

Replacing the Accumulator in p53a, 53B and 53c with Metal Bellows Accumulator

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Abstracts: Replacing the pressure accumulator in API 682 Standard Sealed Flush Option 53B with a metal bellows type pressure accumulator, the improved system retains all the advantages and overcomes the drawbacks, especially the extended operating temperature range from -20-100°C to -200-500°C. The system has been designed to meet the requirements of the standard sealed flush option. That is to say, the metal bellows accumulator integrates its advantages, so after using it, the safety, stability and reliability of the system are improved. With it, it can adapt to deeper chemical processes and more demanding high-parameter chemicals. Technology, reduce chemical residues, and strive to build an ecologically civilized society.

1. Introduction

The accumulator structure in 53B of api682 standard seal flushing scheme for shaft seal system of centrifugal pump and rotary pump plays an important role in oil refining and chemical industry, because the perfect shaft seal system can ensure the safety, stability and reliability of dynamic equipment operation. The standard mechanical seal flushing scheme and auxiliary metal components in api682 standard are important links in the shaft seal system, and the accumulator is one of the most important auxiliary metal components.

2. The current flushing scheme is as follows

In Appendix D (normative appendix) of api682 standard, the accumulator used in 53B of standard seal flushing scheme is bladder accumulator, As shown in Figure 1.

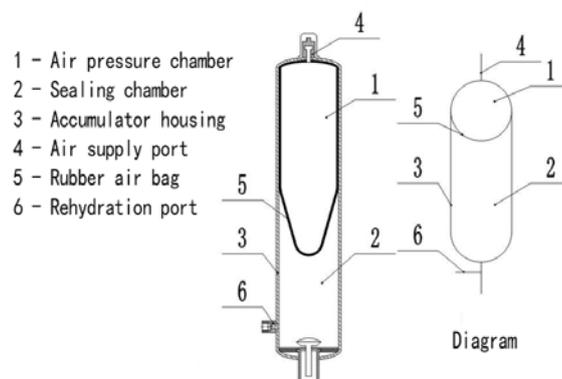


Figure 1 Structure of existing tank accumulator

3B is used under the sealing of arrangement 3. The liquid in the accumulator is the barrier liquid, that is to say, its pressure must be greater than the process pressure of the material. The accumulator adopts the bladder accumulator (see Fig. 1). Its bladder is made of elastic rubber material in the shape of a ball, and its wall thickness cannot be uniform, and the density and elasticity of each part cannot be uniform, and it is not a very regular ball Shape[1]. Therefore, it has the following

disadvantages:

- (1) It is neither resistant to high temperature nor low temperature. The service temperature range of NBR is about - 10-70 °C; the service temperature range of fluororubber is about 0-100 °C;
- (2) Other corrosive liquid is mixed into the barrier liquid to corrode the inner tank;
- (3) The barrier fluid is soluble with the material of the inner tank and easy to swell, and small pieces of rubber often fall off and block the pipeline, resulting in the failure of the whole system;
- (4) The stretching frequency should not be too fast;
- (5) Low fatigue limit;
- (6) The displacement direction of each position on the surface of the whole sphere is different, so there is no liquid level height, so it is not easy to judge the amount of liquid in the accumulator;
- (7) It can be seen from the standard seal flushing scheme 53B in api682 standard that the liquid in the accumulator does not participate in the circulation of the blocking liquid, and its heat cannot be taken away, which is quite unfavorable for this part of liquid;
- (8) The pressure accumulator must be placed vertically, and it cannot be placed horizontally or upside down, otherwise the liner will contact the shell in one direction due to buoyancy, which will hinder the normal expansion and operation of the inner tank and be easy to wear;
- (9) The internal cooler of the accumulator can not be used for cooling as the standard seal flushing scheme 53a, but an external cooler is needed, which not only increases the cost, but also has complex structure.

3. The questions are as follows

Can we find a way to overcome these shortcomings without increasing manufacturing costs? The answer is yes.

A new structure is introduced and recommended, that is to replace the bladder type accumulator (see Figure 1) in the standard seal flushing scheme 53B with metal bellows type accumulator (see Figure 2).

