Study on Design and Analysis of Industrial Y Type Strainer

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Abstract: Industrial Strainers are widely being used in Various Heavy Mechanical Industries such as Petro Chemical, Oil and Gas, Steel industry, Water Treatment and Process Industries. The Main purpose being Removal of unwanted Materials in pipelines is a never ending one. Whether the Flowing Material as Sea Water, Oil, Paint or variety of Food or Chemical products. The cause of damage might be dirt, foreign matter or even Clamps of the Product. The Main widely used Industrial Strainers are Basket, Magnetic, Duplex, Y-Type, Tee type and conical strainer. The material used in overall Manufacturing of the Different Strainers is MS (Mild Steel), SS (Stainless Steel). The most efficient of all the strainers Duplex Strainer, because of its large design ratio and larger Material Handling Capacity. The Main Purpose of this Research is to Study Design and Materials involved in the manufacturing of Y-Type are being mainly used in the fluid pipelines in order to Filter Out the impurities, Foreign Particles and protect the downstream.

Key Words: Industrial Strainers, Mechanical Industries, Basket, Magnetic, Duplex, Y-Type, Tee Type, Conical strainer, Fluid pipelines, Foreign Particles.

1. Introduction:

In the Oil and Gas Industry, a efficient filtration or separation system is basic to the dependability and execution of the actual resources that interaction oil based goods. Streamlining the dependability of these filtration frameworks is fundamental in amplifying your operational presentation. Y-Type Strainers are utilized in numerous mechanical applications to shield plant apparatus to harm from foreign substances like residue, scales, sand, strong particles and different prospects. It is utilized to eliminate solids from streaming gases or liquids utilizing stressing component.

Anurag Gupta et al.,[1] examined the common factors of new product planning, design & development of Y-type strainer. It additionally states about the process required for concept choice manufacturing & establishes criteria for new product achievement, the market research tools available for coordinating the Client/customer needs into the innovative process. Yashwanth et.al., [3][4] But they have not worked on the improvement of pressure drop valve of the strainer. If we consider the general length of process pipe which give process fluid to number of equipment and to ensure these equipment Y strainers are introduced before the same. Pavan et al.,[2][5] have concentrated deeply the internal chain of importance operations of concurrent engineering in the new product development process. The reason of this paper is to develop a dynamic planning strategy that is innovative, efficient and flexible for new product improvement by using the concurrent design idea.

Saeed Ovaysi et al.,[6] have studied a dynamic particle-based model for direct pore-level displaying of incompressible thick fluid flow in disordered media. The model is equipped of simulating flow directly in three-dimensional high resolution micro-CT pictures of rock tests. It is depend on moving particle semi-implicit (MPS) strategy. They modify this procedure to improve its stability for flow in porous media issues. Alexander Grahn et al.,[7] have studied Pressure Drop Model for the CFD Simulation of Clogged
Containment Sump Strainers. The present study aims at modeling the pressure drop of flows through growing cakes of compressible fibrous materials, which may shape on the upstream side of regulation sump strainers after a loss-of-coolant incident.

A. Grahna et al.,[8] have implemented a strainer model for calculating the pressure drop across beds of compressible, fibrous materials. The presented study aims at modeling the pressure drop of flows across growing cakes of compressible, fibrous materials and at the implementation of the model into a general-purpose three-dimensional (3D) computational fluid dynamics (CFD) code. Computed pressure drops are compared with experimentally found values. The ability of the CFD implementation to simulate 3D flows with a non consistently conveyed molecule stage is exemplified utilizing a stage-like channel geometry with a horizontally strainer plate. J. S. Andrade, et al.,[9] has considered Inertial Effects on Fluid Flow through Disordered Porous Media. They had explored the cause of the deviations from the traditional Darcy law by numerical simulation of the Navier-Stokes conditions in two dimensional disordered permeable media.

K. Ann-Sofi Jonson et al.,[10] have studied Fluid Flow in Compressible Porous Media Steady-State Conditions. In this article a model describing liquid stream and pressure factor prompted varieties in porosity under fixed conditions is created. In forthcoming article the powerful conduct during filtration and wet squeezing of compressible permeable media are introduced. Liquid course through inflexible permeable media is for the most part described by Darcy's law. The corresponding expression for compressible materials is determined in this article. Chwan P. Kyan et al.,[11] have considered Flow of Single-stage Fluids through Fibrous Beds. A pore model for the flow of a single stage fluid through a bed of random fibers is proposed. A effective pore number, Ne, represents the impact of dead space on flow; deflection number, N6, the impact of fiber avoidance on pressing factor drop. Test information were acquired with glass, nylon, and Dacron fibers of 8-to 28-micron width and with fluids of thickness ranging from 1 to 22 cp. A generalized up grating factor. Reynolds number equation is presented.

