

The Research of the Texaco Gasifier Sealing Device

Jing Chen^a and Zhiliang Zhang^b

School of Mechatronic Engineering, Southwest Petroleum University, Chengdu 610500, China

^a947890734@qq.com, ^b280238724@qq.com

Abstract

Gasifier is core equipment of the domestic water wall coal water slurry pressurized gasification device. In this paper, combined with the characteristics and main parameters of the texaco gasifier, the structure of coal water slurry water-cooling wall gasifier are reviewed, and the 5.56 mpa texaco gasifier flange seal design and its application in gasifier are analyzed emphatically.

Keywords

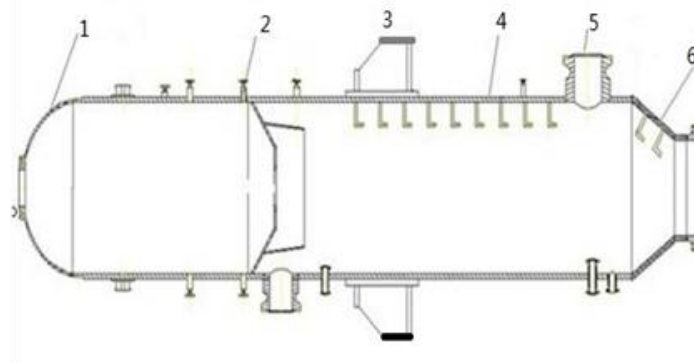
Gasifier, Structure, Seal Design, Flange.

1. Introduction

As the core equipment of the domestic water wall coal water slurry pressurized gasification device, gasifier usually runs under the condition of high temperature and high pressure. Texaco gasifier is a kind of wet feed air bed, which is firstly introduced by Shandong Lunan chemical fertilizer plant and put into production in 1993. At present, there are nearly 30 devices which have been put into operation, running well. Texaco gasifier with decades of manufacturing experience in our country is mainly conventional large pressure vessel [1]. With the continuous development and progress of the equipment, how to design Texaco gasifier more economically, reasonably and professionally, and how to improve the level of manufacturing technology and quality continuously, master the core and key technology of manufacturing, and satisfy the requirement of regulations, standards, technical conditions and design drawings, which are still major issues needed to be solved. Combined with the 5.56 MPa Texaco gasifier, this article focuses on the nominal diameter tube flange design and the design plan are put forward reasonably to raise the level of the integral flange manufacturing technology, quality and economic benefit.

2. Gasifier structure analysis

Due to the high requirements of safety and reliability for gasifier, so the reasonable design of structure is very important for the design, such as selection of structure shape and materials type of cylinder and its bearing structure design. Gasifier is mainly composed of cylinder, head and support as shown in Fig1.



1-spherical head 2- nozzle 3- support 4-barrel 5- the flange 6- the conical head

Fig .1 The structure diagram of gasifier

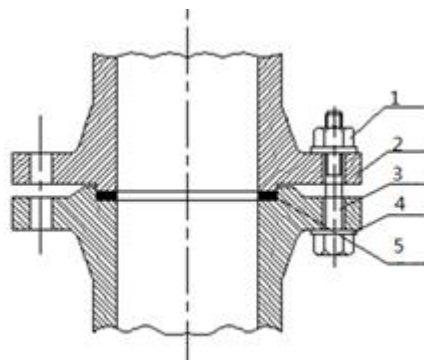
Single volume and welded structure are widely used in manufacturing cylinder. The steel plate are coiled into cylinders by large coiling machine. Then shell rings are welded by welding longitudinal weldings. Gasifier runs under high temperature conditions, which will give rise to some chemical reactions of the media in the lower head. so surfacing of corrosion resistant materials is needed on the lower head, and the corrosion layer are adopted 316 L and outer layer for SA182(15GrMo) [2]. The upper cylinder is mainly for heating chamber and the lower for cold chamber. Surfacing process is conducted on the inner wall of cylinder because of the serious corrosion inside.

The upper head is spherical structure. The surface area of spherical structure is smallest under the same volume, and the thickness of spherical structure is the thinnest under the same pressure condition. From the points of view of saving material and the intensity, spherical head is the most reasonable. The without ruffled taper sealing head is adopted in the bottom which is good for discharging of solid particles and even suspended viscous liquid[3]. In the gasifier structure design, the opening on cylinder and cylinder's tubes are inevitable, and there will be stress concentration appearing nearby the junction of nozzle and the shell of big openings in pressure vessels , so reinforcement is absolutely necessary.

3. The flange design

3.1 The work process

Flange connection is composed of a pair of flange, a number of bolts, nuts and a gasket, as shown in the following Fig 2. Placed between the flange sealing surface, the ring gasket is compressed tightly to fill the whole clearance in convex ring to reach sealing requirements under the action of bolt pre-tightening force. When the equipment and pipe work , the medium pressure have a trend to separate flange, and reduce the clamping force between the sealing surface of gasket[4]. Once the clamping force is reduced below a certain value, the seal will fail. Therefore, the bolt and nut should be tightened to an appropriate pre-tightening force before equipment and pipeline starting operation. Obviously, the pre-tightening force is related to the material and width of the gasket. Gaskets should produce some required deformations and not be crushed or extruded under the appropriate pre-tightening force. Creep relaxation of bolted flanged connections often gradually results in residual stress reduction of the gasket, and lead to the leakage failure of bolted flanged at elevated temperature. Gaskets should produce some required deformations and not be crushed or extruded under the appropriate pre-tightening force. Creep relaxation of bolted flanged connections often gradually results in residual stress reduction of the gasket, and lead to the leakage failure of bolted flanged at elevated temperature.



