Review On Automatic-Cleaning Basket Strainer

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Abstract: Clean water is a basic need of every individual. Today in numerous cities of India large number of waste water is produced. Such waste water is polluting natural water bodies like rivers, lakes etc. Hence waste water filtration & waters final purification is need of hour. In conventional type of filters, when strainer gets clogged we have to manually clean it, which takes time & filtration processes stops during cleaning process. While in 'Self-Cleaning Basket Strainer' when strainer gets clogged, a pressure difference is created between inlet & outlet nozzle, which is sensed by the differential pressure gauges. A differential pressure gauge activates backwash assembly which automatically cleans the strainer. Hence 'Self-Cleaning Basket Strainer' is used to save cleaning time & it automates the filtering process.

Index Terms: Filtration, nozzles, differential pressure, backwashing, skirts, impurities, partition plate.

1 INTRODUCTION

The main source of water pollution is the waste water from the industries as well as domestic areas. The best way to prevent water pollution is to carry out waste water treatment. This waste water treatment involves separation of solid impurities and chemical treatment to adjust acidity and level of oxygen. Earlier filters and strainers used for filtration have one major problem. Their operation is intermittent i.e. these filters have to be shut off for manual cleaning. Hence conventional filters and strainers required more man power for operation. Also in case of increased concentration of impurities, there will be frequent shut down of system and hence water treatment will have reduced capacity & efficiency. Self-cleaning filters and strainers are the best option for conventional filter & strainers. They do not possess the problem which the conventional has. In these modern strainers, filtering mesh is cleaned automatically by in built self-cleaning mechanism. This will reduce manpower required and reliable operation of strainer. This improves the capacity and efficiency of filtration. This will result in effective water treatment .Hence we have decided to undertake this project which will be helpful to society.

2 PARTS DESCRIPTION

Shell: Shell is a cylinder. Shell is used for storing and carrying the fluid under pressure. Shell is designed with great care because its failure may cause loss of life and property. The material used for shell may be brittle such as cast iron or ductile such as plain carbon steel and alloy steel.

Head: A pressure vessel is closed at ends by heads. The heads are either welded or bolted with main vessel shell. We have preferred semi elliptical head over others. Semi elliptical heads are stronger than Formed plain head and torispherical head. Also even though semi elliptical head is weaker than hemispherical head but forming required for hemispherical head is more and it is costly. Hence to optimize cost and strength, we have selected semi elliptical head.

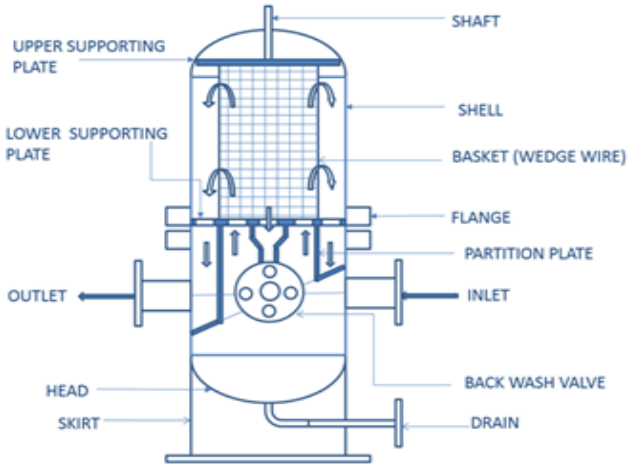

Fig1: *Self Cleaning strainer (AutoCAD Generated)*

Nozzles and Openings: Openings are provided in the pressure vessel for functional requirements. They are required for

1. Inlet and Outlet connections
2. Drain pipe connection
3. Pressure Gauge Connection
4. Safety device connection
5. Manholes, etc.

Nozzles are then formed or welded around these openings.

Skirt: The vertical vessels are supported by bracket or skirt, while horizontal pressure vessels are supported by saddles. The tall vertical vessels are usually supported by skirts. Skirt may be straight or angular. The skirt has sectional modulus and hence gives better resistance to the bending. Therefore, the skirt support is an economical design for a tall vertical pressure vessel. A bearing plate is attached to the bottom of the skirt. These plate is fixed to the concrete foundation by means of anchor bolts to prevent overturning of the vessel due to wind or seismic loads.