Stephen Whitaker et al.,[12] have considered Fluid Motion in Porous Media. In tackling the issue of incompressible flow in porous media, one is defied with the way that the outcome is truly settled i.e., Darcy's law gives a precise depiction of the flow. Because of this, it is not difficult to continue along an assortment of approaches, some of which likely could be mistaken or entirely instinctive, to the correct final result. We will attempt to maintain a strategic distance from this entanglement in the current investigation and build up as cautiously as possible a legitimate, correct course to the final result.

B. F. Ruth et al.,[13][14] have featured the nature of fluid flow through filter sept and its significance in the filtration condition. The consequences of examinations upon fluid flow through an variety of septa are summarized. It is indicated that Poiseuille's law governs fluid flow through channel septa under the states of pressure and rate of flow conventionally experienced during filtrations.

Chandrashekhar, et al., [15-16] The verification that flow is thick all through the whole filtration cycle comprises a critical commitment to the hypothesis and arithmetic of filtration, and sets up a firm test and hypothetical reason for the developed in a previous paper. Strainers are fundamentally used in various enterprises, for example, Pharmaceutical industry, Metals and Mining industry, Water and waste management, Process Industries, Fire fighting industry, Power industry, Chemical industry, Oil and Gas Industry, Pulp and Paper industry, Refineries and Petrochemical Plants. Strainers are used to eliminate
dangerous parts that may cause inadequate or complete breakdown of tasks in the event that they get into the System.

Ernst et. al., [17] Strainers are intended to catch solid particles and other solid unfamiliar substances inside a fluid and prevent them from proceeding through the system. When working appropriately, strainers help prevent potential harm to different pieces of the system. With the better performing in strainer, cost of ownership decreases while life-cycle of the equipment being used is extended, profiting makers over the long run. Stainless steel is the preferred body, basket, and screen material for the drug, food processing, and Chemical industry due to its protection from consumption and simplicity of cleaning. stainless steel costs around multiple times the amount of as Cast Iron.

David et. al., [18] Y Type Strainer is Critical wherever clean fluids are required. While Clean Fluids can help Maximize the Strength, Reliability and Life of any Mechanical Systems, they're particularly huge with Solenoid Valves. This is because Solenoid Valves are exceptionally touchy to Dirt and will just limit appropriately with clean Liquids or Air. Any possibility that any Solids enter the flow; it can agitate and even damage the entire System. Y strainer is a remarkable Component. Despite guaranteeing the introduction of solenoid valves, they are furthermore helping ensure various kinds of mechanical equipment.

1.1 Y Type Strainers: Y Type strainers have a bolt Cover alongside blow off Drain connections. Flanged closes/butt-weld closes, Socket Weld Screws end makes it minimized in size. Despite the fact that it easy to install its sizes doesn't permit it to hold a high amount of Dirt. The manufactured Y type strainers are easy to carry and introduce due to its low weight and minimized size. It makes bigger size and pressing factor of manufactured strainers as well. (Figure 1)

Y Strainers is shape like a "Y" and is utilized to Filter, strain, out particulates from Liquid, Gas and Steam. This mechanical stressing measure is made possible by means of a Filter Element involved cross section, metal, or a wedge wire stressing element. The most widely recognized sort of stressing element is a wire mesh. Some likewise "blow-off valves" that make the cleaning process easy in applications with more Dirt and soil. The strainer itself has a compact, Y shape Structure. The Y shape has better stream qualities then for instance a T Strainer, in light of the fact that the liquid flow through the channel with less alter of direction.

A straight forward Y Type Strainer can keep these segments, which are probably the most significant and costly pieces of the pipeline, shielded from the existences of pipe scale, rust, drugs or some other sort of debris. Y Strainer is accessible in a bunch of plans that can oblige any industries or application.
2. Raw Materials

Y Type Strainer, which are utilized eliminating unfamiliar particles from Fluids, Gas or Steam Lines. Known for their superior and longer assistance life, Y Type Strainers are better solutions to different Industry Businesses.

