A REVIEW OF DESIGN AND ANALYSIS OF RETAINERLESS DUAL PLATE CHECK VALVE FOR REDUCE PRESSURE LOSS AND DRAG FORCE

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Abstract - *When a dual plate check valve closes then many problems find out like noise, vibration and seat wear. Reduced the impact force between the valve disc and its seat when closing some modifications is applied to the valve disc geometry to reduce the drag force acting on it. The value of pressure loss coefficient (cp) and drag force coefficient (cd) has been evaluated at various openings and Reynolds number. It has observed that valve of pressure loss coefficient (cp) and drag force coefficient (cd) lower in case of dual plate check valve.Using ASME standards for dual plate check valves body is categorized as a pressure vessel that contains only internal pressure. This verifies the validity of the CFD results an approximation of the disc rotation characteristics is given, based on the CFD approaches this approximation method is verified on another check valve simulation with different boundary condition and external moments. The design will carried out for cracking pressure, coefficient of valve and equivalent stress. It has been found that are safe stress limit of the material used.CFD module of Ansys 16.0 will used for finding out the pressure loss (cp), drag force (cd) ,flow rate of the valve.*

Key Words: dual plate check valve, retainerless check valve, pressure loss, drag force, pin of check valve, Reynolds number.

1.INTRODUCTION

A valve gadgets that regulate, direct or control the flow of a fluid (gases, beverages, fluidized solids, or slurries) via beginning, last, or partly obstruct variety ways. Valves is mechanically fittings, but it's generally discuss as a divide types. The open valve situation, fluid flow way upper pressure to lower pressure. valve phrase is original from the Latin valve, the variable a part of a door in flip from volvere. The handiest, also really historic, valve be actually a generously hinged wave which drops towards impede liquid (gasoline and fluid) flow in one route, other than driven open through go with flow within the contrary direction. that is referred to as a test valve, because it's prevents the float in single pathway. recent controls valves might also float or control pressure downstream perform on difficult automation systems. [1]

The Valve is many makes use of, consisting of controlling water for irrigation, business makes use of for controlling procedures, residential makes use of like on-off, pressure

manipulate to dish or garments washer and tap into the domestic. Even aerosol is a little valve in constructed. Valves also that use inside navy as well delivery sectors.

The dual plate take a look at valve is a swing valve uniquely designed for all reason non return valve (NRV) packages. The constructional feature makes the valve a whole lot smaller in length, lighter in weight & makes it lots possible in operation in comparison to conventional swing take a look at valve.The dual plate swing take a look at valve employ dual spiral overloaded plates / disc hinged at a principal hinge pine. It operates on the differential pressure between fluid drift pressure & spring torsion pressure. because the flow pressure reduces, the plates tends to close with a cushion impact by spring torsion pressure there by limiting the reversal of fluid flow.
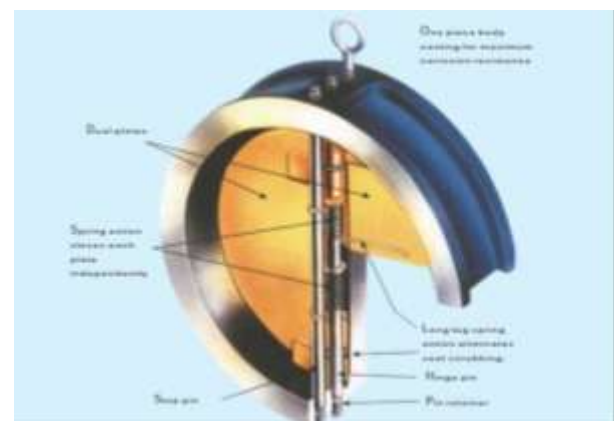

FIG 1: - DUAL PLATE CHECK VALVE

FIG 2:-INSIDE PART OF DUAL PLATE CHECK VALVE

2. LITERATURE SURVEY

Literature survey is an evaluated report of information found in the literature related to selected area of study. In this chapter literature survey of valve, pressure loss, drag forces, fluid and it density, open and close position of check valve has carried out.

This study purposeful on theory of optimum, using the gradient technique. In investigational element the method create mesh and geometry through the following meaning of a numerical model calculated for the model computation of flow in dual plate check valve. Boundary condition are just of the subsequent variety shell, inlet pressure, outlet pressure,rotating and translational periodic situation. [2]

The pressure drop features of two type of dual plate check valve swing plate and dual disc check valve have analyzed through CFD under varying conditions of operations. The CFD software ansys fluent has used. The dual plate check valve inner diameter is 0.05, valve length 0.25m and length of duck 0.75 m and they have got pressure loss coefficient (cp) ,coefficient of drag(cd),permanents pressure loss co efficient has been valuation at various openings and Reynolds number. [3]

The measurement of dynamic characteristics of check valve. The force had stopped as of the special steady flow rate. It has also visible the upper deceleration upper overturn velocity develop previous to the check valve close. via Time-pressure process, suitable mathematical method. [4]

They have studied parameter of Pressure loss, Length of passage, width of the passage, plate thickness, fluid and its density. Validated CFD methodology has used to analyses flow through the dual disc check valve and butterfly valve. here keeping conditions is inlet velocity 2m/s and diameter of pipe 20 mm By keeping Reynolds number1000 and 50000, valve opening angle like 10,20,30,40,50,60,70,80,90 variables data on the variations in Pressure loss coefficient (CP) 0.97 and drag coefficient (CD) 3.228 at 1000 re and 90's angle decreases with increment in both Reynolds number and valve opening angle for dual plate check valve and butterfly valve. [5]

