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DESIGN, DEVELOPMENT AND ANALYSIS OF WAX MELTING TANK

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ABSTRACT
Now a day the one of the main serious problem in process industry is there will be the leakage at the welded joint during continuous working in industry. During the continuous working/melting large amount of thermal stresses are developed at the joint and after some period it will get fail. This work related with Design and Development along with Analysis of Wax Melting Tank. In this work our aim is that to avoid the leakages which are take place at joint. For this purpose we referred the three method out of that we Select one method i.e. by selecting the material which has high strength of material and doing the design (by client or customer along its application) of tank and find out the different stresses developed in the tank .At the same time in this study we try to perform the seamless welding. Seamless welding will be a technology in which we try to obtained excellent performance along with improved considerable part accuracy, also finish with appearance, to shorten the manufacturing cycle of the tank and increase to withstand a tank to withstand with better pressure and increase the life of melting tank. All this analysis will perform by using a CFD/ANSYS Software along with we try to prepare the mathematical model for the same procedure.

KEYWORDS: Pressure Vessel, Seamless Welding, Wall Thickness and stresses.

INTRODUCTION
Melt Wax Fast & Save Time with the Fastest, Even Heating, Energy Efficient Wax Melting Tanks! PWs (Professional Water Jacketed Melting Tanks and Water Jacketed Melters) are the original thermostatically controlled double boiler style melting tank for melting waxes. Pressure vessels/Tank are the containers or pipelines used for storing, receiving or carrying the fluids under pressure and here the fluid is wax(pulp). In Another way, a pressure vessel is a closed container designed to hold gases or liquids at a pressure substantially different from the ambient pressure. The fluid stored may remain as it is, as in case of storage vessels or may undergo a change of state while inside the pressure vessel, as in case of steam boilers or it may combine with other reagents, as in case of chemical processing vessels. Most processing equipment units may be considered to be pressure vessels with various modifications necessary to enable the units to perform required functions. The pressure vessels are designed with great care because the failure of the vessel in service may cause loss of life and property. The material of the pressure vessel may be brittle such as cast iron or ductile such as plain carbon steel and alloy steel. Several types of equipment which are used in the chemical industry have an Unfired Pressure Vessel as a basic component. Such units are Storage Vessels, Kettles, Distillation Columns, Heat Exchangers, Evaporators and Autoclaves. In the industrial sector, pressure vessels are designed to operate safely at a specific pressure and temperature technically referred to as the "Design Pressure" and "Design Temperature". A vessel that is inadequately designed to handle a high pressure constitutes a very significant safety hazard. Because of that, the design and certification of pressure vessels is governed by design codes such as the ASME Boiler and Pressure Vessel Code in North America, the Pressure Equipment Directive of the EU (PED), Japanese Industrial Standard (JIS), CSA B51 in Canada, AS1210 in Australia and other international standards like Lloyd's, Germanischer Lloyd, Det Norske Veritas, Stoomwezen etc. Pressure vessels can theoretically be almost any shape, but shapes made of sections of spheres, cylinders and cones are usually employed. More complicated shapes have historically been much harder to analyze for safe operation and are usually far harder to construct. Theoretically a sphere would be the optimal shape of a pressure vessel. Unfortunately the sphere shape is difficult to manufacture, therefore more expensive, so most of the pressure vessels are cylindrical shape with 2:1 semi elliptical heads or end caps on each end. Smaller pressure vessels are arranged from a pipe and two covers. Disadvantage of these vessels is the fact that larger diameters make them relatively more expensive, so that for example the most economic shape of

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a 1,000 liters (35 cu ft), 250 bars (3,600 psi) pressure vessel might be a diameter of 914.4 millimeters (36 in) and a length of 1,701.8 millimeters (67 in) including the 2:1 semi elliptical domed end caps. Many pressure vessels are made of steel. To manufacture a spherical pressure vessel, forged parts would have to be welded together. Some mechanical properties of steel are increased by forging, but welding can sometimes reduce these desirable properties. In case of welding, in order to make the pressure vessel meet international safety standards, carefully selected steel with a high impact resistance & corrosion resistant material should also be used. Two types of analysis are commonly applied to pressure vessels. The most Common method is based on a simple mechanics approach and is applicable to "thin wall" Pressure vessels which by definition have a ratio of inner radius r to wall thickness t of $r/t \geq 10$. The second method is based on elasticity solution and is always applicable regardless the r/t ratio and can be referred to as the solution for "thick wall" pressure vessels. Both types of analysis are discussed here, although for most engineering applications, the thin wall pressure vessel can be used.

