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Special drainage pipe dredging tool for gas medium pressure condensate tank

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Abstract

This paper briefly describes the types of blockage in the drainage pipe of the medium pressure condensate tank in the ancillary facilities of the gas pipeline network, and introduces the innovative product of the drainage pipe dredging tool of the medium pressure condensate tank, as well as its composition, principle, operation method, precautions and its advantages in dredging the drainage pipe of the medium pressure condensate tank.

Keywords

Innovation of special tools for blocking, Artificial gas, Drainage pipe of gas medium pressure, Condensate tank.

1. Introduction

In the urban gas pipeline network transmission and distribution system, the medium-pressure gas pipeline is the artery of urban gas supply, which is directly delivered to large industrial enterprises or delivered to the low-pressure pipeline network after pressure regulation for the use of civilian users and industrial households. In the process of design and construction of medium-pressure pipelines, condensate tanks are generally set at a pipeline slope of not less than 0.3%[1].The consideration is to solve the problem of water discharge during operation. Condenser tank is a supporting facility on gas pipeline network, which is specially used to extract accumulated water from pipeline. Accidents such as overflowing sewage and road collapse occur in the drainage pipe netease, which affect the safety of urban operation and even pollute the urban water body[2].Constrained by production process, artificial gas contains a large amount of impurities such as hydrogen sulfide, naphthalene, benzene, ammonia and tar, which easily corrodes and blocks pipelines, and has strong toxicity, especially in winter, which is affected by cold and freezing weather in northern China.Condensate and impurities produced by artificial gas in medium-pressure pipe network often block the drain pipe on the condensate tank, and then affect the drainage work of the pipe network. This paper introduces the reasons and solutions for the blockage of the drain pipe of the medium pressure condensate tank, and a special tool for innovative dredging of the drain pipe.

2. The causes and solutions of the blockage of the drain pipe of the medium pressure condensate tank

There are four main reasons for the blockage of drainage pipe of gas medium pressure condensate tank [3].

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2.1 Accumulated water

There is water vapor in the gas, which condenses into accumulated water and flows to the lowest point of the pipeline and the condensate tank in case of cold or pressure increase, blocking the drain pipe of the condensate tank. If it accumulates to a certain extent, it will block the pipeline. This kind of blockage is often encountered when the intermediate pressure condensate tank is blocked. To solve this kind of blockage, it is only necessary to remove the accumulated water in the pipeline, and establish a strict operation management system.Pumping out accumulated water regularly, filling out pumping records and mastering its pumping cycle.

2.2 Freezing and blocking

Medium-pressure gas pipeline is divided into two types: A and B, with design pressures of 0.2-0.4 MPa and 0.01-0.2 MPa respectively. Medium-pressure gas pipeline with accumulated water runs in winter. When the circulating pressure device at the head of condensate tank drain pipe fails or the pressure circulating valve is not opened due to construction and maintenance quality reasons, the accumulated water in the pipeline will be washed to the head of drain pipe by pipeline pressure to form freezing and blocking.The conventional solution is to dissolve it with warm boiled water at 70℃, water vapor or volatile methanol, or dredge it with iron drill. However, the premise is to reduce the pressure in the pipeline to 0, which will not only lose a lot of gas, waste manpower and material resources, and affect the efficiency of gas supply and operation, but also easily make the pipeline expand with heat and shrink with cold, and make the flexible interface loose[4].Some people work with air by adding simple protective tools because of their convenience, illegal operation and non-stop pressure, which not only has serious potential safety hazards, but also makes the sewage in the pipeline gush out easily, causing harm to the construction personnel and the environment.

2.3 Accumulated naphthalene

The artificial gas contains naphthalene vapor, which will condense into solid when the temperature is lowered, or the naphthalene removal equipment is imperfect, so that naphthalene accumulates on the inner wall of the pipeline, reducing the flow rate of the gas pipeline or completely blocking the pipeline. In cold season, naphthalene often accumulates in the curved pipeline and the branch pipe connected with the ground, and the drainage pipe diameter of the condensate tank is small, which makes it easier to block by naphthalene accumulation. The solution is the same as freezing and blocking.Because naphthalene can be dissolved in warm boiled water above 70℃, the potential safety hazards are the same.

