A Review on Design, Stress and CFD Analysis of Feed Water Storage Tank Heating System

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ABSTRACT - The feed water storage tanks are containers used to handle fluids which are highly toxic, compressible and which work at high pressures.A pressure vessel is a container designed to hold gases or liquids at apressure substantially different from the ambient pressure.Pressure vessels can be dangerous, and fatal accidents have occurred in the history of their development and operation.Design involves parameters such as maximum safe operating pressure and temperature,safety factor, corrosion allowance and minimum design temperature.This paper contains work done in design,analysis & CFD analysis of pressure vessels to reduce failures in the pressure vessels and study of the parameters such as material selection,operating pressure, temperature,design,analysis etc.The future scope and advancements in pressure vessel design with softwares is also discussed in this review.

Keyword: Design,Feed Water Tank,stress analysis, CFD REFERENCES

1. INTRODUCTION

A pressure vessel is a container having a pressure differential with respect to the atmosphere.The purpose of a pressure vessel is to store high temperature and high pressure fluid,the fuids can be highly toxic & non toxic.They are measurely used in chemical industries ,processing plants,nuclear power plants and oil refining industries.There many aaccidents caused due to failure of pressure vessels which resulted human death and long lasting effects on the near by enviornment. The pressure vessel has to be designed according to standard ASME codes such as ASME section VIII ,division 1&2. These codes are designed by concidering factor of safety between 3-5.The design of pressure vessel is based on parameters such as pressure,temperature,corrosion,material selection etc.

2. Review of work done by earlier investigators

2.1 Review of pressure vessel design

BERGMAN[1], Vessals subjected to different connected power acting with inward and outer pressure.Applied powers act either neighborhood focuses or through the mass of the vessal particular codes outfit the planner with a rundown of aproved material and the most extreme pressure esteems in strain allowed over their usuable scope of temprature.Design runs in the codes are restricted to vessels at round and hollow or circular shape under inner or outside pressure.The paper talk about some issue of outline of tube shaped weight vessals that have thier tomahawks vertical and are subjected to connected powers notwithstanding intenal and outside pressure.The vertical powers considered are weight of the vessals and its substance and the heaviness of any power incorporates wind weight seimec power and channeling push. While outlining tank; seismic tremor range,wind load,stress increse is to considered.The greatest permissible elastic pressure esteem permited in Par UG-23 (a).windenburg and Trilling (10) have built up a diagram which gives n as a capacity t/D and L/D for weight on the sides and finishes of the weight vessel.
Dinesh Uparmar[2], describes the writing audit of a Design and approval of capacity tank utilizing the explanatory strategy according to ASME code they requried. FEA approval for creation of tank FEM is examine thbe impact of bidirectional excitation on barrel shaped tanks.first the precise of the FEM methodology was validated.Then tanks were displayed analysed.The exactness of FEM was likewise checked at last a streamlined strategy was produced for an exact basic and quicker route for the plan of steel stockpiling tank under seismic load.In some circumstance because of constrained space avilable exit funneled are made of round shape.their is a rate sparing in material of 26.02% by utilizing multilayerd

vessals in the place of strong wall.It decress the general weight at the parts as well as the cost of the material.

Thakkar et all[3], in this paper the creator attempted endeavors to outline the weight vessel utilizing ASME codes and principles to authorize the plan. The structure is to be outlined, created, fitted and checked according to ASME standard. Plant security and respectability are of central worry in weight vessel outline and these obviously rely upon the ampleness of configuration codes. Consequently the paper reasons that the outline of a weight vessel is to a greater extent a choice strategy, determination of its segments to be more exact rather planning every single part. The weight vessel segments are simply chosen, yet the choice is exceptionally basic, a slight change in determination will prompt an alternate weight vessel by and large from what is intended to be outlined. It is watched that all the weight vessel segments are chosen on premise of accessible ASME gauges and the makes additionally take after the ASME benchmarks while producing the parts. With the goal that leaves the fashioner free from outlining the segments. This part of Design extraordinarily decreases the Development Time for another weight vessel.