1-nut 2- flange 3- the bolt 4-the gasket 5- spacer
Fig.2 The schematic diagram of Flange connection

Gasket materials should have enough ability to rebound to maintain good sealing performance continuously. The gasket also need an appropriate width. The wider gasket is, the greater the pre-tightening force is and the higher the requirements of the bolt and the flange are. Compared with the metal gasket, rubber gasket and the synthetic resin gasket have disadvantages in performance of high temperature and pressure resistance, but the corrosion resistance and softness are better than the metal. So the rubber gasket and the synthetic resin gasket are suitable for equipment and pipe flange

seal under medium and low pressure and at room temperature and medium temperature. Metal gasket materials involve soft aluminum, copper, mild steel and chrome steel[5]. Metal gasket is used for the flange connection at medium and high temperature and under high pressure. In addition, there is a kind of composite gasket which is combined with the metal materials and nonmetal materials in order to improve some performance such as the heat resistance and flexibility.

3.2 The main factors affecting the properties of sealant

The bolt pre-tightening force: sufficient compression of the gasket is needed to achieve the initial sealing gasket. Improving the sealing gasket bolt pre-tightening force appropriately can increase the sealing ability of the gasket. The bolt pre-tightening force should not be too large, otherwise the gasket will overall yield and reduce the resilience and ability to recover, even the gasket will be squeezed out or crushed. Additionally, the pre-tightening force should act on the gasket as evenly as possible. Usually reducing the bolt diameter, increasing the bolts quantity and an appropriate bolt pre-tightening force are used to improve the sealing performance[6].

The performance of gasket: Gasket's role is to seal the gap between the two flange sealing surfaces and prevent leakage of fluid. It includes non-metallic gaskets, metal gaskets and composite gasket. The elastic deformation of gasket material is required to rebound under appropriate pre-tightened force and make gasket surface and flange surface contact closely. Working medium and operating temperature should also be considered before the selection of gasket materials. In addition, the width of the gasket is also a major factor to influence the seal performance. The wider gasket is, the greater the pre-tightening force is needed and the bigger size of the bolt is required. The selection of sealing surface type is closely related to operating conditions, the consequences of leakage and the properties of the gasket.

Flange stiffness: flange stiffness is related to lots of factors, increasing the thickness of the flange ring, narrowing the central circle diameter of bolt and increasing the outside diameter of the flange ring can improve the stiffness of the flange. The flexural capacity of the flange can be significantly increased by hubbed flange and increasing the cone neck part size. But raising the flange rigidity blindly will make the flange heavy and increase the costs.

Operating conditions: the physical and chemical properties of pressure, temperature and medium have a complex effect on the sealing performance. The effect of the pressure or the effect of medium on the sealing is not significant. They often work together to influence the sealing performance. Combined with high temperature, they can seriously affect the sealing performance, especially the undulant high temperature, and even make the seal complete failure due to fatigue.

3.3 The selection of flange structure

Texaco gasifier belongs to the third class pressure vessel which should adopt butt welding neck as far as possible. The selection of tube flange is fundamentally the same as the selection of pressure vessel flange. The selection of sealing surface type is closely related to operating conditions, the consequences of leakage and the properties of the gasket. The bump surfaces sealing chosen which is made up of a concave flange and a convex can be used for the occasion of flammable, explosive, toxic and higher pressure. So the bump surfaces sealing is suitable for the Texaco gasifier. Then the parameters of the flange cover can be determined according to the nominal diameter of the flange.

In the chemical production, equipment manufacturing materials are not only required a certain mechanical properties and process performance, but also required the corrosion resistant performance. Due to the container working in high temperature, and the working medium is mainly hydrogen and hydrogen sulfide which requires good plasticity, high toughness, good welding processing performance and high corrosion resistance of the material. The materials used in the container is mainly 15CrMoR which belongs to pearlitic steel. They are Plates for Corrosion-resistant Hydrogen at Medium Temperature and have high strength, good plasticity and toughness and compatibility with the media. The steel plate materials are commonly used in petrochemical equipment manufacture such as: water tower, the second transform furnace, desulfurization trough, transformation,

methanation furnace, reactor and regenerator, transformation of hydrogenation reactor, methanation heater, gas steam generator, etc. To sum up, due to the flange contacting with the corrosive medium, so 15CrMoR forged steel is selected.

4. Conclusion

According to the analysis above, the sealing device design is one of the important factors for the operation of Texaco gasifier. Only strictly grasping the flange design, material selection, fabrication, inspection and installation of each link can the overall quality of the gasifier be ensured. Only combining the production, operation of the coal water slurry gasification units such as the specific circumstances and fully considering the worst possible operating conditions can the safe operation of gasifier be ensured. Therefore, in the design process of the Texaco gasifier, we should strictly abide the flange seal design criteria on the basis of coal-water slurry gasifier design experience both at home and abroad, and strive to combine the design, material selection, manufacturing and inspection organically to gain the best economic and social benefits with the lowest cost.

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