VEE BEE FILTRATION

Case Studies - LNG Projects

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Best Practice:
Welding of the internal element frame

Best Practice:
Perforated plates with continuous margins

Foreword

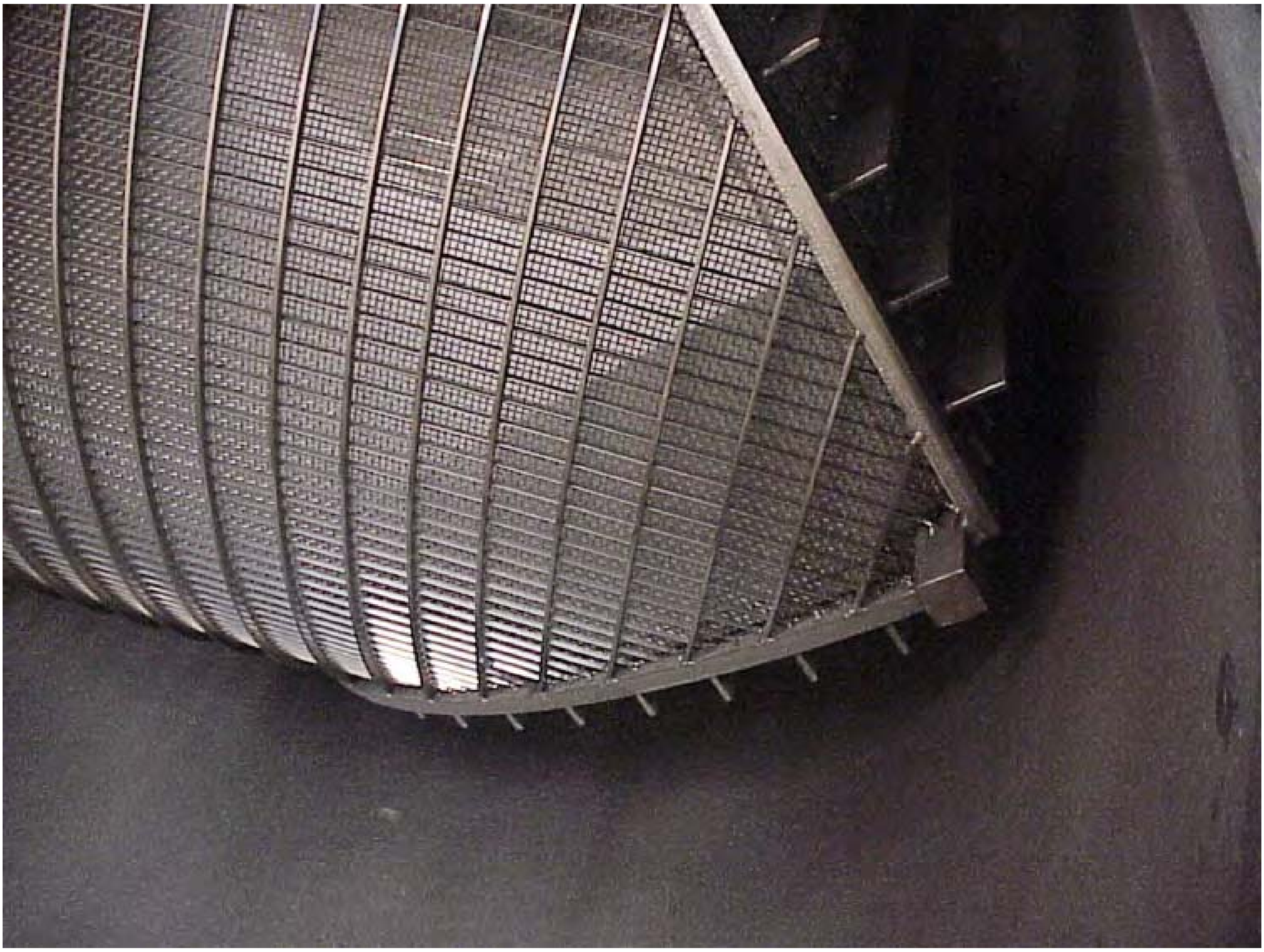
When Millions of US Dollars are tied up in the latest compressor technology you naturally want to be certain that you are protecting your investment in every way possible. Your aim should be to use equipment that offers you the lowest possible pressure drop based on your process design conditions, the best possible mechanically designed unit to accommodate any natural frequency / vortex shedding and mechanical strength issues whilst maintaining the highest levels of protection.

Vee Bee can offer these solutions by providing bespoke designed equipment that meets all of the above requirements. We have, over the past 12 years, introduced CFD (Computational Fluid Dynamics) and FEA (Finite Element Analysis) to complement our 56 years of experience to provide these design solutions.

Before the introduction of CFD the only way to verify product pressure drops was to proof test in a laboratory which becomes impractical when you are sizing units up to 84” nominal bore. Our clients have become more exacting in the data they require and want to know the ‘actual’ differential pressure as opposed to the industry standard statement “estimated differential pressure” the ‘actual’ burst pressure of the element and the natural frequency of the element (which could be compromised by the compressor potentially ending in a costly failure).

Engineering the required design involves allowing suitable research and development design time, employing accurate design techniques to develop the right concept, testing verification and planned structured manufacturing. During these steps our Engineers employ 3D modelling techniques, CFD, FEA. We can rapidly customise our existing design frameworks to meet client specific application requirements or we can, where necessary, create an entirely new design. Our historical data, previously conducted laboratory tests and feedback from site allows us to accurately predict pressure loss through our products. In addition it allows us to determine the behaviour of the product when introduced to other upstream and downstream pipeline equipment. Vee Bee can review your actual pipe layouts to see what effect this has on your circuit hydraulics.