Partition plate: Partition plate is used to separate inlet and outlet flow. Inlet and Outlet connections are kept at same height, hence to separate the flow we kept lower end of partition plate elliptical. Lower elliptical end is welded to lower shell. Lower supporting plate rests on upper portion of partition plate.

Flanges: Flanges are welded to various openings of pressure vessel. Flanges are used to join two pressure shells & to make pipe connections.

Backwash Arm and Shaft: Backwash arm is main component in cleaning phase. A shaft is connected to arm for rotation. Opening of backwash arm should be 1/6th to 1/8th of total opening area of strainer. Shaft is rotated by electric motor. For proper filtration, it should be rotated at lesser speed i.e. about 2 to 3 rpm.

Gaskets, O-rings, Bolts and Bush: Gaskets are used to prevent leakage. Gaskets are placed between serrations of flanges. O-rings are used to facilitate easy rotation of backwash arm. Bolts are used to connect the flanges. Also anchor bolts are used to fix vessel to the concrete foundation which will prevent overturning of vessel. Bolts are preloaded such that even under the operating condition (i.e. when pressure vessel is subjected to internal pressure) the gasket is under the compression that is required to make the joint leak tight. Bush is used for easy rotation of shaft.

3 WORKING

3.1 Filtration Phase

The working of filtration phase is as follows.

i. This duration of this phase is about 30 to 40 minutes and is affected by the concentration of impurities present in the fluid.
ii. The fluid containing dirt, impurities enters the vessel through inlet nozzle. It is diverted through 90˚ in upward direction by partition plate.
iii. The heavy impurities in the fluid get separated from the flow due to their high inertia. These impurities get collected in the lower head.
iv. These impurities can be drawn out by opening drain valve after a certain period regularly*.
v. The diverted fluid enters the strainer basket from inside through the slots made in lower supporting plate.
vi. The fluid passes through fine mesh of strainer and leaves the impurities behind on the strainer. The strainer will go on clogging due to deposition of impurities on it.

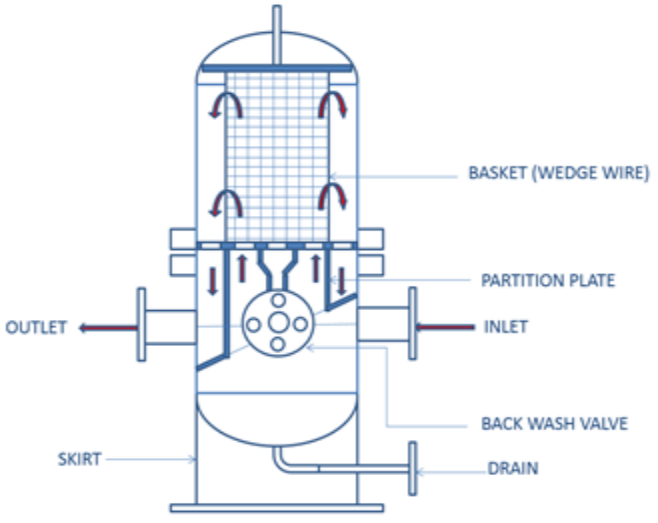

Fig2: *Filtration Phase*

vii. The filtered and clean fluid after filtration will get diverted downward by the upper shell itself. The filtered fluid is separated from unfiltered fluid due to partition plate.
viii. After all, the clean fluid comes out from the outlet nozzle. This fluid is then can be carried to desired location through pipes.

*special design of Programmable Logic Controller is used

3.2 Backwash Phase

The working of backwash phase is as follows

i. The duration of this phase is of 2 to 3 minutes.
ii. Due to continuous filtering, the filtering element i.e. the strainer gets clogged.
iii. Due to this, the pressure differential across the inlet and outlet nozzle increases. When this difference exceeds the threshold value, backwashing is triggered.
iv. In this phase, backwash valve opens which is connected to backwash arm through pipe. The opening and closing of valve is governed by the actuator. This actuator actuates by the signal sent by sensors sensing the differential pressure.
v. As the backwash nozzle is at atmospheric pressure and outlet nozzle at high pressure (less than pressure at inlet nozzle), fluid flow chooses path of high pressure difference i.e. towards backwash nozzle.
vi. Hence inside the strainer vessel, fluid flow gets reversed across the strainer basket. The fluid starts flowing from outside the strainer to inside of strainer.
vii. This reversed fluid flow brings about the cleaning of mesh of strainer basket and hence carries the impurities with itself.