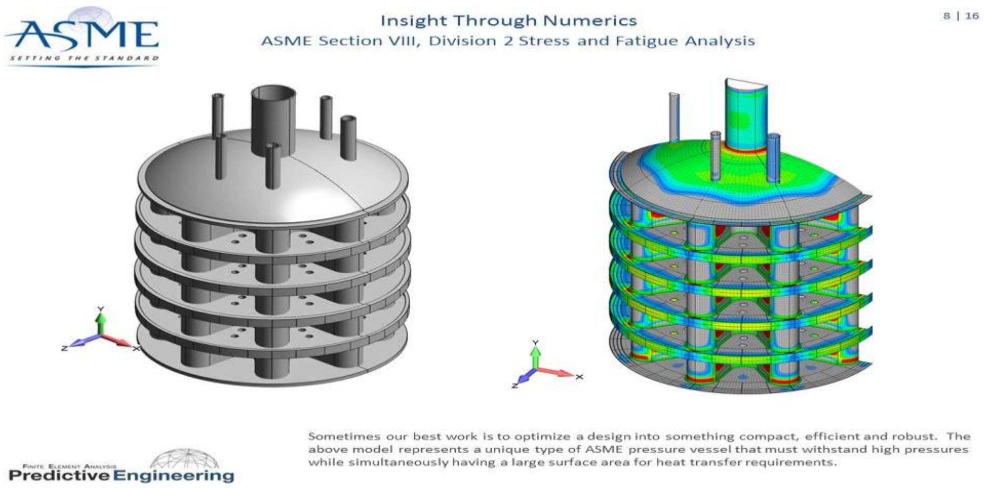
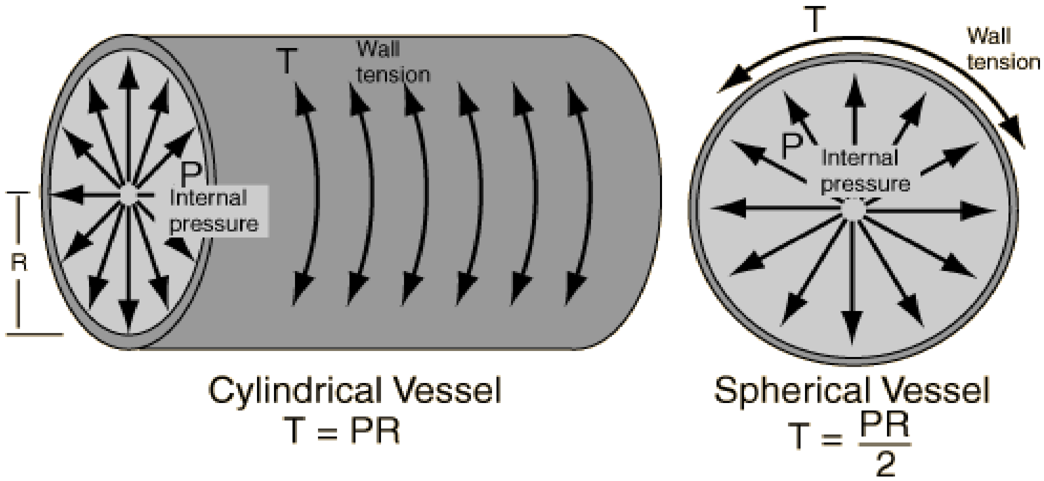


Fig. 1.1. Optimization of thermal stresses

Many times existence of any temperature gradient across a wall of the thick-walled vessel induces a thermal stress. Often, thermal stresses are greater than those generated by application of internal or external pressure. If we considered an economical point view, the thermo elasto-plastic method is used for design of such vessels. Detailed analyses of thermal stress in spherical and cylindrical vessels in the elastic range shows nature of thick-walled spherical and cylindrical vessels under thermal and mechanical stresses is considered. The exact solution for the stress distribution in a thick-walled sphere made of elastic-perfectly plastic material and under a steady state, radial temperature gradient. And approximate solution with negligible elastic strain is also examined; the approximate and exact solutions yield the same results as the temperature gradient approaches infinity. The onset of yield in thick-walled spherical vessels for a various combinations of temperature and pressure along with various radius ratio. Elasto-plastic thermal stresses in a spherical vessel under a temperature gradient across the wall thickness are studied.

