Strainers with low resistance flow and low maintenance

Strainers and filters protect pumps, plant components and equipment against damage and malfunctioning caused by contamination in the pipeline. This article compares different types of strainers showing their pros and cons and gives hints how to choose the right strainer

DIRK WALDOW, GÜNTER WALDOW

Strainers and filters protect pumps, plant components and equipment against damage and malfunctioning caused by contamination in the pipeline. Generally, a strainer is the only element in a pipeline increasing its initial flow resistance while filtering debris and particles causing plant shut-down for maintenance. Especially strainers with small – effective – filtering area will clog quite easily. Having the strainer installed at the suction side of a pump, the pump inlet pressure will drop, due to the increase in pressure loss and hence lead to cavitation of the pump.

If in the procurement phase, the focus has not been on the necessity of low flow resistance (ζ) and a large effective filtering area, the results may be stoppage of the plant for repairing the pump or interruption of the operation due to the frequent maintenance/cleaning of the sieve. The installation of a better performing strainer subsequently will be mostly expensive. Therefore, the general requirements on strainers are given by:

- Dependable filtering effect
- Large filtering volume and filter area
- Insignificant pressure-drop in clean condition
- Insignificant rise in pressure loss while dirty
- Lengthened service intervals
- Easy and time saving cleaning operation
- Reasonable price.

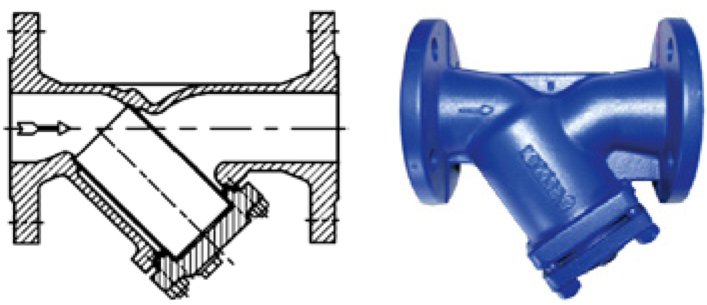

***Figure 1**: Y-Filter*

STATE OF THE ART

Standard types of strainers are the Y-type (Y-Filter) or pot/basket strainers (T-Filter and W-Filter). In following those three types are introduced with respect to their individual characteristics, advantages/disadvantages when manufactured or in use/service.

Y-Filter The Y-Filter in principle is utilizing the casing of a slanted valve unit with a cylindrical sieve format (***Figure 1***).

Advantages in manufacturing a Y-Filter:

- Reasonably priced casing, because of serial production with valve bodies;
- Use of valve casings with damaged seats.

Disadvantages in manufacturing a Y-Filter:

- Large deployment of sieve material compared to the effective filter area;
- Limitation in enlargement of the filter area.

Advantages in using a Y-Filter:

- Large deposition volume for particles which, separated from the flow, entered the dead zone and strike the sieve area at an angle;
- Equally well suited for both horizontal and (from top to bottom) vertical flow.

Disadvantages in using a Y-Filter:

- Increased pressure drop, caused by change in the flow direction
- Difficulty handling of flange fittings
- Troublesome insertion of sealant during maintenance (overhead work, dripping)
- Residual deposition area.

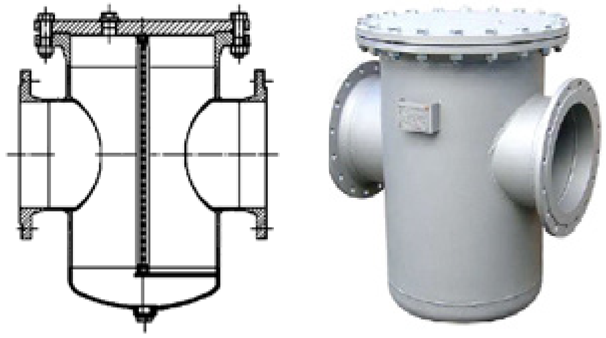

Figure 2: T-Filter

Pot/basket strainer (T-Filter) In principle a T-FILTER has the casing of a gate valve with a flat or half-cupped sieve (*Figure 2*).

Advantages in manufacturing a T-Filter:

- A geometrically simple construction, welded or of cast iron;
- Good possibility to extend filtering area.

Disadvantages in manufacturing a T-Filter:

- Extensive strengthening of sieve necessary, in order to create a unit withstanding pressure;
- Additional cost, should the filtering of the dead zone be required.

