International Journal of Advanced Technology in Engineering and Science
Vol. No.4, Issue No. 07, July 2016
www.ijates.com
ijates
ISSN 2348 - 7550

MODELING AND ANALYSIS OF MULTILAYER HIGH PRESSURE VESSELS

[1]Yeddula Suvarna , [2]B. Ravisekhar

[1]Pursuing M.Tech, [2]Assistant Professor, Vignanabharati Institute of Technology,

Vidyanagar, Proddatur Y.S.R District.AP, (INDIA)

ABSTRACT

The limitations of single wall cylindrical formed metallic vessels for confining huge volumes of high internal pressures has been perceived in process industries like chemical and petroleum industries. In procedure engineering as the pressure of the working fluid extends, increment in the thickness of the vessel wanted to hold that fluid is an automatic decision. The expansion in the thickness past a specific point has fabrication challenges and in addition demands more grounded material for the vessel development. Multilayer Pressure Vessels have extend the art of pressure vessel advancement and gave the processer designer a solid piece of equipment important in a broad assortment of working conditions for the issues made by the capacity of hydrogen and hydrogenation forms.

In this Project "MODELING AND ANALYSIS OF MULTILAYER HIGH PRESSURE VESSELS" components of multilayered high pressure vessels, their advantages over mono block vessel are analyzed. The analysis is finished by considering the E glass epoxy and S2 glass Epoxy materials in the multilayer pressure vessel. The Multilayer pressure vessel is analyzed in ANSYS, an adaptable Finite Element Package for stresses made in them. The conclusions are drawn from the multilayer pressure vessel by comparing ANSYS values of above two materials.

I. INTRODUCTION

The pressure vessels are same as that of the containers or reservoirs which incorporates big amount of inner and external pressures. The garage of fluids underneath high pressures is carried out in pressure vessel. The liquid being put away might also revel in a trade of state inside the pressure vessels as if there must improve an prevalence of steam boilers or it can merge with unique reagents as in chemical plants. Pressure vessels have huge programs in thermal and atomic energy plant life, chemical and process industries, in sea depths and space, and in water, steam, fuel and air supply in industries. The fabric of a stress vessel may be vulnerable, for instance, forged iron, or malleable, for instance, mild steel.

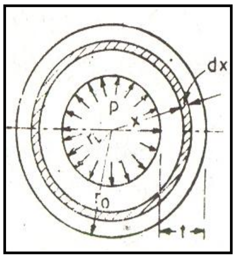
The weight vessels are same as that of the compartments or stores which contains huge measure of inner and outside weights. The capacity of liquids under high weights is done in Pressure vessel. The fluid being secured may encounter a change of state inside the weight vessels as though there ought to raise an event of steam boilers or it might converge with various reagents as in concoction plants. Weight vessels have wide applications in warm and nuclear force plants, substance and procedure commercial ventures, in ocean profundities and space, and in water, steam, gas and air supply in businesses. The material of a weight vessel might be powerless, for instance, cast iron, or flexible, for instance, gentle steel.

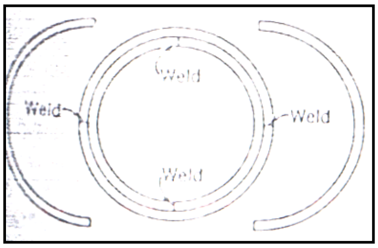
II. HIGH PRESSURE VESSELS:

They are vessel with a fundamental base and a removable top head, and are by and large furnished with an inlet, heating and cooling system an agitator system. High Pressure vessels are utilized for a pressure limit of 15 N/mm2 to a biggest of 300 N/mm2. These are basically thick cylinder vessels and hollow vessels, going in size from small tubes to a few meter diameters. Both the measure of the pressure and vessel included will deal with the kind of development used.

Methods for constructing high-pressure vessels.

1. To build a solid wall vessel from a strong bar of metal forging and boring process are utilized.
2. By bowing a metal sheet with longitudinal weld a cylinder is formed.
3. Shrink fit advancement, the vessel is produced from two or more concentric shells, each shell continuously contracted on from inside outward. From financial and fabrication contemplations, the amount of shells should be limited to two.
4. By wire twisting around a focal cylinder a vessel is fabricated. Under pressure around cylinder a 6 to 10mm thick wire is wound.
5. A vessel made by wrapping a movement of sheets of modestly thin metal solidly cycle one another over a center tube, and holding each sheet with a longitudinal weld. Rings are embedded in the terminations to hold the interior shell round while ensuing layers are fused. The liner cylinder is by up to12 mm thick, while the subsequent layers are up to 6 mm thick.