2.2 Review on stress analysis

Apurva R. Pendbhaje,et all[4], in this paper creator presents plan, and investigation of pres-beyond any doubt vessel. Endeavors are made in this paper to outline the weight vessel utilizing ASME codes and guidelines to sanction the plan. To plan of weight vessel the choice of Code are imperative as a source of perspective manual for accomplish the wellbeing weight vessel. The choices of ASME VIII div 2 are depicted. The standard of material utilize are clarified. For this plan, ASME VIII (division 2) "Development of Pressure vessel Codes" are chosen. The determination of material is base on the fittingness of the plan prerequisite. It is watched that all the weight vessel segments are chosen on premise of accessible ASME benchmarks and the makes likewise take after the ASME gauges while fabricating the parts. So leaves the planner free from outlining the parts. This part of Design significantly lessens the Development Time for another weight vessel.

Viraj H. Barge[5], in this paper creator goes for plan and examination of the proposed model of vertical reactant section to discover pressure and avoidance in its different segments utilizing FEA and afterward upgrading the thickness of vertical reactant segment. In this way the displaying is done in CATIA programming and investigation done in ANSYS 12.0 programming. From investigation we can see that relatively low pressure instigated on internal reactant segment. Most extreme von-misses pressure is found at top bit of internal reactant. In this way the auxiliary improvement for parts of reactant is accomplished as thickness.Devaraju[6], It states that,where the weight vessel in operation,it is subjected to various weight which prompt pressure. It is expected to intrenal weight and liquid weight.The weight vessel brought to withstand all sort of burdens, for example, wind loads inside weight vessel ought to be watched while designin the importants methods for perusing the heaviness of shell structure. The utilization of composite material enhance the execution of the vessel and furthermore help to decrease the weight and cost.

Mohammad Qazam Naser[7], the point of the venture is to plan a weight vessel whose deal propse it to withstand the weight of the substance strored in it. The weight vessekl is broke down for the thremal loads. Weight stacks and joined weight and also warm loads, additionally broke down for prompted worry to demonstrate that the created pressure and temprature are inside the controlled qualities. The weight vessels are composed according to ASME code area VIII, Division 1.Pressure vessel is a contunies used to contains things at more than higer weight this implies they can withstand more noteworthy than typical measure of weight without bursting.The weight vessel is outlined in light of thin cylidricals aproch on the grounds that width to thickness 15>20mm.The thin chamber can withstand inner weight and warm loads. The components of wellbeing of the weight vessel is I.S for consolidated impact of warm and weight load.If factor of security is 2 strically required,we should increse the thickness by in view of number of outline.

Murugan et all [8],this paper subjected to thermo-investigation of high weight cryogenic tank (fluid hydrogen tank) is introduced. The limited component examination of hydrogen tank performed in ANSYS programming. Temperature conveyance of the tank and size are gotten in investigation and utilized for estimation of transient warmth exchange , prompted warm pressure, basic pressure, mutilation in material because of chill-down and pressurization. With a specific end goal to evade warm split, chill-down at

controlled rate of cooling confining temperature distinction over the tank tallness is kept up. Consequently the investigation demonstrates that the pressure created is an inside passable cutoff points for the material at cryogenic temperature.

2.3 Review on CFD analysis

Lingkai Kong [9], this paper presents recreation of warm stratification warm capacity water tank with an inside barrel with openings by three dimensional Computational Fluid Dynamics (CFD) strategies. In particular, this paper centers both around researching the impact of the internal barrel's plan and working parameters and on the water stream trademark, warm stratification and general execution of the hot warmth stockpiling water tank amid warm charging activity process introduced in warm vitality frameworks. The aftereffects of the CFX after the start of the charging procedure. Dabbed lines A show the consequence of tank without an inside barrel with openings. Strong lines B show the aftereffect of tank with an inside barrel with openings. The dimensionless liquid temperature unmistakably demonstrates the water temperature changes with time, and shows the general pattern of the thermocline in the warm stratification warm capacity water tank with an inside chamber with openings. The high temp water streams into the tank and trades warm with the frosty water. Along these lines, the thermocline shows up. At that point as time changes, the thermocline thickness expands, which is caused by warm exchange.