The document also present the opinion on design of the check valve and analysis of the Spring acting main role in definite cracking pressure and it is also failure, due to shear by apply compression load. The cracking pressure and coefficient of valve by testing are 0.035-0.045 and 0.652 MPa respectively.which are very close to the theoretical values. Various simulations, numerical and boundary conditions in FEM using method and get equivalent stress of 418.736 MPa and deformation of 13 mm. [6]

This paper expanded on the transient study of a dual plate check valve during the opening time. The characteristic of the pressure drop across the check valve is highly correlated to the velocity per unit area at the minimum cross section. Due to the small gaps between the discs and the valve seat, the disc will not move until the inlet velocity grows to some certain value, causing a local peak point pressure drop curve. Pressure dropping by seat. [7]

The input data for hub end valve was referred from API 594, API 598, ASME B 16.5, ASME B 16.34 standard have been used for generating starting the design for the valve.FEA module of the Solid works software has been used for the design of components of the valve with validation The design has been checked for stresses, strain & displacement for rating of 2500. It has been found that are in the safe stress limit of the material used. then flow rate of valve is 0.0769 (m3/sec).CFD module of Solidworks has been used to find flow rate of valve and its flow coefficient (Cv). [8]

When a check valve closes, its disc slams on the valve seat, this slam may cause many problems like noise, vibration and seat wear. Also the modified valve disc shows a good performance concerning valve flow coefficient at normal operating conditions when the disc is fully opened at 75° where the flow coefficient for the modified valve plate is almost the similar as the original valve disc (0.44 % lower).it is comparison between the result of original and modified valve disc model. Using by solidworks flow simulation. [9]

The objective of this paper is to perform analysis and optimization of the critical component of Check Valve, its Body or Housing. The critical design analysis of stress development using 3D CAD models of check valve housing and finite element engineering simulation of various stress and deformation tests at pressure class 600,size of the valve 10" inch and working allowable maximum pressure 10 MPa in Ansys v14.5. [10]

The study of a variety of creative writing it seem the depth of cut ,feed type or geometry of tool or inserts are the most important parameter which have an effect on geometrical characteristics of work piece as flatness in milling machine. The various levels along with its range are also studied. Our attempt is to apply DOE to achieve desired flatness and predict the flatness for dual plate check valve. The model may helps to predict the response of the output parameter. The weather quality/geometry lies within desired tolerance level and find the responsible factors, which are mainly affecting the geometry of work piece like flatness, straightness. [11]

The parameter are minimum valve angle 2.51, maximum valve angle 60, diameter of plate 410 mm, inner diameter of pipe 378 mm, radius to centre of gravity 247.3 mm, moment of inertia 2.987, seat area 0.1122 m2 by using Finite difference methods CFD. The force factor Ff as well the loss factor kloc are evaluated by this CFD simulation for steady flow and also for a transient flow with a gradient of 2.0 (m/s²) of the inlet velocity. The dynamic simulation of a required counting of the relative motion of the fluid and disc. [12]

The failures that were not due to improper seating were due to the valve being either stuck open or stuck closed.

Failure area identifies the part of the valve that was affected, resulting in failure. Hinge pin, including bushings, Disc stud, Seat area, General wear such as damaged spring. [13]

That valve geometry affected the magnitude of pressure surges and reverse velocities. Reverse velocities and pressure surges are greater for valves with a larger mass of valve components. Reverse velocities are greater for valves with larger strokes or travel of components to close. Reverse velocities are less for valves that were spring assisted to close. These conclusions are justified because of the increased time necessary to accelerate and overcome the inertia of valve internals and the distance they must travel. [14]

3. CONCLUSION

The literature survey has shown that many researchers have successfully investigated the process parameter on flow rate of valve, pressure loss, drag forces, fluid and it density, open and close position of check valve. Dual plate check valve has non-return valve so the main forced on the pressure loss, drag force and flow rate by the disc angle, hinge pin and stop pin. The dual plate check valve is analyzed and results were obtained by varying the valve opening angles like $10^0, 20^0, 30^0, 40^0, 50^0, 60^0, 70^0, 80^0, 90^0$ and varying Reynolds numbers. When the fluid flow is passed from the dual plate check valve then angle of the disc various and disc are quickly open and takes some more time to close compare to open and possibility of leakage by top and bottom of hinge pin due to pressure. Therefore, pressure loss is increases. It has been found that the stresses, displacement and strain for structural of valve body at different size and its pressure ratting. Pressure loss co efficient 0.97 and co efficient drag force 3.228 at 1000 Reynolds number using inlet velocity 2 m/s and diameter of pipe 20 mm, models test in k-epsilon.

4. Future scope

- ❖ To avoid mention problem we suggest new design of spring, hinge pin, disc thickness. Analysis can happen made from various positions of disc (plate) and hinge pin and valve body for decrease pressure loss co efficient and co efficient drag force.
- ❖ This verifies the validity of the CFD results an approximation of the disc rotation characteristics is given, based on the CFD approaches. For get solution of analysis is found to use laminar, K-epsilon, K-omega model, which will indicate the flow rate or Reynolds numbers.
- ❖ The static structural used for Equivalent Stress, Equivalent Elastic Strain and Total Deformation. Dual plate check valve made of API &ASME and other standard so shall use new parts design also base on that.
- ❖ The design will check for pressure class rating 150 with in 6 inch because this pressure class is between high and low range of class.

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