(a) Solid Wall Vessel **(b) Multi Layered Cylindrical Vessel**

Fig.1 Types of High Pressure Vessels

LITERATURE SURVEY

III. MULTI - LAYER PRESSURE VESSEL FOR HIGH PRESSURE SERVICE:

The significance of a very much designed vessel, made with caution review and quality control methods, stay as the crucial factor for acquiring a sheltered, sparing, and serviceable unit.

As ahead of schedule as 1890 Mr. Carl Schaeffer of Oberhausen, Germany, got a U.S. patent covering the multiple layer development for “riveted” boilers and so forth vessels. The patent is required for the perpetually expanding pressure of steam required for steam boilers, the harm granted to thick sheet iron amid shaping and the disproportional cost of the thick plates. Be that it may from the early investigations, the patent was provoked by the present restrictions of the solid wall developments and was never generally acknowledged.

In any case, with approach of welding and the expansion requirement for high-pressure vessels, designers in the 1930's started to create vessel concepts, which utilized various layers of material for the vessel wall. Since that time a huge number of numerous wall vessels have been put into administration, both here and abroad, with a magnificent record of execution. There are various multilayer vessel ideas accessible to the user today. The wicker sort vessel, created in Germany, utilizes a creased metal tape or strip winding injury around an core cylinder. Winding depressions to coordinate the grooves of the tape are initially machined into the external surface of the inner cylinder. At that time, layer at once, until the full wall thickness is come to.

Each succeeding layer mechanically locks the hidden layers together through the lattice of creases in the tape or ribbon. In this manner, the vessel stresses are borne by the ribbon acting in tension and the longitudinal stress are taken by the ribbon acting in shear over the foldings. A couple of these vessels have been foreign made from the states. In Japan, another layer vessel idea has been produced wherein individual vessel "cans" or cylinder are fabricated by cooling a consistent material of the light gage material around an inner cylinder until the correct divider thickness is reached. The individual cans are then welded together to finish the vessel shell**.**

IV. ELEMENTS TAKEN INTO CONSIDERATION FOR HIGH PRESSUREVESSELS LAYOUT:

In chemical technique industries the high pressure utilization open up some other discipline to designers. This noticeably new procedure began in the commercial synthesis of ammonia salts from its elements and with the technique for the cracking of oil.

High pressure vessels currently reached out as much as 350 MPa.

For designing high pressure vessels essential factors to be taken into consideration are:

- **B**arriers in dimensions like length and Diameter.
- Pressure and temperature like working situations.
- Physical properties and cost of the available substances.
- Reactants and products corrosive nature.
- Failure theories.
- Forging, welding or casting relying on type of creation.
- Fabrication strategies.
- Fatigue, Brittle failure and Creep.
- Cost-effective considerations.

Different codes representing the strategies for the design, fabrication, inspection, trying out and operation of vessels were produced, really as a protection degree. These techniques outfit gauges with the aid of which any state can be assured or the well being of presser vessels added inside of its limits. The particulars in those codes were to start with based upon the details produced for steam boilers. Section VIII of ASME Boiler and pressure Vessel Code, 1956 is the code applied for unfired pressure vessels.

V. DESIGN OF MULTILAYER HIGH PRESSURE VESSEL

Multi layer vessels are developed by wrapping a progression of sheets over a main tube. The development includes the utilization of a few layers of material, normally with the purpose of quality control and optimum properties. Multi layer development is utilized for higher pressures. It gives inbuilt safety, uses material economically, no stress relief is required. For corrosive applications the inward liner is made of extraordinary material and is not considered for strength criteria. The outer load bearing shells can be made of high tensile low carbon alloys. Multi layer vessels are built up by wrapping a series of sheets over a core tube.
Multi layer vessels are evolved through wrapping a development of sheets over a main tube. The development includes the usage of a few layers of material, generally with the reason of satisfactory manage and top-quality residences. Multi layer improvement is utilized for higher pressures. It offers in-built protection, uses material economically, no strain relief is required. For corrosive packages the inward liner is product of extraordinary fabric and is not considered for strength criteria. The outer load bearing shells may be made from high tensile low carbon alloys. Multi layer vessels are constructed up by way of wrapping a series of sheets over a center tube.

