

A STUDY ON STRESS ANALYSIS FOR DESIGN OF PRESSURE VESSEL

¹A. DEVARAJU, ²K. PAZHANIVEL

¹Principal and Professor, Department of Mechanical Engineering, Adhi College of Engineering and Technology, Kanchipuram, India

²Professor, Department of Mechanical Engineering, Thiruvalluvar College of Engineering & Technology, Vandavasi, India

E-mail: ¹adevaa2011@gmail.com.

Abstract- Pressure vessel is a leak proof vessel which has two important functions viz. (1) it should be failure free container and (2) it should separate the gas and liquid. Pressure vessels are very often in spherical, cylindrical and cylindrical shells with hemispherical end shapes. Main part of cylindrical pressure vessel is shell and head. When the pressure vessel is in operation, it is subjected to different pressures which lead to stress. It is due to internal pressure and different loads because of self weight and fluid weight. Normally, the stresses will be acted on vessel wall. If vessels could not retain its strength, wall material exceeds the maximum allowable limit which leads to failure. Therefore, it is important to understand and quantify (resolve) the stresses. The main objective of this paper is to design the standard cylindrical pressure vessel and calculate the stresses induced in the various part of the vessel by manually and compare these results with the ANSYS results.

Keywords- Pressure Vessel, ANSYS, Design Stress, Failure Criteria.

I. INTRODUCTION

Pressure vessel is an important equipments in many engineering industries like power plants, sugar mills, paper mills etc. Pressure vessels are found in different shapes such as vertical and horizontal [1]. Pressure vessels are leak proof containers. These are having wide range of applications and it is produced in several fabrication industries like steel plants in addition to the main equipment like blast furnace [2]. High pressure rise is developed in the pressure vessel and pressure vessel has to withstand severe forces. So, the design of pressure vessel is most important in mechanical engineering field. That's why we can say that pressure vessel is the heart for storage of fluid. Hence, the pressure vessel must be designed after the series of Hydrostatic tests [3]. The safety and stability of pressure vessel is determined by the ANSYS analysis [4].

The prime objective of design is to provide stability of pressure vessel. That is; the pressure vessel should withstand all kind of loads such as wind loads, internal pressure and self weight. Stability of pressure vessel is observed by placing various measuring instruments such as pressure gauge, temperature sensor, strain etc. The stability of pressure vessel should be observed while designing the vessel and also in operation. The payload performance/ speed/ operating range depends upon the weight. The pressure vessel should be designed at lower the weight and better the performance. One of the important ways of reducing the weight is by reducing the weight of the shell structure. The use of composite materials improves the performance of the vessel and also helps to reduce weight as well as material cost. The important design of thin shell pressure vessel is stress analysis [5]. The simplified

thin shell design is illustrated by Hossein. kazem and mahmood. minavand [6]. Even though few researchers have published the research work on stress analysis of pressure vessel, it is in sufficient level. Hence, in this paper, the various stress has been calculated by manually and it is compared with ANSYS result.

II. METHODOLOGY

2.1 About Ansys software

ANSYS is a analyzing software which is used for various analysis such a dynamic analysis, structural analysis, heat transfer analysis, fluid analysis etc. To analyze the pressure vessel in ANSYS software, a certain geometric shape and size (called basic-size) is required. This basic size can be taken from conventional design. The ANSYS analysis (1) provides different solution for same design (2) helps for better modification and (3) helps for better use of the available material. Whereas, in conventional design, group of human being will do and it will take long time. Moreover, it require skilled human resources and, obviously, does not guarantee for the best design solution. Alternatively, the pressure vessel designed by ANSYS software can make subsequent changes. Thereby, ANSYS analysis allows the designer to make some fine adjustments and, to identify and approach other design issues which could otherwise remain hidden or neglected. All the above clearly shows that the optimal design (by ANSYS software) is having more advantages than conventional design (by human sources).

2.2 Material Used and Its Properties

Materials selected for the Pressure Vessel are given in below Table.1. The following metals are to be used