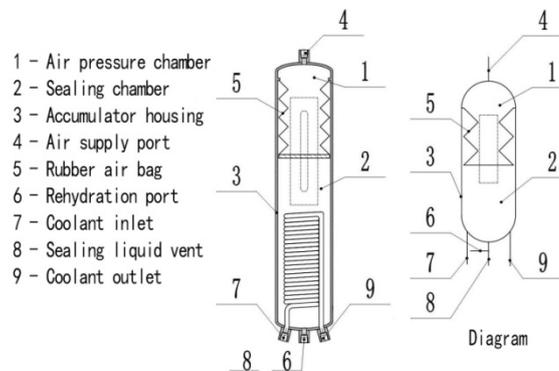


Figure 2 structure of metal bellows accumulator

4. Measures to solve the problem

The size as like as two peas of the metal bellows accumulator is exactly the same as that of the standard accumulator in the standard API682 53B.

So in scheme 53B, the other parts of the whole system can be retained, and only the accumulator can be replaced. Figure 1 describes the specific structure of the existing bladder type accumulator, which has a steel, closed and pressure resistant shell. The elastic rubber air bag of the shell contains gas, and the sealing isolation liquid is installed inside and outside the shell. The more compressed gas is injected into the rubber air bag, the greater the pressure in the shell, and the greater the pressure of the sealing isolation liquid after being pressed. This liquid with pressure provides barrier fluid between the two seals of double seal in arrangement 3 mentioned in api682 standard, so that the pressure of the barrier fluid is higher than the process pressure of the material in the seal chamber.

Figure 2 depicts a metal bellows accumulator

The shell is a steel, closed and pressure resistant container; the container with a metal bellows structure divides the container in the accumulator into two parts: the gas part and the liquid part, and these two parts can not be mixed in the work all the time; the metal bellows 5 is welded or pressed with the metal steel belt, which is integrated with the inner wall 3 of the shell and the bottom surface of the container. However, its length can be expanded freely, so the volume of the metal bellows container can be changed according to the needs at any time during operation.

Volume of accumulator = volume of gas in accumulator + volume of liquid in accumulator + volume of bellows

Because the volume of the accumulator is a constant, when the volume of the liquid in the accumulator increases, the volume of the gas in the accumulator decreases. If the mass of the gas does not change in the process of successive changes, when the volume of the gas decreases, the pressure in the whole accumulator increases; otherwise, the pressure in the accumulator decreases.

Figure 4 shows that the existing 53B is replaced by the flushing scheme 53B with a metal bellows accumulator. The gas container is provided with an inlet / outlet port; the liquid container is provided with an inlet / outlet port and an exhaust port, so that the liquid can be circulated in the accumulator. At the same time, a make-up pump is also provided[2]. When the liquid leaks, the blocking liquid can be forcibly replenished while maintaining the original system pressure. In addition, a cooling tube is arranged in the liquid container of the accumulator to enable the accumulator to have cooling function, thus simplifying the 53B system of the standard seal flushing scheme in Appendix D (standard appendix) of api682 standard (as shown in Fig. 3 and Fig. 4).