VI. INTRODUCTION TO S 2 GLASS

High-quality glass, carbon or different propelled filaments are applied as part of utilizations requiring extra distinguished quality and lower weight. S-type glass is for the most component high quality glass inside the united states, R-glass in Europe and T-glass in Japan. In Sixties for army applications S-glass have been produced, and for business applications a lower cost adaptation, S-2 glass became created.
High-quality glass has reputedly higher measures of silica oxide, aluminum oxide and magnesium oxide than E-glass. S-2 glass is round 40-70% more grounded than E-glass.

VII. FINITE ELEMENT ANALYSIS

FEA is the purposeful usage of the finite element method (FEM), that is utilized by architects, and scientists to scientifically version and numerically apprehend extremely complex structural, liquid, and multiphase troubles.

ijates
ISSN 2348 - 7550

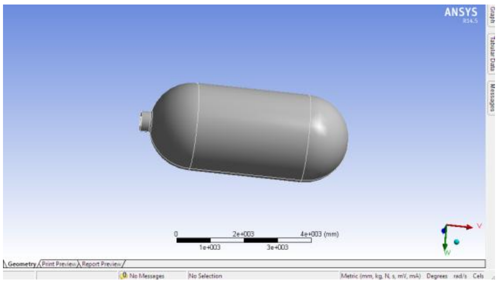
FEA programming may be utilized in enormous variety of groups, yet is most usually applied as part of the aeronautical, biomechanical and locomotive industries.

A finite element (FE) model consists of an association of points, known as “nodes”, which frame the state of the design. Joined with these nodes are the finite elements themselves which frame the finite element mesh and comprise the material and basic properties of the model, characterizing response of it in specific conditions. The density of the finite element mesh may differ all through the material, contingent upon the foreseen trade in stress levels of a specific part. Areas that experience in high adjustments in stress for the most part require a higher mesh density than people who experience little or no stress variant. Purposes of interest may also contain crack functions of beforehand tried material, fillets, corners, complex point of intersect, and high-stress regions.

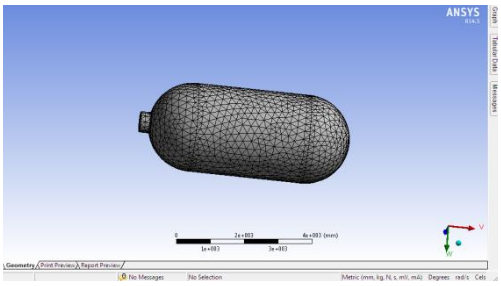
In synthetic procedure commercial ventures the high weight usage opened up another field to creators. This generally new method began in the modern combination of smelling salts from its components and with the methodology for the breaking of oil.

Structural Analysis of Pressure vessel:

Model of pressure vessel:

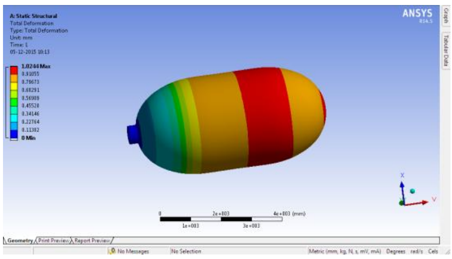


Meshed model:



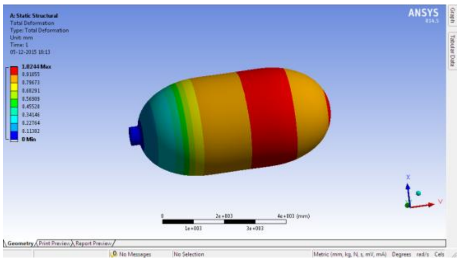
Material type: Steel

Total Deformation



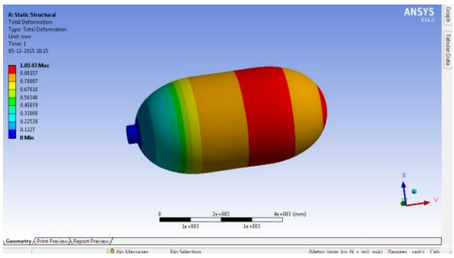
Equivalent Stress:

International Journal of Advanced Technology in Engineering and Science
Vol. No.4, Issue No. 07, July 2016
www.ijates.com
ijates
ISSN 2348 - 7550

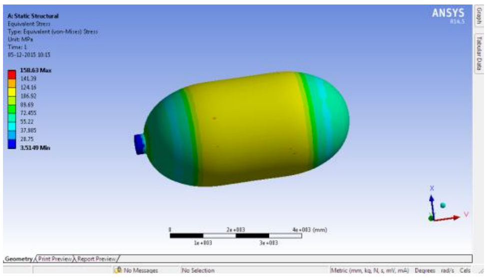


Material type: Liner material

Total deformation:

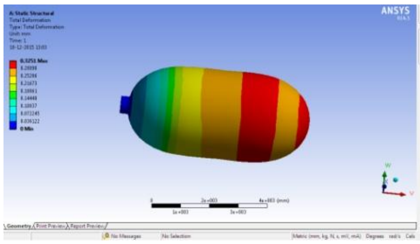


Equivalent stress:

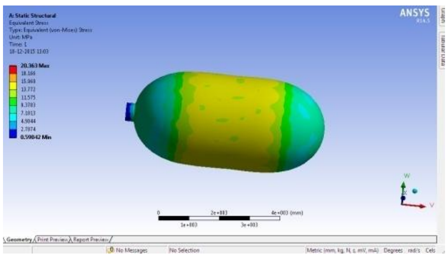


Material type: S2 Epoxy

Total Deformation:

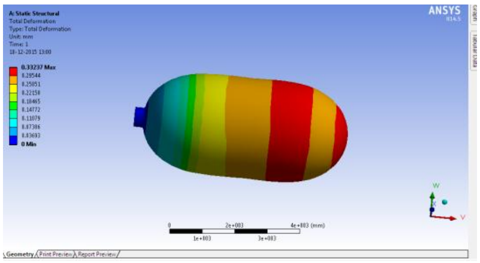


Equivalent stress:

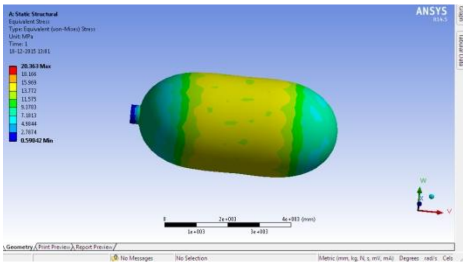


Material type: E Glass

Total Deformation:



Equivalent stress:



VIII. RESULTS AND DISCUSSION

SINGLE LAYER			MULTI LAYER		
	DISP (mm)	**STRESS (N/mm^2)**		**DISP (mm)**	**STRESS (N/mm^2)**
STEEL	0.738338	144.38	**STEEL**	2.784	169.062
			S2 GLASS	0.3251	20.43
			E GLASS	0.33237	20.363

IX. CONCLUSION

Solid wall pressure vessels are extensively used now-a-days. The huge difference of weight is observed by introducing the multi layered vessels. Here S2 Glass epoxy and E Glass epoxy are the materials used for analysis of multilayer pressure vessels.

The usage of multilayer pressure vessel decreases the weight as well as the material cost required to manufacture. Decreasing the weight and also cost is the main aspect of the designer. Multi layered vessels are compared to solid vessels with respect to the stresses developed. The most important aspect of the designer is to minimize the stress concentration developed. The effective usage of material during the fabrication is also observed.

By observing, the vessels are favored to work under conditions of high temperature and high pressures. The usage of multilayer pressure vessels is having more advantages than single wall pressure vessels.

By using composite material S2 Glass epoxy and E Glass epoxy in place of steel, decreases the overall weight of multilayered vessels. And also by analysis it is proved that using E glass Epoxy andS2 glass epoxy is also safe since the analyzed stress value is less.

REFERENCES

[1]. BHPV manual on Multilayer Pressure Vessels.
[2]. Brownell and Young, “Process Equipment Design” Seely, F.B., and Smith,

[3]. John F.Henvey " Pressure Vessel Design -Nuclear and Chemical Applications" An East-west Edition, Newyork

[4]. Henry H.Bednar " Pressure Vessel Code Book"

[5]. Fratcher, G.E : New alloys for Multilayer Vessels" Vol 33

[6]. Harold.H.Wait e, "Pressure Vessel and Piping Design Analysis"

[7]. Mc Cabe, J.S and Rothrock, E.W., " Multilayer Vessels for High Pressure," ASME Mechanical Engineering PP 34-39.

AUTHOR DETAILS

1.Yeddula suvarna, pursuing M.Tech from Vignanabharati institute of technology, Vidyanagar, Proddatur Y.S.R District.AP, INDIA

2.Ravisekhar, working as Assistant Professor from Vignanabharati institute of technology, Vidyanagar, Proddatur Y.S.R District.AP, INDIA