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Design and analysis of high pressure control valve 3000# rating

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ABSTRACT: Control valves are one of the oldest valve types used for throttling application for all sizes due to better controllability and range. There are different types of globe valve available, but for control valve condition cage and plug designs are widely employed. Cage and design consist of body, valve cage, plug and an actuation mechanism.At present the globe valves designed for various purposes are of these 150/300/600/1500/2500/4500 classes. Now the requirements of globe valves are to control high pressure and high temperature, which doesn't come under these classes. My project is to design and analysis of multi stage 3000 rating globe valve. This project is about to design a globe valve, which can control high pressure required in the boiler which is used in thermal power plants and in petroleum refineries, which is not under the above given classes. The 3000 pressure rating globe valve is redesigned and two dimensional and the three dimensional design software are used to design the particular globe valve and the flow path analysis and stress analysis is done using analysis softwares.

I. INTRODUCTION (CONTROL VALVES)

Control valve are widely used for throttling applications in the process industry for both liquid and gaseous applications. The main advantages are relatively low cost, linear characteristics and good controllability and range.

To obtain the required flow and pressure drop characteristics for the valves, different types of internals were evolved for control type valves. Cage and plug internal is one among them.

At present the available classes of control valves are 150/300/600/900/1500/2500/4500. There is no control present in the rating of 3000, which is highly required in the field of oil refineries and boilers. The basic requirement araised for the 3000 rating valve is because to control high pressure and high volume of flow.

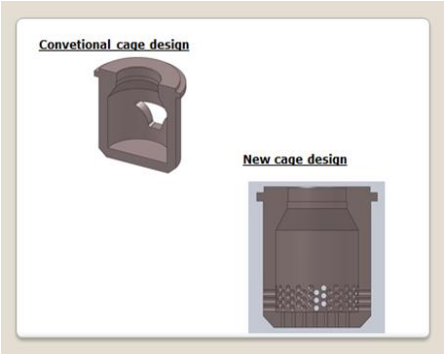
My project is to Design and Analysis of high pressure Multistage 3000 Rating Control Valve., which can be used for controlling high pressure, high temperature, and high volume output, is required.

Detailed Presentation

•At present the availability of control valves are of classes 150/300/600/900/1500/2500/4500. There is no error free design for control valve in the rating of 3000, hence to design the same and analyse the same using analysis softwares.

- To do flow analysis of the control valve
- To do stress analysis of the control valve
- To do design and and analysis of 3000 rating control valve using valve equations.
- To obtain the required flow and pressure drop characteristics for the valves, different types of part assembly were evolved for globe type valves. Cage and plug is one among them.

Globe valves are one of the oldest valve types used for throttling application for all sizes due to better controllability and range.



A. Units

SI units and CGS units are utilized.

C Equations

II. DESIGN CALCULATIONS

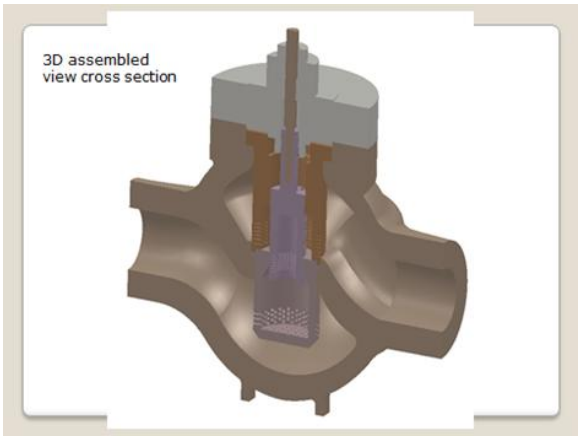
- Valve Inlet Pressure - Max : 126 Kg per CM ^2
- Outlet Pressure - Max : 119.5 Kg per CM^2
- Specific Gravity - Water : 1.
- Operating Temperature – Max : 151 Degree Centigrade
-