Advantages in using a T-Filter:

- Negligible pressure drop when new, because of lack of flow turn-back;
- Easy handling of flange fittings and sieve set, also with large ratings;
- Easy assembly of gasket.

Disadvantages in using a T-Filter:

- The vertical flow clogs the sieve area quickly (especially when flow direction is from top to bottom), which causes a rapid increase of pressure drop;
- Results are shortened maintenance intervals.

When dirty (T-FILTER sieve/screen): Note the missing turnarounds and the extra reserve of available filter area (*Figure 3*). Even though a large segment of the filter area remains not in use, the increase in pressure drop is of such magnitude that the strainer needs to be cleaned.

In horizontal flow position of the T-FILTER, the cleaning intervals are of longer duration (a large part of the dirt bounces off the sieve and is deposited in the dead zone of the dirt catcher). However, also cleaning of the sieve is necessary, when the piping cross-section is blocked by "dirt disk" of equal size.

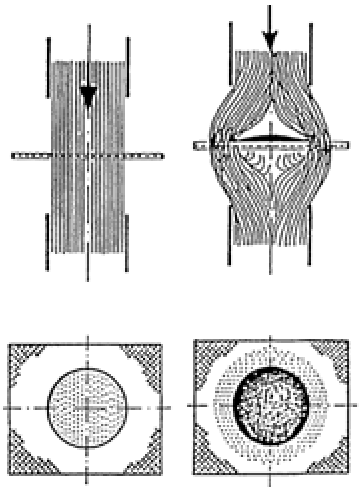

Figure 3: Flow path in a T-Filter under clean (left) and dirty conditions (right)

Basket strainer (W-Filter) The W-Filter (*Figure 4*) is in principle a T-Filter but without the disadvantages of the same. The sieve is a wedge casing which is set in the flow direction of the medium. This results in following advantages:

- The inherent robustness of sieve body saves expensive re-enforcement and permits the use of reduced wire size for the same mesh format, which results in a larger open filter area
- Good dirt deposition through flat angle of impact of the dirt particles
- Complete removal of filtered particles together with the extraction of the sieve unit
- Effective sealing between filter and sieve body – also with fine mesh format
- Negligible loss of pressure, also when unit is heavily clogged by dirt
- Lengthened intervals for maintenance, because of superior dirt separation
- Horizontal and vertical (top to bottom flow direction) mountings are about equally effective

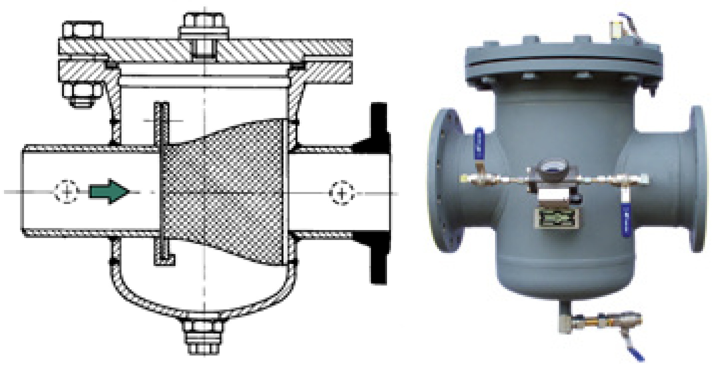

Figure 4: W-Filter type W-SF (welded/flanged end)

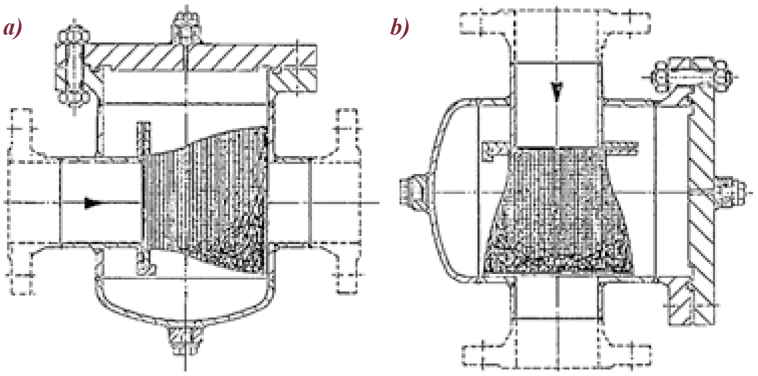

Figure 5: W-Filter (dirty) in horizontal flow path (a) and in vertical flow path (b)

- Reasonably priced model through low-cost manufacturing potential.