Table 1: Specification of Y Strainer

| Type               | Y Type Strainer              |
|--------------------|------------------------------|
| Size Range         | 25mm to 400mm                |
| Pressure Rating    | 150 to 1500                  |
| Body Materials     | Alloy 20, Cast Iron, WCB, CF 8. |
| Material           | M.S., MSRL, SS 304/316, Brass, Monal |
| End Connection     | Flanged as per ASNI B 16.5 Butt Welded |

This product is designed to eliminate unfamiliar material from pipe lines and protect the pumps, meters, valves, and other mechanical equipment, which is called as Strainer. "Y" Type Strainers are named after their shape and typically for filtration. Large filtration area can be utilized with fine mesh. The Strainer improves the medium, and draws out the life of valves; secure costly pumps, meters and different types of equipment. It is reasonable for Gas, water, Air, oil, steam and other liquids. Y-strainer can be introduced in horizontal or vertical position (Downward stream) with the screen component pointing descending. This permits the strainer screen to gather material in the strainer at the absolute bottom of the screen.
3. Parts of Strainer

3.1 Body:
SS (Stainless steel) is an austenitic Chromium-Nickel Stainless Steel with superior Corrosion resistance. The low Carbon contents less to Carbide precipitation during Welding. This use is serious destructive conditions. (Figure 3)

3.2 Filter Element:
The filter element is the central component of industrial filters. The channel component is the focal segment of mechanical channels. The filtration take in process, for example, maintenance limit, dirt holding limit and pressure loss are dictated by the filter element components and the filter media utilized in them. (Figure 4)

3.3 Flange
A Flange is an outside or interior edge for strength, as the Flange of an iron pillar, for example, an I-shaft or a T-bar; or for connection to another object, as the flange on the finish of a line, steam cylinder and Flange of a rail vehicle or cable car wheel (Figure 5). The word "Flange" is additionally utilized for a sort of hardware used to frame Flange. Flange with Pipes can be can be disassembled and assembled easily. Elliptical plate Fit inside the Strainer. This is Well Welded and Place in the Y Strainer. Plate is joined along with Mesh. (Figure 6)

3.4 Bolts & Nuts:
A bolt is a form of threaded fastener with an external male thread (Figure 7) and A nut is a type of fastener with a Female threaded hole internal (Figure 8). Nut and Bolt held together while Vibration or rotation the object.
Figure 5: Bolt Design for Y Strainer

Figure 6: Nut Design for Y Strainer

Figure 7: Body of the Y Strainer

Figure 8: Filter Element of the Y Strainer
3.5 Gasket

A gasket is a mechanical seal which occupies the space between at least two mating surfaces, for the most part to stop leakage from or into the joined items while under compression. (Figure 9)

3.6 Shell Flange

A Flange is a plate for covering or shutting the finish of a Pipe. A Flange joint is an association of Pipes, where the interfacing pieces have spines by which the parts are joined together. (Figure 10)

3.7 Shell Cover

Flange is a plate for covering or shutting the finish of a pipe. It has the Drain Plug, where it assists with flushing the Liquid. (Figure 11)

3.8 Drain with plug

The insertion of a plug into a drainage outlet allows the container to be filled with water or other fluids to Drain out. (Figure 12)
4. Assembly of Y Strainer:

![Assembly of Y Strainer 1](image1)

![Assembly of Strainer 2](image2)

5. Calculation:

We will calculate Pressure Loss Using $Cv$ Factor:

$$\Delta P = \left(\frac{Q}{Cv}\right)^2 \times 133.66 \quad \text{(1)}$$

$Cv$ = Flow Coefficient

$Q = \text{Flow in } M^2/\text{Hr}$

$\Delta P = \text{Pressure Drop}$

The Pressure Loss in the Y strainer can be Calculated with Flow rate and $Cv$ Factor for the Y Strainer. We will consider 2, 4 & 8 psi pressure to find the Pressure loss in Y Strainer with Equation (1).