Fan and Furbo[10], this paper speaks to the examination on of trial and numerical consequences of warm stratification and normal convection in the verticle round and hollow high temp water tank amid remain by periods.The transient warmth stream and warmth move in the tank amid cooling caused by warm misfortune are researched by CFD calcultions and by warm estimations. The exploratory outcome demonstrate's that on account of warmth misfortune from the tank the fluoid near the tank divider has a lower temperature than the liquid at the focal point of the tank the colder liquid near the tank move down along the divider and the liquid with higher temperature move upward to larger amount.

Hyung Seok Kang and Chul Hwa Song[11], "CFD examination for warm blending in a sub cooled water tank under a high steam mass motion release condition".In this paper A Computational Fluid Dynamics (CFD) investigation for a warm blending in a subcooled water tank uder high stream mass motion release condition this test is performed to build up the approach for a numerical investigation of the warm blending amongst steam and subcooled water.In CFD anylsis the steam buildup wonder by an immediate contact was recreated by the supposed buildup area model.If the steam is immediate interacted with subcooled water the stem is begin condensing.The CFD investigation result demonstrates that the dense water released from the buildup display effortlessly crashes into the tank divider in a brief span since its speed is high .after impact the consolidated water moves upward along the divider and its stream heading because of gravity power and it against slam into base wall.The auxiliary stream around the buildup locale is produced because of solid force stream of the consolidated water and the entraired water.When the steam fly of a high weight and temperature is dense and blended with a subcooled pool water in the tank, warm blending marvel is mimicked with alleged the steam buildup district show for a transient instance of 30 s with CFX4.4. The affectability examination of framework and numerical models is likewise performed to discover the advanced philosophy for the warm blending investigation. The examination of CFD comes about with the test information demonstrates a decent assention inside 7– 8% esteem. This distinction may emerge from that the temperature and the speed of the figured consolidated water by embracing the buildup area demonstrate are higher than the genuine esteem. Another reason might be because of an appropriate constraint of buildup district model to embrace the region normal idea. This idea likewise disregards a three-dimensional stream includes in the tank, while the CFX count is performed by accepting the axi-symmetry to spare a calculation time.

Chrysanthos Maraveas[12], this paper tends to particular issues in regards to the examination and conduct of tube shaped self bolstered tanks under tremor stacking and all the more vitally their seismic outline, by contrasting current codes utilized as a part of training and the limited component technique (FEM). The outcomes allude to two extensive barrel shaped tanks and they demonstrate that despite the fact that the present plan strategies neglect to portray their correct conduct. Compressive anxieties computed by the two API 650 [1] and FEM examination are low and as a rule are not anticipated that would cause neighborhood clasping of the tank's shell amid quake excitation. The most extreme wave stature can be figured with

palatable exactness as per Eurocode 8[2]. In the FEM investigation malleable anxieties don't surpass the yield worry of the material anytime, fortifying the contention that present plan techniques create comes about erring on the side of caution.

3. CONCLUSION

From this literature review, it is seen that information about various factors those helps in understanding of factors affecting design, manufacturing & analysis of pressure vessels.Factors such as maximum safe operating pressure and temperature,safety factor, corrosion allowance and minimum design temperature. As per the review paper mentioned in this review, some of the investigators used latest softwares tools like PRO-E and CATIA for modeling of various pressure vessels.The design of Feed water storage tank were carried out as per ASME codes, section VIII. It is also noticed that the modeling of tank by few investigators was done in Solidworks and analysed for induced stresses using Ansys software. They compared ansys results with analytical results for induced stresses and were found whithin acceptable range. From this study, it is seen that ASME codes and other codes are providing solutions for more general cases and they require higher factor of safety. Most of the researchers had been worked on thin-pressure vessels, and there is need to work on thick pressure vessels as they are having more industrial applicationss.

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