The "welding construction from commercial piping, bottles, sealant, screws and sieve meshing" takes the demands of the market fully into account, such as:

- Special dimensions;
- Units without flanges, with single side flange or flanges on both sides
- High pressure capability through the thick-walled design
- High, respectively low temperatures through use of selected materials
- Short delivery periods – also for a limited number of orders

In both cases, the same degree of contamination is present as described under T-Filter section (dirty). There is still a large and effective filter area (*Figure 5*) available and the rise in pressure drop is so small that the cleaning of strainer remains unnecessary for some time to come. Out of the experience by plant operators it is experienced, that the maintenance intervals of a W-Filter are at minimum three times longer than of a conventional available T-Filter. Often, the cost for filter cleaning, including plant operating stoppage, is higher than the price of a complete strainer unit.

Cleaning intervals are different at constant pollutant quantities and maximum pressure drop (Δp max) – resulting in shut down, loss of production and maintenance cost.

In the following table (*Figure 6*) the different types of strainers and its characteristics in regards to their respective pressure increase and maintenance intervals are visualised. The shown surfaces are an equivalent to the energy consumption of a pump needed to overcome the resistance of a strainer.

Ensuring, that the differential pressure is increased at a later stage, will also provide a drop of the necessary inlet pressure of the pump just before the cleaning of the sieve is required. In addition, if the maintenance interval is longer, a longer operation of the plant is given.

Figure 7 shows a W-Filter in a large power plant in Germany.

ACKNOWLEDGEMENT

The authors would like to thank Mr. Jordan (EVONIK – former Hüls-Degussa), for the highly valuable information about the experiences in handling and maintenance of strainers of various types.
Furthermore, thanks to Mr. Bangerter and Mr. Larsen (VEKS Denmark) on their feed-back about the improvement of their District Heating operation in Amager/Denmark and the respective heat distribution by utilising the Filter Type W.

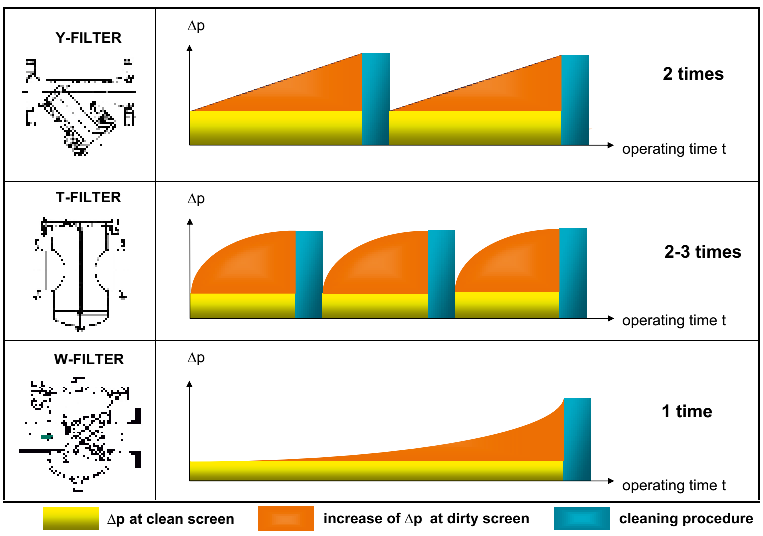

Figure 6: Cleaning intervals of different types of strainers

Figure 7: Filter type W-SS DN800/PN10 in a newly built power plant in Germany

10 TIPS FOR THE SELECTION OF DIRT FILTERS

How to select the right strainer
The following ten points to consider for selecting strainers in plants are recommended to minimize cost and maximize plant efficiency:

1. Low resistance value (ζ)
Saving energy cost for the operator. Strainers with a high pressure drop show a higher level of energy consumption (kW) due to a higher utilization of the pump overcoming the respective pressure difference - summing up to a yearly amount higher than the initial price of the product! Therefore, a mayor focus should be on selecting components with a low ζ-value.

2. Large effective filtering area
The most important figure is the size of the filtering area which is provided into the stream, but not the installed filtering area. In most the technical brochures, one can find the total filtering area of the strainer. Similarly, plant engineers tender for an installed filtering area three or four times of the pipe connection. As we can see out of the flow and sieve characteristics of the different strainers, the effective filtering area can be much smaller. Therefore, assess the strainer considered for installation in your plant under the aspect of effective filtering area and do not let yourself been misleading by the given data in the brochure.