**Case (1):**

We will obtain the Pressure loss for 2 Psi.

$$\Delta P = \left(\frac{Q}{Cv}\right)^2 \times 133.66$$

2Psi = 13.7 Kpa

$$\Delta P = \left(\frac{13.7Kpa}{30}\right)^2 \times 133.66$$

$$\Delta P = 27.87 \text{ Kpa}$$
Case (2):

We will obtain the Pressure loss for 4 Psi.

\[ \Delta P = \frac{Q}{Cv}^2 \] (133.66)

4Psi = 27.5 Kpa

\[ \Delta P = \frac{27.5Kpa}{30}^2 \] (133.66)

\[ \Delta P = 112.38 \text{ Kpa} \]

Case (3):

We will obtain the Pressure loss for 8 Psi.

\[ \Delta P = \frac{Q}{Cv}^2 \] (133.66)

8 Psi = 55.15 Kpa

\[ \Delta P = \frac{55.15Kpa}{30}^2 \] (133.66)

\[ \Delta P = 455.69 \text{ Kpa} \]

- The Pressure loss in the Y Strainer from above result as 27.8, 112.3 & 455.69 Kpa is obtained. Pressure loss increases or decreases. Difference occurs with the difference in Size of the mesh. Hence Maximum Pressure loss can be up to 500Kpa to run for Long Period of time.
- The Higher the Mesh size the More stability is attained in the Outflow of the water.
- If it is smaller at the inlet Pressure will be more. 
  \[ P > \text{Outlet} \]
  \[ P < \text{Outlet} \]
- Depending upon the Foreign Material entering along the Liquid (Microns) the life of the Strainer is obtained.

Calculate Pressure Drop in Strainers:

- The purpose of the Guideline is to Lay down the Procedure for estimation of Pressure Drop across Y Strainers in a Piping system.
- For Pressure drop estimation Graphs are referred.
- This Graph gives Pressure Drop based on Specific gravity of Water and Viscosity of Water.
- Screen openings chart indicates the Percentage open Area of Perforated plate and Meshed screens.
- For Fluids of High viscosity and finer weave Meshes viscosity and Density correction Factor chart will be referred.
Pressure Drop: For maximum efficiency, a differential pressure gauge installed across the inlet and outlet will indicate pressure loss due to clogging and may be used as a guide to determine when cleaning is required. Normally, when differential pressure reached 2-8 Psi, screen must be cleaned. (Figure 15)

![Pressure Drop Chart](image)

Figure 15: Pressure Drop Chart

Chemical Analysis and Material Properties:

The Test Report of the Y Strainer shows the result of the Chemical Analysis and Material Properties. This report shows the Ultimate Tension Strength, Yield Strength, Elongation and Percentage of Chemical Components in the Material. If the Pressure is more then, Liquid will not allow to Flow properly and strainer gasket will fails and the mesh will fail its purpose to sustain the foreign particle.

Manufacturing Process: Steps Involved in the manufacturing Y Strainer are material selection (Figure 16), plasma cutting (Pipe & Sheet), MIG & Arc Welding, Buffing and Grinding, Perforated Sheet, Mesh (On Customer Enquiry), Assemble and Fitting, Hydro Test, Quality Control Check, Final Inspection, Paint, Packing, Dispatch.

The applications of industrial strainers are Heavy Duty Construction, Thermal Plant, Cement Industries, Process Industry, Pharma-Industries, Power Industry, Oil and Gas Industry, Food Industries, Water and Waste Management, Hydro-Carbon and Steel Industry, Refineries and Petrochemical Plants.
6. Conclusion

Y Strainer is designed and studied in the above research paper. The material used is SS Stainless strainer (316 L) with negligible losses. The future studies can be done with a different material for the further development. Strainers are not long, at this point kept to a Simple cast body with a Wire Mesh screen, yet are a Technical, Highly Refined, Designed bit Carefully of Equipment. In some cases they work at 1,500 degrees F and 10,000 psig or at cryogenic Temperatures. They are modified with Steam coats, Cover Lifting davits, Magnets, Motorized Cleaning gadgets and Automatic vent Valves. They are Supplied with Screwed, Flanged, Socket weld, Butt weld, Ring joint and Silver brazing end Connections. Appropriately, the execution of a Strainer should be thoroughly examined and engineered. While it is acceptable practice to utilize a Strainer to secure Down-stream Equipment, it is imperative to carefully consider the choices Available. Picking the right Strainer can Save Money by Protecting Equipment, yet in addition by keeping Operations and Maintenance Costs at the very least.

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