2.4 Other impurities

Besides naphthalene, the accumulation of other impurities in the pipeline may also block the pipeline. The common impurity in the pipeline is rust floc, which is often mixed with tar dust and accumulated in the pipeline. The solution is, after stopping depressurizing to 0, use iron drill to insert and dredge along the drain pipe, break impurities into pieces and fall into the condensate tank, and pump them out with accumulated water, or replace the drain pipe. Therefore, with naphthalene removal,The same hidden danger exists in freezing and blocking.

To sum up, to safely and effectively remove the blocking problem of condensate tank drain pipe, it can only be operated by stopping depressurization and releasing the remaining gas in the pipe section. How to be more effective and safer can dredge the drain pipe of medium pressure condensate tank without stopping depressurization, which requires the use of special dredging tools.

3. Special drainage pipe dredging tool for medium pressure condensate tank

The innovation of special drainage pipe dredging tool for medium-pressure condensate tank (hereinafter referred to as special part) (Attached Fig. 1) can avoid the step of stopping and reducing pressure during dredging, avoid the loss and waste of gas, save time and improve efficiency. It can effectively block the jet of fuel gas and accumulated water in the dredging process, which is convenient and safe, and the dredging effect can be observed at the same time. After the drainage

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pipe is dredged,The accumulated water will be discharged by-pass along the drainage of special parts, or the special parts can be disassembled for pumping operation.

3.1 Composition, structure and function of special parts

The pipe fittings mainly used for special parts are commonly used pipe fittings and machined parts (Attached Table 1), which are divided into four important components, which are made up of threaded connection. They are sealing element, drainage bypass, quick union and dredging line.

3.1.1 Sealing element

The seal is a machined part, which is divided into a first rigid connection end and a second rigid connection end, and is internally provided with a sealing rubber ring. As the most important part of this special part, it plays a sealing role, blocking the gas and accumulated water in the intermediate pressure condensate tank in the condensate tank to prevent leakage; Meanwhile, in order to reduce the friction resistance between the rubber ring and the dredging line,The inner wall of cylindrical aprons is processed into internal threads.

3.1.2 Drainage bypass

The drainage bypass is connected to the lower end of the seal in a threaded way, and all of them are galvanized pipe fittings except the copper ball valve. Inspection port as dredging result of drainage pipe of medium pressure condensate tank, and drainage port after dredging.

3.1.3 Quick union

The quick union is under the drainage bypass, which is an important part of connecting the drainage pipe and special parts of the intermediate pressure condensate tank.

3.1.4 Dredge line

The dredging line runs through the whole special part, which refers to the penetrating line of the pipeline threader and plays the most important dredging role. At the lower end of the penetration line, there is an anti-misoperation design to prevent misoperation in the dredging process, and the dredging line will be pulled out of the special parts by mistake, resulting in leakage.

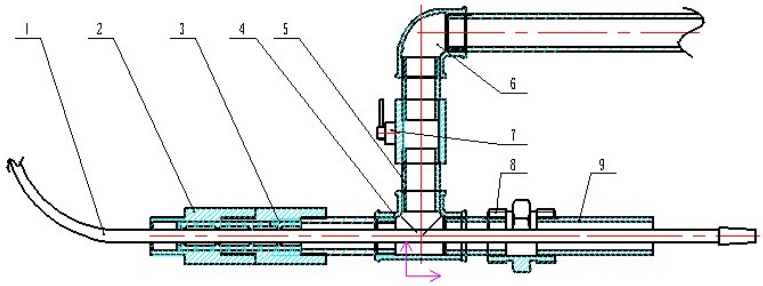

Fig. 1 The innovation of special drainage pipe dredging tool for medium-pressure condensate tank (hereinafter referred to as special part)

Table 1 The pipe fittings mainly used for special parts are commonly used pipe fittings and machined parts