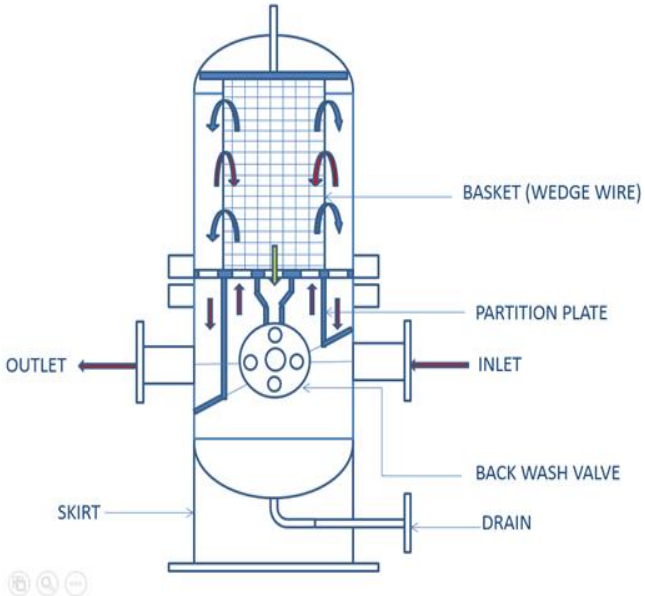

Fig3: *Backwash Phase*

viii. This dirt carrying fluid enters the backwash arm which is rotating to cover all the inner surface of strainer. The fluid flows through the funnel to the backwash pipe through which it is disposed off.
ix. Generally this phase starts when the strainer is clogged 50%. Frequent backwashing is undesirable since it involves loss of fluid.
x. After sufficient cleaning of strainer mesh, the flow

resistance decreases hence reducing differential pressure. This triggers the actuator which closes the backwash valve and again filtering phase starts.

4 BACKWASHING PROCESS

Main function of self-cleaning basket strainer is to clean the strainer when it gets clogged above certain limit. Hence differential pressure across the strainer should measure regularly. When basket is not clogged, pressure drop across basket is 0.187728 bar. During filtration, basket started to get clogged. When it gets clogged to 50% , then pressure drop become 0.258734 bar. At that point of time, sequence valve gets opened and backwashing starts. During backwashing, flow will not get interrupted. Backwashing will go on till, it completely cleans the basket. When differential pressure across basket reaches normal value then sequence valve get closed. Backwashing also get stopped.

5 PLC DESIGN REQUIREMENTS

i. Adjustable timer,
ii. 10 amp control relay for backwash valve activation,
iii. Differential pressure override,
iv. Display lights to indicate Power On – Backwash Valve Open
v. High Differential Pressure.
vi. The panel also has contact terminals for a motor starter and an external alarm connection.
vii. The panel requires 2300 VAC input is available as an option. The panel has a differential pressure switch and an electrically-actuated ball valve that controls the backwash function.
viii. A selector switch is also included to manually control the backwash valve functions of OFF or ON-Auto.
ix. An electrically-operated butterfly valve is included to control the external source of cleaning water.

5.1 Modes of operation

Automatic Intermittent and continuous Back washing are the two modes which can be easily switched by using Selector switch. When the selector switch is in 'Auto' position the drive motor will begins with the opening of backwash valve. The frequency of the backwashing is controlled by setting the timer in the automatic intermittent adjustable mode and the ″open″ time of the backwash valve. Field adjustments are be made to suit the application. The differential pressure sets are be carried by measuring the pressure difference between inlet and outlet when strainer not clogged (0.187728 bar) and when the strainer is clogged up to 50% high pressure difference is .258734 bar, which states that above this pressure ,pressure switch will override and the cycle timer starts which continuous to backwash until differential pressure is reached. As differential pressure is reached the strainer will continue for next 1 minute to backwash (time delay relay). In continuous backwashing operation is being used where the backwashing fluid can be reused to its source.when high solid loadings are encountered this mode is applied. When the selector switch is in ON position continuous backwashing is encountered. Opening and closing of backwash valve is manually done in this operation. In both the operations backwash plate rotates with as low speed as 2-4 rpm.

6 CONCLUSION

Scope of our project is limited to filtration involved in waste water treatment. For filtration purpose strainers and filters can be used. Whether to use a filter or strainer depend on size of impurities to be removed. For waste water treatment plant we have decided to use a strainer.

7 ACKNOWLEDGMENT

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