In the study of optimization, for the thermal stress analysis, the temperature of the external surface of the vessel is held constant, at the same time, the temperature of its internal surface is increased and the resultant stresses are achieved. By doing study of some reported works in this field, by considering a maximum plastic radius and with the help of concept of thermal auto frottage for the strengthening mechanism, the analysis of thick-walled spheres with no convective heat transfer to the ambient is presented. Modeling and closed form solutions for stress distributions in the elastic part, due to combined pressure and temperature gradient, thermal loading and unloading and design curves are covered in Sections 2.1–2.5. However, in practice convective heat transfer occurs between the external surface of the vessel and the surroundings. This means that any changes in the temperature of the internal surface will change the temperature of the external surface. This change, in turn is a function of the internal temperature, the size of the external surface, the mechanical properties of the vessel's material, and the properties of the fluid, which is in contact with the external surface of the vessel. In the pressure vessel the optimization of nozzle and heads also conducted independently. Although this is a practical and widely used approach, it leads to undesirable problems such as thickness variation from nozzle to head (among others) and, as a consequence, reduces the optimality of the final result (which may also be influenced by the adopted boundary conditions.



1.2. Forces acted in cylindrical Spherical Vessel

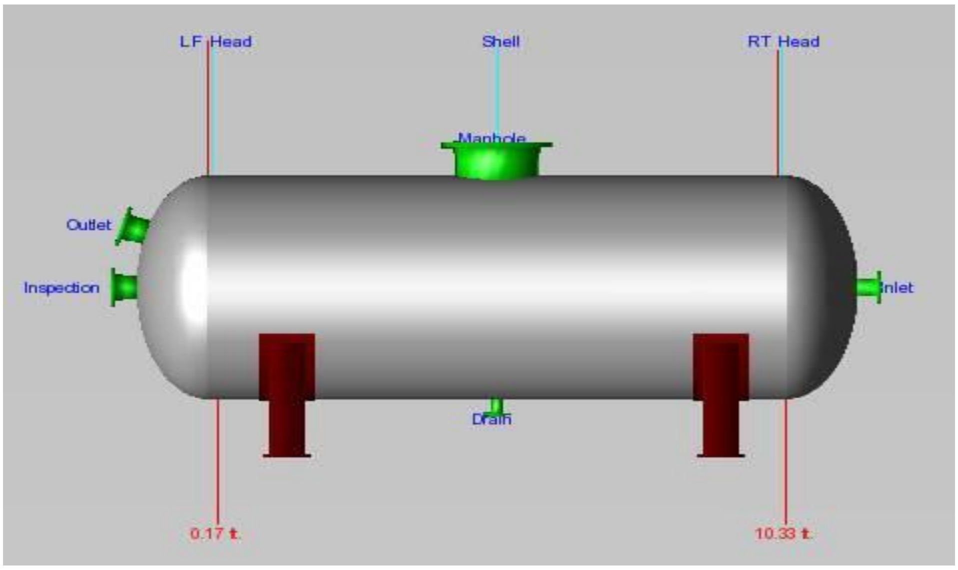


Fig. 1.3 Pressure Vessel

Thus, for that optimization of pressure vessels considering a model of the entire vessel. A multi-objective function based on the terms of von-Mises stress values is defined in order to minimize the tank maximum von-Mises stresses. Mechanical and thermal loads are considered. Shape optimization techniques are applied, and the design optimization procedure is implemented by combining the commercial finite element analysis system ANSYS along with MAT-LAB optimization algorithm. Along with them composite tank have a strength /weight ratio higher than steel tank, they have a higher manufacturing cost. This work emphasizes homogeneous tank, and focuses on CNG (Compressed Natural Gas) tank design by means of the optimization techniques. The formulation and numerical implementation of the optimization problem for the pressure vessel is described

