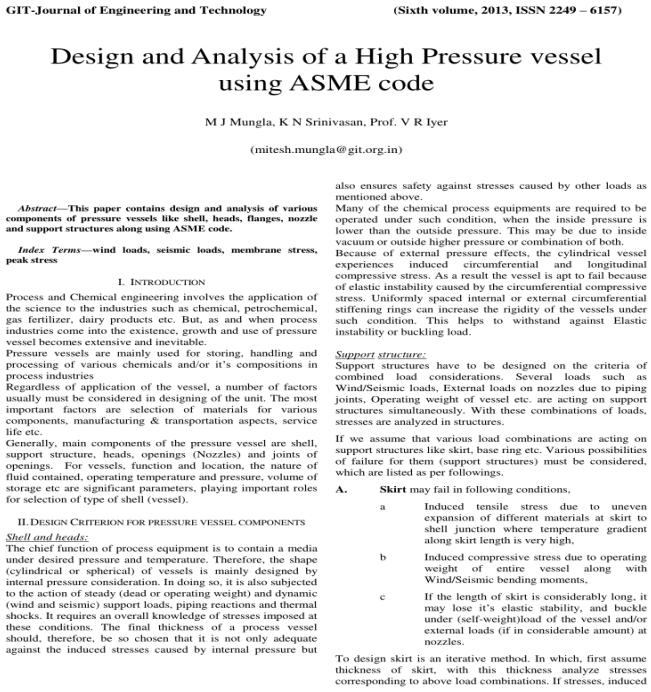
Scientific And Engineering Aspects Of Nondestructive Evaluation: Presented At The 1993 Pressure Vess



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Design and Analysis of a High Pressure vessel using ASME code

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Abstract—**This paper contains design and analysis of various components of pressure vessels like shell, heads, flanges, nozzle and support structures along using ASME code.**

Index Terms—**wind loads, seismic loads, membrane stress, peak stress**

I. Introduction

Process and Chemical engineering involves the application of the science to the industries such as chemical, petrochemical, gas fertilizer, dairy products etc. But, as and when process industries come into the existence, growth and use of pressure vessel becomes extensive and inevitable.

Pressure vessels are mainly used for storing, handling and processing of various chemicals and/or it's compositions in process industries

Regardless of application of the vessel, a number of factors usually must be considered in designing of the unit. The most important factors are selection of materials for various components, manufacturing & transportation aspects, service life etc.

Generally, main components of the pressure vessel are shell, support structure, heads, openings (Nozzles) and joints of openings. For vessels, function and location, the nature of fluid contained, operating temperature and pressure, volume of storage etc are significant parameters, playing important roles for selection of type of shell (vessel).

II. Design Criterion for pressure vessel components

Shell and heads:

The chief function of process equipment is to contain a media under desired pressure and temperature. Therefore, the shape (cylindrical or spherical) of vessels is mainly designed by internal pressure consideration. In doing so, it is also subjected to the action of steady (dead or operating weight) and dynamic (wind and seismic) support loads, piping reactions and thermal shocks. It requires an overall knowledge of stresses imposed at these conditions. The final thickness of a process vessel should, therefore, be so chosen that it is not only adequate against the induced stresses caused by internal pressure but also ensures safety against stresses caused by other loads as mentioned above.

Many of the chemical process equipments are required to be operated under such condition, when the inside pressure is lower than the outside pressure. This may be due to inside vacuum or outside higher pressure or combination of both.

Because of external pressure effects, the cylindrical vessel experiences induced circumferential and longitudinal compressive stress. As a result the vessel is apt to fail because of elastic instability caused by the circumferential compressive stress. Uniformly spaced internal or external circumferential stiffening rings can increase the rigidity of the vessels under such condition. This helps to withstand against Elastic instability or buckling load.

Support structure:

Support structures have to be designed on the criteria of combined load considerations. Several loads such as Wind/Seismic loads, External loads on nozzles due to piping joints, Operating weight of vessel etc. are acting on support structures simultaneously. With these combinations of loads, stresses are analyzed in structures.

If we assume that various load combinations are acting on support structures like skirt, base ring etc. Various possibilities of failure for them (support structures) must be considered, which are listed as per followings.

A. Skirt may fail in following conditions,

a Induced tensile stress due to uneven expansion of different materials at skirt to shell junction where temperature gradient along skirt length is very high,

b Induced compressive stress due to operating weight of entire vessel along with Wind/Seismic bending moments,

c If the length of skirt is considerably long, it may lose it's elastic stability, and buckle under (self-weight)load of the vessel and/or external loads (if in considerable amount) at nozzles.

To design skirt is an iterative method. In which, first assume thickness of skirt, with this thickness analyze stresses corresponding to above load combinations. If stresses, induced

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Critical Assessment (ECA) so This is one aspect which can be overlooked with inevitable.vessels under pressure, or the verification of design, construction and test on . j) acceptance of no-destructive testing (NDT); k) witnessing and.The Nondestructive testing science is a broad field that covers variety of testing . behavior, presenting regions of False Positive and False Negative. . General aspects of PoD curves modeled through experimental data . defect detection by method of ultrasound in the walls of pressure vessels of up to mm in.1Department of Nuclear Engineering, Faculty of Chemical and Energy Common aspects of these failures are crack advances in metallurgy, welding technology and non-destructive testing helped, but an actual understanding of the science and mechanics of pressure vessel failure did not finally .. 1 ():