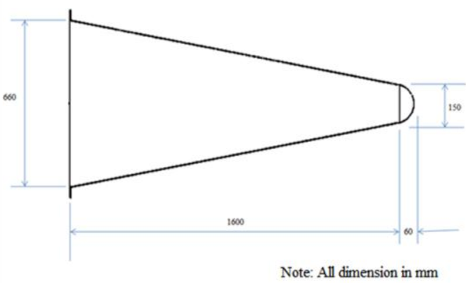
(a) Filter element. **(b) Dome shaped Ellipsoidal part.**





(c) Stiffener frame. **(d) Dome Stiffener.**





(e) Dome Holder. **(e) Filter element and dome.**

Figure 1. Investigated shapes of Strainer (Geometry and dimensions).

The function and efficiency of the equipment are playing an important role. The unacceptable sized foreign particle will hamper largely on both function and efficiency. In order to avoid the problems encountered a device called strainer is used which prevents to the maximum extent [3].

II. Prediction Of Deformation

The project work started from the design preparation, design steps followed in the design of Conical strainer. The design of Conical Strainer consider 2MPa operating pressure for finding all the factor which are required for the manufacturing of a Conical Strainer [4,5].

The scope of this step is to find the value such as thickness of filter element used to find the maximum stress developed in the strainer element. The numerical analysis and analytical calculation is conducted, which has helped to find the deflection and maximum stress in the component. This method adopted helps to justify the design, to accept or reject due to the applied load i.e. Pressure.

1.1 Thickness for the Conical Filter Element.

The selection of suitable thickness is the most important step to be considered in designing of Conical Strainer. Formulae to find the thickness of the perforated sheet for the given operating pressure.

$$P = \frac{2*S*t*\cos\psi}{D+1.2*t*cos\psi} \quad (1)$$

Where S = Allowable Stress in N/mm2
t = Thickness of Filler element in mm.
Ψ = Angle between Strainer axis to slant end in degree.

1.2 Thickness of Conical Strainer.

For finding the total thickness required for the Conical Strainer

$$T=t+C_1 \quad (2)$$

Where C_1 = Corrosion allowance

1.3 Percentage of open area.

The strength of the component depends on the percentage of open area. If the percentage of open area increases the stiffness will be reduced.

$A_1 = \frac{\sqrt{3} * C^2}{4}$ (3)

The Partial area of Hole is to be calculated for the Strainer having hole angle of 60 degree.

$A_2 = 1.5705 * R^2$ (4)

Finally the percentage of area is calculated by using the formula 5.

Percentage of open area= A2/A1 (5)

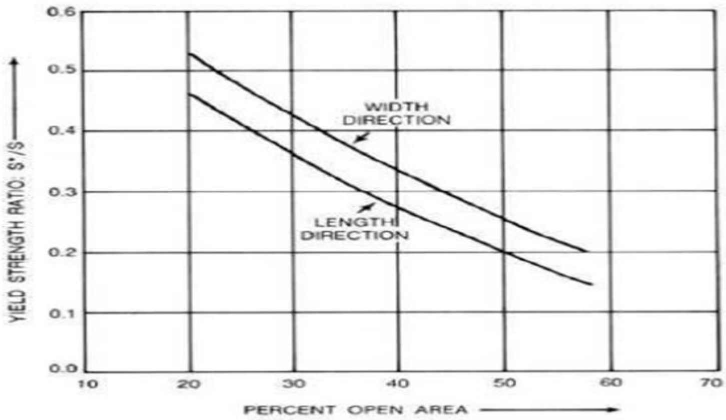


Figure 2. Effect of percentage of open area on yield strength.

III. Computer Programme : Validation And Verification

To ensure the validity and accuracy of the calculations, the results are compared to available theoretical data. The calculated stress is compared with the stress value by the FEA. The table 1 shows the stress validation in the Strainer without stiffener.

Table 1. Comparison maximum von-Mises stress from the FE with the theoretical stress value for a Conical Strainer without stiffener.