MATERIALS AND METHODS

Selection of material

The aim of designing is to withstand the material (wax tank) under high pressure with high thermal stress. Fast, Safe Wax Melting: Melting tanks are designed to melt our waxes fast, evenly and safely using precise temperature controls and prevent damaging our wax with hot spots, fires, or burning. Only For Melting

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Wax**:** Unlike other meters/conventional tank which work with "rough""inexact" materials like tar and adhesives, our wax melting tanks are designed only to melt wax fast and safely.Exclusive inner surface which is polished, non-reactive, non-porous and corrosion resistant for better quality wax melting without cross contamination and easy clean up. But important point will be People melting glue or asphalt don't care about color and scent changes or burning wax with uneven heat. Melts All Waxes**:** Our Professional Candle Wax melting tanks and pots are specifically designed for fast, safe and reliable melting of organic and inorganic, refined and semi-refined, petroleum, animal, vegetable and synthetic based waxes and oils, including Paraffin Wax, Soy Wax, Vegetable Wax, Palm Wax, Beeswax and more. Our wax melting tanks melt and heat waxes and oils, from wickless flameless wax (melting point of 90ºF), to organic waxes like soy (mp 120º-125ºF) to beeswax (mp 155º-170ºF) and up to paraffin, palm oil and gels (mp 170º-212ºF).So our material will be Stainless Steel Lid i.e. 100% US Steel, High Grade Construction without rusting, chipping, or flaking
Material -Stainless Steel - Grade 304 (UNS S30400).

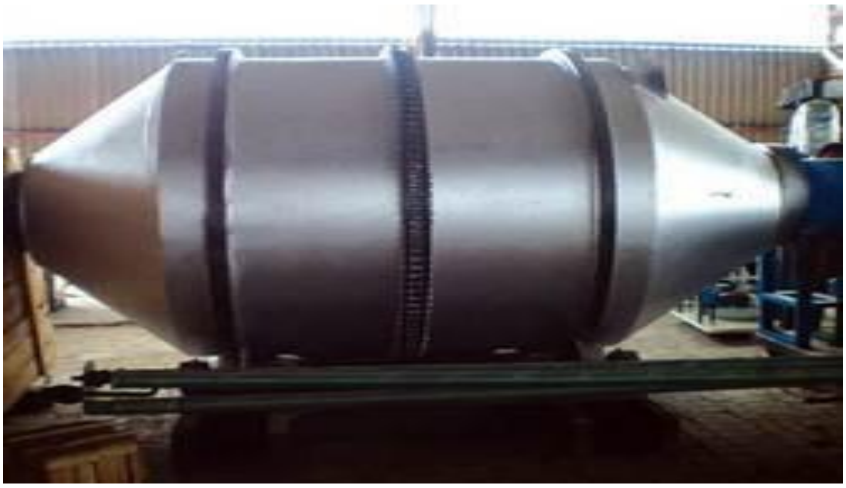

Fig. 1.4 wax tank

CALCULATION AND DISCUSSION

Formulae:
Cylindrical Shell Thickness

$$t = 2.7 \text{ mm}$$

Internal Design Pressure (Pi) = 4.92 Kg/ cm^2 = 0.483 MPa
Shell Inside Diameter (Un Corroded) = 990.00 mm
Inside Radius (Corroded) (R) = R+ CA = 495.000 + 0.000 = 495.00 mm
Provided Thickness (Nominal) = 5.00 mm
Joint Efficiency Factor= 0.385SE = 0.385 * 80 * 1 = 30.80 MPa
Minimum Required Thickness=t = 3.7 mm
Governing thickness + Corrosion Allowance = 3.70 + 0.00 = 3.70 mm
Hemce**:** Required Thickness= 3.139 mm< 5.000 mm (Provided) Thickness is Optimum.

CONCLUSION

From this study we can conclude that with the help of this method we are easily avoid the leakages problems at the joints during wax melting processes in industry. Also we are able to optimize the cost and increase the life of the tank.

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