Vee Bee was established in 1957 by William V Bradley under the name of Filtration & Valves, becoming Vee Bee in 1980, providing commodity strainers to all process industries. However over the years we realised that our clients required more than just a commodity and so we set to work focusing our design team on a bespoke high-end solution looking at the application and assessing the potential pitfalls before they happen.



54” Angled Tee Strainer

LNG Plant 1

Vee Bee were asked to provide filtration equipment for the second train being built at an existing LNG plant. The requirement was to supply identical units to the previous train which had been bought from another manufacturer. The design had to comply with the sizes and process conditions given in the data sheets while meeting strict differential pressure requirements

Vee Bee ran CFD simulations on each of the items. Over 60% of the items would not comply with the clients required differential pressures.

Vee Bee re-designed the elements to provide differential pressures as close to the clients requirements as possible, while maintaining the confines of the pipeline size. Our CFD technology was utilised to analyse the several designs to see which would provide the lowest differential pressure. The element was then subjected to mechanical strength calculations and FEA to ensure that the design would comply with the burst pressure requirements specified.

LNG Plant 2

Vee Bee were asked to provide a solution to a problem that a client was experiencing with a conical strainer being used on cryogenic service. During operation the strainer was icing up and therefore restricting the flow through the line. The process of isolating the line and removing the strainer for cleaning and de-icing was time consuming and costly. The strainer had to be designed to accommodate for flow in both directions and capable of withstanding a 10 Bar burst pressure in the normal flow direction and a 7 Bar burst pressure in the reverse flow direction. The strainer was also required to retain particles down to 0.25mm (250 micron) diameter.

To be able to accommodate the burst pressures Vee Bee determined a requirement for two perforated cones, one inside the other, with the mesh sandwiched between the two cones. In order for this design to be effective the perforated holes within the inner and outer cone would need to be perfectly aligned so that the open area was not reduced and the flow characteristics not compromised.

The high burst pressure required the perforated plate to be thicker than normal. This presented forming problems especially as the inner and outer cone had to be symmetrical. To overcome this problem Vee Bee designed a strainer that was manufactured from eight pairs of flat perforated panels. Each pair of panels were assembled with the fine mesh sandwiched between two layers of coarse mesh in-between the perforated panels. The panels were then welded together and each of the resulting eight segments were welded to a frame to produce an octagonal strainer. Vee Bee carried out extensive CFD to ensure that the design was suitable for the process conditions specified and then verified the construction by FEA.



High Pressure Conical Strainer
Fine meshes sandwiched between two perforated plates
Internal Frame

72” Conical Strainers

LNG Plant 3

During the commissioning of an LNG plant the plant designer and the compressor supplier recognised the need for two `last chance´ 72” conical strainers capable of withstanding 3.5 Bar to be installed directly in-front of the compressors. As the plant was already at the commissioning stage the strainers were required on a very tight schedule.

Vee Bee designed the strainers to meet the clients requirement of 3.5 Bar burst pressure. The design was verified by analytical calculations and confirmed by FEA. Vee Bee designed and manufactured the strainers in less than four weeks.

During commissioning the client experienced problems with elements in strainers supplied by an alternative manufacturer. Vee Bee were subsequently asked to then design and manufacture replacement elements for these strainers to ensure the continued running of the plant.

Best Practice

There is an increased level of concern in the industry that existing data used for sizing these large compressor strainers is incorrect. Clients and contractors are not receiving essential information about these potential problems until the plant starts its commissioning phase.

Vee Bee are passing on our experience to all of our clients regarding best practice when dealing with these types of strainers.

- Internal elements. The internal element is often seen as more of an annoyance than a necessity as it can be expensive and it creates a pressure loss within a system. The element should be treated as an important and integral part of the system as it is placed directly in the flow preventing harm to more valuable equipment.

- Differential pressure calculations using all of the equipment variables. Internal radii, seating rings, heavier wall fittings and other variables can all affect the differential pressure through the strainer. Vee Bee uses actual manufacturers data when available or “worst case” data according to international standards to ensure the accuracy of data provided.

- Piping layouts. Valves, elbows and other pieces of equipment and fittings can have a detrimental effect on differential pressure through a strainer. Vee Bee are able to model piping layouts to give accurate data.

- Element manufacture. Welding to ASME VIII Section 9 complete with NDT as required.

- Element finish. Critical welds are ground back to reduce the risk of failure by fatigue.

- Element mechanical design. Internal elements are the most important part of the unit and therefore should be designed to the same standards as a pressure vessel, utilising FEA and other analytical calculations to verify the element design.

- Natural Frequency. The natural frequency of the pipeline or reciprocating equipment can have a major effect on the element. If the frequency of the element matches that of the pipe work then the element will eventually fail. Frequency analyses should be carried out where this may be an issue.

- Standard designs. Where possible, especially on large plants, elements should be designed to be interchangeable reducing the risk of installing incorrect elements and reducing the requirements for multiple spare parts.

On critical applications Vee Bee believe that 'fit for purpose' is not acceptable. The units should be designed to reduce the risk of failure and to ensure the smooth operation of the plant. Allowing the client to know what pressure drop is going to be achieved and giving them the confidence to use this data to estimate much more accurately the level of productivity the plant can potentially achieve.

Angled Tee Type Strainers

Best Practice:
High integrity framework

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