Optimisation of Butterfly Valve by using Simulation Software

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Abstract: *This paper represent how to design a disk plate, shaft, body thickness of butterfly valve. How to reduce weight of disk which is suitable for disk. Pressure at different angles of opening valve disk also can measure the discharge at different angle of opening, body thickness of butterfly valve is suitable for a different pressure reducing extra material from butterfly valve it is easy to manufacture to company reducing a number of holding part, it is easy to also assembly and maintenance analyzing the theoretical value 3D modeling perform by using CAD software, stress and displacement analysis conduct by ANSYS.*

Keywords: *Design shaft, disk, body thickness, analysis.*

1. Introduction

Many power plant uses butterfly valve for control the flow passage area by opening a valve at various angles.

Butterfly valve is a flow control device it is used for regulate the fluid flow many hydraulic power plant uses butterfly valve for control. The flowing fluid passage area by opening a valve at various angle butterfly valves has a short circular body around disc, rubber seal, disk shaft. The flow control element is a disk is approximately the same diameter as inside diameter of adjoining pipe. Closing mechanism is a disk that rotates about shaft axis and these is actuate by external actuator (gear box).

Concentric butterfly valve the stem is centered in the middle of the disc and disk centered in the box. The concentric butterfly valve is used in water and water treatment plants, fire protection system, water distribution system, etc.

There are different kinds of butterfly valves, each adapted for different pressures and different usage. The zero-offset butterfly valve, which uses the flexibility of rubber, has the lowest pressure rating. The high-performance double offset butterfly valve, used in slightly higher-pressure systems, is offset from the centre line of the disc seat and body seal (offset one), and the Centre line of the bore (offset two). This creates a cam action during operation to lift the seat out of the seal resulting in less friction than is created in the zero offset design and decreases its tendency to wear. The valve best suited for high-pressure systems is the triple offset butterfly valve. In this valve the disc seat contact axis is offset, which acts to virtually eliminate sliding contact between disc and seat. In the case of triple offset valves, the seat is made of metal so that it can be machined such as to achieve a bubble tight shut-off when in contact with the disc.

In our case, we have taken a valve from which fluid flows. And a disc which is fixed at a point. Rotating disc we have taken so that analysis could be easier and consume less time. And we have taken water as a medium to flow.

2. Specification

According to customer requirement (uses) company designed the butterfly valve.

Customer requirement changes day to day company designed butterfly valve considering frequent changes in butterfly valve.

REQUIREMENT

- Type concentric butterfly valve
- Slandered butterfly valve material – IS1309
- Pressure rating – 1.6 Mpa N/m2
- Size (Dn) – 500mm
- Shaft – stainless steel (A276)
- Body – cast iron (FG200)
- Seal material – NBR/DTEE/EPDM
- Body rating – bolted

3. Design and Discussion

1) Considering customer requirement valve design that meet to desired need.
2) First the identified the need according to the valve user / company and then decide the design.
3) Second is that initially model of valve is made and then analysis the design to predict the fluid and structural performance of the valve.
4) The optimization in the form of mathematical function this includes design of computer experiment size optimization.
5) Finally the suitable design is confirmed by verifying the accuracy of the optimization.

DESIGN OF SHAFT

Considering standard value of diameter from catalogue design a shaft diameter nominal diameter of pipe is given (standard) on (500) disc diameter is always

consider. Less than the nominal diameter which is given

Disc diameter – 461

Shaft design by two basis

Shearing basis: -

1. Nominal pressure are given and disc diameter is known

Calculating force - F=3.14/4*(Ds)2*Pn

Cross sectional area – As = 3.14/4 (Ds)2

T=F/As

Twisting basis

Ultimate stress, yield stress are calculate by considering F.O.S., S3

F.O.S. = yield point stress / working stress

F.O.S.= Ultimate stress / working stress

Or Ultimate Stress =Pmax / Ao

T= 0.4*Ys/Fos

T=U*F*R

Here

U= coefficient of friction

F= Force on disk

R= radius of disk

T=3.14/16 * (2R)2*t

Equating c and d equation we get radius & diameter value.

R3/R = U*F*R/3.14*t

And this value select standard from catalogue

Body thickness

Body thickness is most important term. valve body sustain a internal pressure it may be high low fluid cause the force of vibration cavitation.

Body thickness = 1.5*Pc*Di/(2*118) – (1.2Pc) + constant

Fig 1: Body

Disc taper angle

Proper taper angle is necessary for disc, fitting in body and to flow passage area.

D=large diameter of disc

d= smaller diameter of disc

Fig 2: Disk

Bolted body joints

Bolted body joints shall use bolting threaded in accordance with standard dimension available catalogue satisfy the bolt cross

K2= stiffness

Sut= allowable bolt stress

Ag= area bounded by the effective outside periphery of gasket.

Ab= total effective bolt tensile stress area.

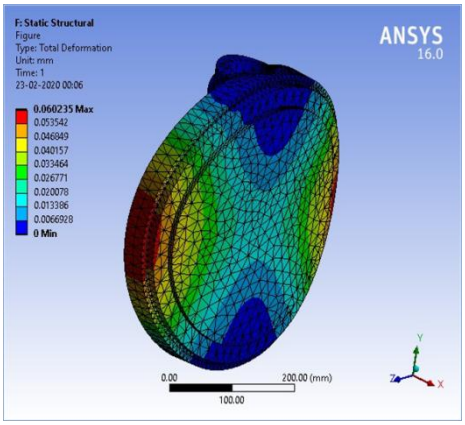
- **Selection of (rubber) seal material:**

  A) Mechanical property

  B) Thermal property

- **Pressure testing limitations** –

A valve that conduct a pressure test or causes a pressure to be concluded on a valve. Valve is installed in a piping system need to be concerned with pressure limit passed by valve confirming to this standard.



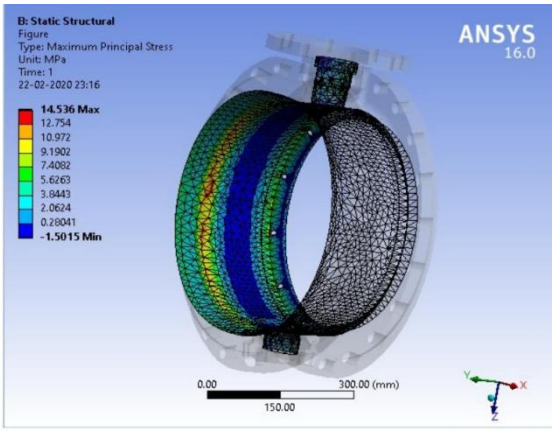


Fig 3: Ansys Software

4. Result

1. Observing the flow characteristic through a butterfly valve under different opening and for different type fluid flow is studied by experimental and computational fluid dynamic technique. Calculating the performance value of the valve and compare against.
2. Studying the flow characteristic and types fluid force on disc. According this disc are designed.
3. By removing the extra clamping part like nut, bolt, small key etc. It is easy to assemble and maintenance.

5. Conclusion

Considering the requirement of the industry. The butterfly valve is designed. Design approach is used to design actuating mechanism standard catalogues have been used to select pipe diameter, rubber seal diameter, nut, bolt, key.

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