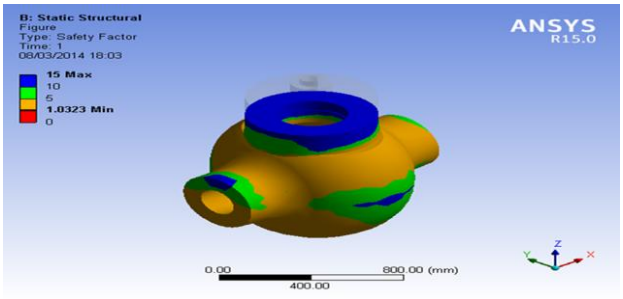
1. EQUATION OF CV FOR WATER

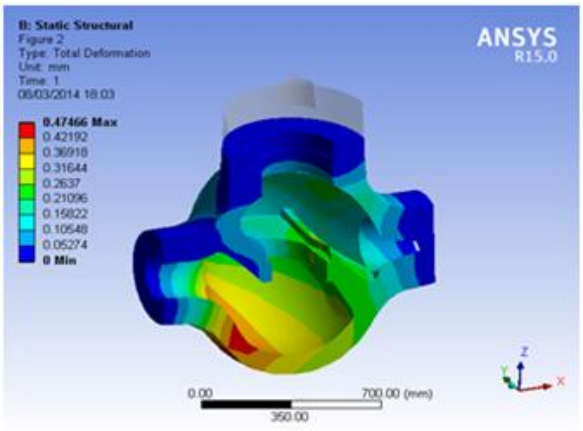
- Cv = 1.17 V x √ ---------- EQ 1
  Where
- V = Maximum Volume Flow: in M3 per Hour
- P1 = Inlet and
- P2 = Outlet Pressure.
- Cv = 1.17 x 848 x 0.5
  = 496
  = Rounded Value of the above result = 500
- Calculated Cv = 500
- Application of the Valve = Throttling

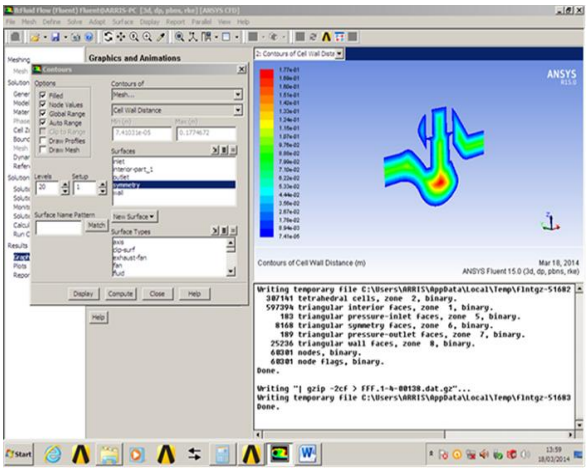
2. VALVE BODY SHELL THICKNESS

- t = PR / (2SE – 0.2P) ----------EQ 2
- (ASME Reference Section VIII – Division 2 Pressure Vessels)
- where
- t = Minimum required thickness of shell.
- P= Internal Design pressure in psi.
- R= Inside Radius of the shell course under consideration.
- S= Maximum allowable Stress Value, psi.
- E= Joint efficiency for or the efficiency of appropriate joint in cylindrical or Spherical shells.
- Applying values in eq 2
- Pressure Inside = 126 kg/cm2
- Therefore,
- P = 14.223 x 126
- P= 1792
- R= 80
- 2SE = 1916
- 0.2P=358.4
- t= 143360 / (1916 – 358.4)
- Thickness, t= 92.04 mm
  The design is modelled and analysed using software. The software is calibrated using results of the existing valve details.


3D assembled
view cross section


B: Static Structural
Figure
Type: Safety Factor
Time: 1
08/03/2014 18:03
15 Max
10
5
1.0323 Min
0
ANSYS
R15.0
0.00
800.00 (mm)
400.00


B: Static Structural
Figure 2
Type: Total Deformation
Unit: mm
Time: 1
08/03/2014 18:03
0.47466 Max
0.42192
0.36918
0.31644
0.2637
0.21096
0.15822
0.10548
0.05274
0 Min
ANSYS
R15.0
0.00
700.00 (mm)
350.00


Graphics and Animations
ANSYS
Writing temporary file C:\Users\ARRIS\AppData\Local\Temp\fltgz-51682
307141 tetrahedral cells, zone 2, binary.
597394 triangular interior faces, zone 1, binary.
183 triangular pressure-inlet faces, zone 5, binary.
8168 triangular symmetry faces, zone 6, binary.
189 triangular pressure-outlet faces, zone 7, binary.
25236 triangular wall faces, zone 8, binary.
68381 nodes, binary.
68381 node flags, binary.
Done.
Writing "| gzip -2cf > FFF.1-k-00138.dat.gz"...
Writing temporary file C:\Users\ARRIS\AppData\Local\Temp\fltgz-51683
Done.

Acknowledgment

The elementary building block to the over–all module, my project owes its being to numerous genioues personalities. I convey my humblest thanks with deep sense of gratitude to all those who helped me, without which I would be failing in my duty.At the outlet I wish to place on record my sincere thanks and gratitude to my Managing Trustee **Mr SANKAR VANAVARAYAR** for his patronage and leadership which has helped me to carry out this project.

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