

Trial Analysis on the Performance of Composite Pressure Vessels

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Keywords: composite; pressure vessel; performance

Abstract: Pressure vessels are widely used. The choice of materials has a great influence on the pressure vessel, which affects the performance of the vessel. The material of the pressure vessel has certain corrosion resistance and mechanical strength. A pressure vessel is a kind of equipment that can withstand a certain pressure. It has certain dangers during use. In order to reduce the risk factor, it is necessary to put forward higher requirements on the pressure vessel. The material selection, temperature, corrosion resistance, etc. will all be affected the performance of pressure vessels. This paper mainly discusses the advantages and current status of composite material pressure vessels, the research on the performance of composite pressure vessels, and the significance of composite materials to pressure vessels.

1. Introduction

With the rapid development of the industry, higher requirements are placed on the performance of the pressure vessel. Then the performance of the pressure vessel is affected by many factors. The toughness, corrosion resistance and density of the material itself will cause certain pressure on the performance of the pressure vessel. The pressure vessel has certain dangers during use. The traditional pressure vessel material is metal sheet, the inner lining is made of alloy steel material and the surface layer is wrapped with metal sheet to improve the strength and toughness of the pressure vessel. However, this type of pressure vessel is not conducive to industrial development and will be used in many occasions, causing great inconvenience. Once the composite material appears, its excellent properties are widely used in industrial manufacturing.

2. Discussion of composite pressure vessel

(1) Characteristics of composite pressure vessels Composite materials are two or more materials of different nature that are chemically or physically combined.

Two or more advantages, while having new properties. Various materials complement each other and produce synergistic effects, so that the composite material can meet various needs in performance, and it is widely used in the fields of aviation, automobile manufacturing and medical equipment. Composite materials have a variety of material properties, and composite pressure vessels have many properties, such as: toughness, pressure vessels are vulnerable to damage during use, and composite materials combine to increase the performance of materials, can increase the load Avoid cracks during use, significantly improve the toughness of the pressure vessel; corrosion resistance, the traditional pressure vessel has metal steel plate, it is easy to corrode and rust in a humid place, which is not conducive to the service life of the pressure vessel, and also pollute In the surrounding environment, the composite material has strong corrosion resistance, and it can meet the demand for pressure vessels without the treatment of inner and outer layers. It is used in the aerospace field; it has strong chemical stability, low density, and high density of metal pressure vessels. Perfectly blended with other materials to reduce the density value, better for the use of pressure vessels, reduce the risk factor; greater than the specific strength and specific modulus, the pressure load of the pressure vessel is the most concerned in industrial production. One of the key points, the inclusion of fiber materials in composite materials enhances mechanical strength, in the long In the case of high-strength, long-cycle operation, the high mechanical strength of the pressure vessel can greatly reduce the risk factor. Corrosion resistance, heat resistance, blood-sucking

strength, etc. will have a certain impact on the use of composite pressure vessels. In the design of composite pressure vessels, the scientifically set safety factor range, safety and stability have been greatly improved ^[1].

(2) Analysis of the status quo of composite pressure vessels Composite pressure vessels occupy an important position in the industrial manufacturing field and are widely used in aerospace, submarines. The combination of composite materials and pressure vessels, the composite material perfectly combines a variety of properties to meet the needs of enterprises for pressure vessels. The materials selected for small pressure vessels are mostly composite materials, metal and metal composites, metal and non-metal composites, non-metallic and non-metallic composites. These combinations can be scientifically combined according to the requirements for performance. Pressure vessel safety and stability ^[2]. For the time being, network theory is the main design concept of composite pressure vessel in China. The design concept of network theory is uniform force and dispersion, and network analysis can manage and analyze data such as stiffness and winding direction of pressure vessel. The design of composite pressure vessel is related to its excellent performance. The network theory method is used for data analysis of composite materials. The performance of composite pressure vessel is continuously optimized from the data. The stress inside the composite pressure vessel is uniform and the fiber dispersion is uniform. To enhance the stiffness and strength, the finite element mixing method, the finite element shift method and the boundary element method can also be used to analyze the load data of the composite pressure vessel.

3. Research on performance of pressure vessel based on composite materials

3.1 Performance of composite pressure vessels Composite pressure vessels are characterized by light weight, high strength, good toughness, low density and high structural efficiency.

Used in aircraft, submarines, medical equipment, etc. The use of metal materials in metal pressure vessels in the past is costly and susceptible to external factors such as temperature, humidity, load bearing strength, etc ^[3]. The pressure vessel of metal material has far better performance of the pressure vessel without composite material. The damage of the metal material pressure vessel is sudden and is not easy to be noticed by the maintenance personnel, and the fusion of the reinforcement and the matrix in the composite pressure vessel. Effectively combines the advantages of both or more, and prevents the rapid diffusion of cracks and improves the overall toughness of the pressure vessel. The fiber material added in the composite pressure vessel has a significant mechanical effect, and its own characteristics have a mesh structure, which effectively enhances the robustness of the pressure vessel. The curing time of the container has an important influence on the production of the pressure vessel, and there may be bubbles and floating glue. This indicates that the performance of the pressure vessel is poor, and the pressure vessel is cured by a curing system, which is strictly found according to this curing opportunity. Pressure vessels perform best. The level of the amount of glue will affect the performance of the pressure vessel. If the amount of glue is too high, the volume fraction of the fiber in the pressure vessel will decrease, and the performance will be greatly reduced. When the amount of glue is too low, the void of the composite will be not totally filled, causing problems with the pressure vessel, and its performance is not optimal. Therefore, the optimum amount of glue has a higher comprehensive performance and the performance of the pressure vessel is the best ^[4]. In the selection of materials, composite pressure vessels need to select metal with good ductility as the base material. The spiral winding process requires high ductility of metal, which can meet the requirements of airtightness of composite pressure vessels. Great improvement.

3.2 The significance of composite materials for pressure vessels Pressure vessels are devices that need to withstand certain pressures and have potential threats. They are widely used in medical devices.

Aerospace, petrochemical and other fields have played an important role in industrial production.

With the continuous development of China's industrial revolution, higher requirements have been put forward for composite pressure vessels, and the relevant index requirements for composite pressure vessels are more stringent. How to reduce the risk factor of pressure vessels, how to achieve composite technology Breakthrough, to provide more optimized performance for pressure vessels, and to extend the life of its use must be the direction of current and future pressure vessel research, and has great room for progress and development, and further study and research. Compared with the previous metal pressure vessels, the composite material can highlight its performance advantages. Corrosion resistance can avoid the pressure vessel being affected by temperature, humidity and environment. The mechanical strength can reduce the risk factor of the pressure vessel and create greater economic value. . Composite pressure vessels may fail due to blasting of the composite layer or leakage of the inner liner. This puts higher requirements on the internal structural performance of the composite pressure vessel. In addition, there are cycles of use and external environment. Composite pressure vessels have a certain effect ^[5].

4. Conclusion

In summary, the excellent properties of composite materials are deeply loved by industrial manufacturers, and the safety, stability, heat resistance, corrosion resistance, etc., improve the use of pressure vessels. With the continuous development of composite materials, it has been applied in various fields of industrial production, and its superior performance has been well received by people, saving production costs, improving the service life of pressure vessels, and at the same time protecting the environment. At present, further research on the performance of composite pressure vessels is expected, and it is expected to further target the process of modified composite materials. Composite materials must be the future development trend of pressure vessels.

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