	Theoretical value	FE result	% error
S (Stress, N/mm^2)	149.745	160.714	7.32
U (Deformation, mm)	-	1.584	-

Table 1 show the comparison between the theoretical results and the numerical data. The percentage of error got from theoretical to numerical is 7.32, acceptable. Figure 3 shows the modelling of the Conical strainer without Stiffener, Figure 4 and Figure 5 shows that Maximum Von-Mises stress and deformation in the Strainer model without stiffener.

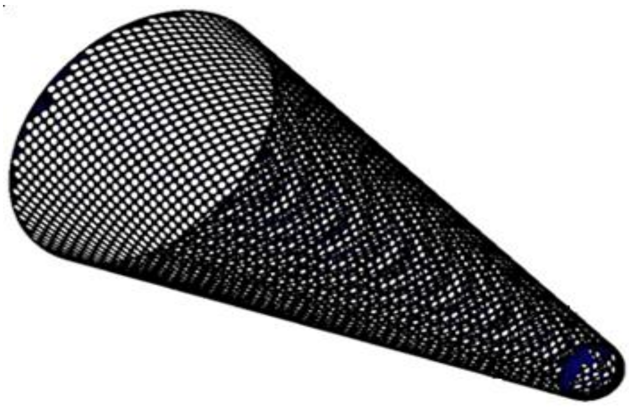


Figure 3. Conical Strainer without Stiffener.

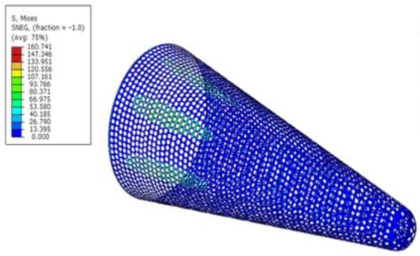


Figure 4. Variation of Maximum Von-Mises stress in the model.

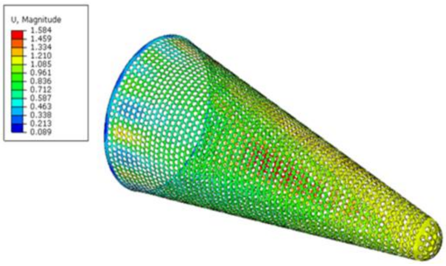


Figure 5. Variation of deformation in the Strainer model.

IV. RESULTS AND DISCUSSIONS

The prediction of the deformation of the investigated projectiles shown in Figure 1 was carried using the methods and the computer programmespecified above [7]. The effects of Strainer with stiffener and Strainer without stiffener are analysed.

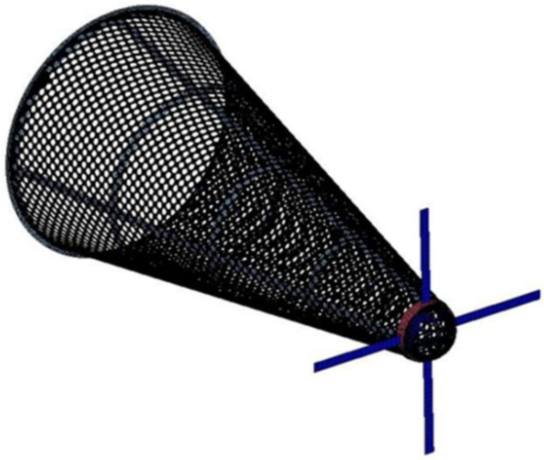


Figure 6. Strainer with Stiffener assembly.

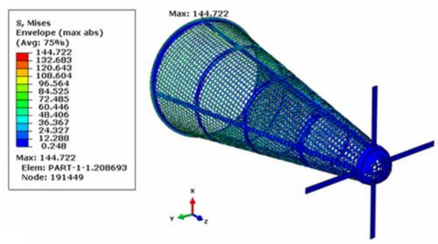


Figure 7. Variation of Maximum Von-Mises stress in the model.

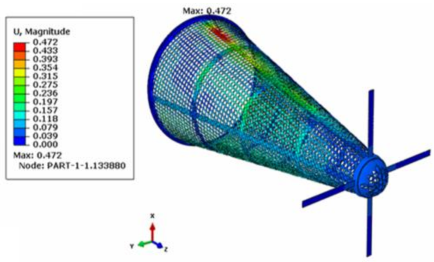


Figure 8. Variation of deformation in the Strainer model.