3. Angle of impact between flow and sieve
Sieves with an impact angle of 90° will clock easier as ones with a flat impact angle. With the vertical impact angle, the particles with about the same dimensions as the mesh size will stick in the sieve and block the flow: cleaning and maintenance intervals are lengthened.

4. Closed sieve-body
Using an open sieve, filtered particles will remain within the housing of a strainer, triggering additional cleaning cost due to the requirement to install an additional cleaning device or cater for intermediate collection of the sludge. Utilizing a closed sieve, filtered particles will be removed together with the sieve – the filter mud is already cleaned and recyclable.

5. Easy applicability of the strainer
Pipeline layout is simplified by installing a strainer both in horizontal and vertical position. Consider a strainer that can be installed both ways by providing the respective advantages of long maintenance intervals with the given low differential pressure.

6. Good handling of top flange (‚cover')
Strainer of larger dimensions provide exhausting and time consuming maintenance, if cover, sealing and bolts are positioned head over or with an angel of <45° pointing down. Blind flanges (cover) of DN200 PN25 have already a weight of 23kg; handling those flanges will be easier by using a swivel/swing-arm so as to avoid the usage of a crane.

7. Weld able housing material
Already in the design phase of plants, but-welded end strainer may be considered to lower cost by saving flanges, additional sealing and excluding potential leakage points. Should the adjacent component of the strainers have a flange connection (e.g. the suction part of a pump, a compensator, etc.), order a strainer with single-sided connecting flange. In case you would like to change the type of strainer at a location already a less performing strainer had been utilised, order custom-made face-to-face dimension. If, for technical reasons, pipe connections of different values are to be found in front or behind the filter, ask for a custom-made solution for installation.

8. Connections for manometers
A strainer increases its pressure drop during operation and has to be cleaned. Therefore, information on the level of dirt within the strainer should be gained and manometers installed. Mountings for measuring the differential pressure might be considered with the procurement of the strainer, so as to prevent additional installation cost later. With the pre-set maximum pressure loss allowed in the pipeline, i.e. 1bar, these manometers could just indicate the level of dirt by a color code or via electronic indicators.

9. Filtering fineness
Filtering fineness of the sieve shall be "as course as necessary and as fine as possible!" Any mesh size which has been chosen too fine, results in an increased frequency of maintenance. You may operate your strainer with a finer mesh size of, i.e. 0.5mm, during startup of the plant and courser mesh size, i.e. 2.0mm, in continuous operation.

10. Sealing of the top flange (cover)
The only consumable part of a good strainer shall be the sealing of the cover. Sometimes strainers are supplied with a company-specific seal so as to bind customers and may even ask for a premium price. Therefore, strainers with standard seals, available in the market, should be considered with procurement.

THE AUTHORS

DIRK WALDOW
Managing Director
W-FILTER
Speyer, Germany
Tel.: +49 62 32 4 49 86
dirk.waldow@w-filter.com

GÜNTER WALDOW
Managing Director
W-FILTER
Speyer, Germany
Tel.: +49 62 32 3 37 56
guenter.waldow@w-filter.com

THE COMPANY

W-FILTER has been established in the year 1980 and is nowadays in second generation of the family business further ensuring the continuity in the market of industrial valves. The company is known for its main focus on engineering, production and distribution of strainers and startup filters.

Welded construction allows standard and customized solutions in the dimensions DN 50 - DN 1000 (PN 6 - PN 100). The products are characterized by low flow resistance, less and comfortable cleaning intervals which are contributing to an increase of the efficiency of plants, while installation both in horizontal and vertical pipelines is possible.

Already during the development of the products, the Pressure Equipment Directive 97/23/EC, AD2000 A4 and a variety of standards are taken into account. With the selection and processing of high-quality material the products are manufactured by specialized welders and certified factories in accordance to ISO 9001:2008, AD-HP0 / EN 729-3, DIN 18800, WHG und ASME S+U Stamp.

Well-known multinational companies in the following industrial sectors all over Europe, Middle East, Africa and Asia Pacific are amongst the customers:

- Energy and Environmental Technology: i.e. bio energy, CHP, CCPP
- Chemical- and Petrochemical: i.e. isophoron, refinery, pipeline terminal
- Utility and District Heating Systems: i.e. DHC, power plants
- Customized Solutions: i.e. steel plants, water and sewage industry

In all those areas, the main focus has been on low flow resistances and hence an increased energy efficiency, as well as maximum availability and long maintenance intervals of the plants.