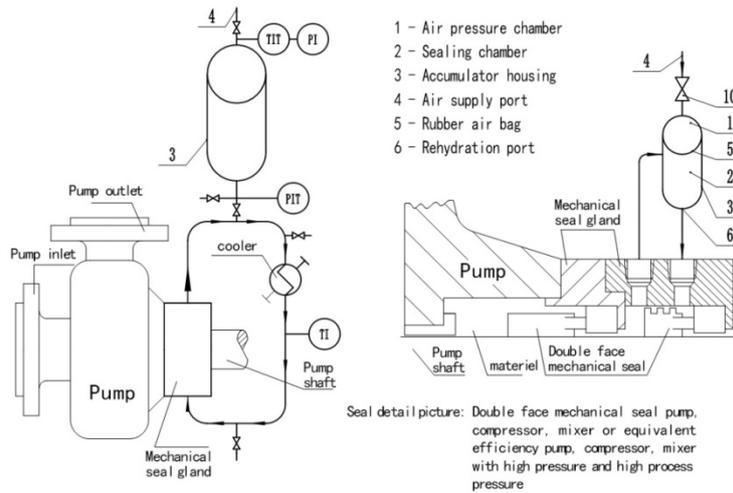


Fig. 3 flushing scheme of existing bladder accumulator 53B

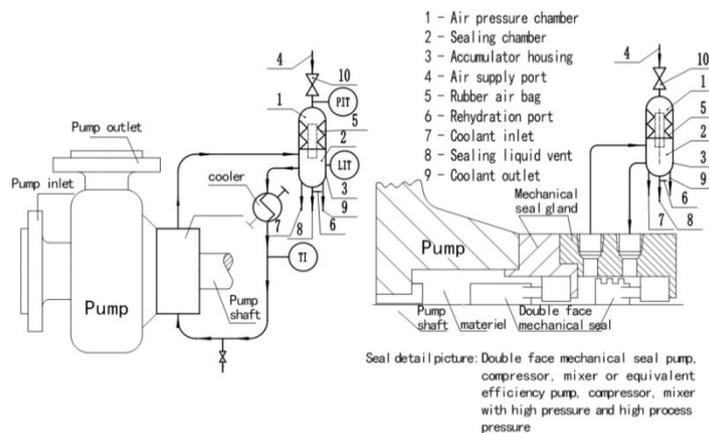


Fig. 4 flushing scheme of metal bellows accumulator 53B

Fig. 3 is the schematic diagram of the main pipeline and instrument installation of the existing flushing scheme using the bladder accumulator. It can be seen from Fig. 3 that the barrier fluid can not be circulated in the accumulator shell, and the external cooler is required, which increases the cost.

Fig. 4 is a metal bellows accumulator, which has cooling circulation function, detailed drawing of sealing chamber and route of blocking fluid in and out of sealing chamber. This is our goal, that is, to obtain a kind of circulating fluid that meets both our pressure requirements and our temperature requirements as the blocking fluid of sealing chamber.

The symbols in Fig. 3 and Fig. 4 indicate: L1. Window; pit. Pressure sensor; lit, lit. Liquid level sensor; pit. Pressure sensor; tit. Temperature sensor Temperature sensor.

5. Conclusion

Compared with the prior art, this technology has the following advantages:

(1) Because there is no element made of rubber material in the metal bellows accumulator, it can be used to replace the bladder accumulator in the standard seal flushing scheme 53B of api682 standard, which can greatly improve the low temperature and high temperature resistance, and even the working temperature range can reach - 200-500 °C.

(2) Because there is no element made of rubber material in the metal bellows accumulator, it can be used to replace the bladder accumulator in the flushing scheme 53B to greatly improve the corrosion resistance and swelling resistance; and it can avoid the small pieces of rubber falling off to block the pipeline and cause the whole system failure.

(3) The expansion of metal bellows is realized by displacement along the only axis. Therefore, the inner tank accumulator in flushing scheme 53B can not only be arranged with window to directly observe the liquid level, but also can be arranged for remote control.

(4) The inner tank accumulator in flushing scheme 53B can be placed in a slant or horizontal way, or even inverted by using metal bellows accumulator.

(5) Especially under alternating load, the fatigue limit of metal bellows is higher than that of rubber parts. It can be used to replace the bladder accumulator in flushing scheme 53B to improve the fatigue life.

(6) The metal bellows accumulator can be like the standard seal flushing scheme 53a in api682 standard. Instead of separate cooler, it can be equipped with cooling coil inside to simplify the system, save space and cost.

(7) The metal bellows accumulator can make the liquid in it participate in the circulation of the barrier liquid, and can effectively take away the heat of the isolation sealing liquid, which is quite beneficial to ensure the stability of the properties of this part of the liquid.

(8) The expansion frequency of metal bellows is much faster than that of rubber liner, so it is sensitive and can avoid a lot of misjudgment and misoperation.

(9) The pressure difference between liquid and gas can be adjusted in advance by spring in metal bellows accumulator. We can adjust the pressure difference as much as we want.

(10) Make the external dimension of the metal bellows accumulator consistent with the original one, so as to achieve interchangeability.

(11) The metal bellows accumulator can completely replace the accumulator in flushing plan 53a and the piston accumulator in flushing plan 53c to improve the interchangeability, simplify the standard configuration, reduce the cost and save land.

References

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