Effect of Stiffener.

The effect of Stiffener results in reduction of stress and deformation in the member. This can be justified by using the model of Strainer having stiffener and Strainer without having stiffener.
Figure 6 shows the modelled Strainer with stiffener. By using stiffener in the strainer, model had got reduction in the stress and deformation values are shown in Figure 7 and Figure 8. Finally conclusion is that stiffener in the strainer is more safe for designed application.

V. CONCLUSIONS

The analysis is carried out on strainer having stiffener and without stiffener in order to increase the stiffness and to reduce the deformation. The fluid flow through the strainer causes large deformation of filtering element. It significantly effects on the rate of flow. The main purpose of strainer is to remove the unwanted contamination in the flowing fluid without affecting the flow rate. The analysis is carried out to reduce the deformation of the strainer.

- After analysis the strainer with operating conditions, the stress obtained in strainer without stiffener is 160.714 N/mm^{2}and strainer with stiffener is 144.722 N/mm^2 respectively. The corresponding deformation obtained for strainer without stiffener and strainer with stiffener are 1.584 mm and 0.472mm respectively. So it is evident that the strainer with stiffener is preferable than the strainer without stiffener.
- The stress obtained in the strainer without stiffener and the strainer with stiffener is within the yield point. The Factor of Safety for the obtained stress value is 1.28 and 1.42 for the strainer without stiffener and the strainer with stiffener respectively. The FOS 1.42 is safer than the FOS 1.28 in design because of more Factor of Safety. Therefore strainer with stiffener having FOS 1.42 is accepted for production.
- The Conical strainer with calculated thickness 1.6mm have been designed in such a way that, the strainer should withstand the pressure of 2Mpa by changing the hole angle, pitch and dimension of the component expect change in thickness of perforated sheet. The use of conical strainer is good in large debris collection capacity. The conical strainers are easy to install in the pipeline and maintenance of conical strainer.

Acknowledgements

The authors wish to acknowledge the Management, Principal, Head of Department – Mechanical Engineeringof K. S. Institute of Technology, for providing an opportunity and resources to carry out this work.

REFERENCES

[1]. Fluid Control Institute, Inc (FCI), Engineering Specification for the Selection, Installation and Maintenance of Pipeline Strainers, *Pipeline Strainer Section Fluid Controls Institute, Inc.*
[2]. Piping Engineering, *Guidelines for the Preparation of Strainer Specification*, Part 1, 2016, 1-6.
[3]. ACME Fluid Systems, "Strainer Selection Guidelines".
[4]. William R. Ryan, *Turbine engine with enhanced fluid flow strainer system*, Patent US20110265438, 2016.
[5]. Spiraxsarco, *TP1, TP2 and TP3 Temporary Cone and Flat shaped Strainers and Spacer Ring*, Reference number- 1698051/3, IM-169-07.
[6]. The Mack iron work company, *CATALOG G-1*, G1-9.
[7]. M. Carlomagno, S. Rossin, M. Delvecchio and A. Anichini, Experimental and Numerical Validation of Conical Strainer Fluid/Structural Performance Model, *American Society of Mechanical Engineers, 6*, 2012, 155-171.
[8]. Ernst H *(2002)* Success factors of new product development: a review of the empirical literature, *International Journal of management Reviews*, *4 (1)*,2002, 1 – 40.
[9]. Anurag Gupta ,Pushpdant Jain , Prabhsah Jain, Product Planning & Development of Y-Type Strainer Used In Thermal Power Plant and Process Plant, *International Journal of Engineering Inventions, 3 (5)*, 2013, 42-50.

International Journal of Engineering Science Invention (IJESI) is UGC approved Journal with Sl. No. 3822, Journal no. 43302.

M. Umashankar "Design of Conical Strainer and Analysis Using FEA" International Journal of Engineering Science Invention (IJESI), vol. 07, no. 02, 2018, pp. 61–65.