9	DN25 steel pipe	2	Galvanized steel			
8	Quick connector	1	Galvanized steel			
7	The valve	1	copper			
6	The 90 ° DN25 elbow	1	Galvanized steel			
5	Outside the DN25 silk	2	Galvanized steel			
4	DN25 equal diameter tee	1	Galvanized steel			
3	Rubber seal ring	1	rubber			1—2
2	Sealing fitting	2	Stainless steel			1—1
1	Medium pressure line through line	6	plastic			
The serial number	The name of the	The number	material	Single piece	A total of	Drawing no.
				The weight of the		

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3.2 Principle, Usage and Precautions of Special Parts

1). Firstly, separate the special piece quick union, connect the thread at the bottom of the union short pipe with the drain pipe of the intermediate pressure condensate tank, and clean the thread waterline before connection to ensure that there is no sediment and the interface is tightly connected The design of quick union is convenient for operation, and prevents the special parts from being screwed up due to insufficient vertical space between the special parts and the well chamber of the condensate tank.

2). Connect the special parts with the quick union, pay attention to clean the interface impurities, and check whether the interface connection is tight.

3). Check the seal to ensure that the second rigid pipe wall section has been tightened, and compress the rubber ring until the end of the first rigid pipe wall is tightly combined.

4). Open the valve of special parts bypass pipe.

5). Open the valve of the drain pipe head of the intermediate pressure condensate tank.

6). Insert the dredging line slowly. If the valve is stuck when installing through the head of the drain pipe, please rotate the dredging line slowly to adjust the angle and insert it again. No brute force construction is allowed to prevent gas leakage caused by damaging the pipe fittings.

7). When dredging, pay attention to the special parts bypass pipe. When there is gas or water gushing out, close the special parts bypass pipe valve immediately.

8). Pull out the dredging line. When the dredging line is stuck in the seal, open the special parts bypass valve for drainage, or close the valve at the head of the condensate tank drain pipe, and disassemble the special parts for normal drainage. Before dismantling the special parts, the special parts bypass valve should be opened, and the water and pressure in the special parts should be discharged before dismantling.

4. Actual operation mode

In order to block the gas and accumulated water in the intermediate pressure condensate tank and prevent leakage, the sealing element is sealed with O-ring. When the interference of the sealing ring is too large, it is easy to be damaged by shearing, and when it is too small, it is easy to lose sealing[5]. Therefore, it is necessary to select the sealing ring and design the groove size of the sealing ring correctly.

4.1 Sealing mechanism of sealing ring

Sealing ring seal belongs to extrusion elastomer seal, which relies on the pre-extrusion of sealing ring to generate pre-tightening force by elastic deformation, and meanwhile, the pressure of working medium also squeezes the sealing ring to generate self-tightening force. Extruded elastomer seal is a self-tightening seal [6].

Under the action of medium pressure p1, the stress state of the sealing ring is shown in Fig. 2, and the contact pressure generated is

$$P_C = Pco + \Delta P_C \quad (1)$$

PC——Total contact pressure under medium pressure, MPa;

Pco——Initial pressure of sealing ring, called pre-contact pressure, MPa;

ΔPC——The contact pressure transmitted by the medium pressure to the contact surface through the sealing ring, which is called the medium acting contact pressure.

ΔPC =Kp1， MPa, where k is the lateral pressure coefficient, K=U/(1-U), and K≈0.9~0.985 for rubber seals; U is Poisson's ratio of sealing ring material, and for rubber sealing ring, U=0.48~0.496.

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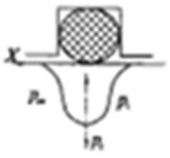

Fig. 2 Contact pressure distribution of sealing ring

To keep the seal, it must be ensured that P_C>p1, and ΔP_C is always less than p1, so sufficient pre-contact pressure P_{CO} should be maintained, that is, the sealing ring should have sufficient pre-compression ratio to ensure the seal. However, if the precompression ratio is too large, it will affect the working life of the sealing ring. Therefore, the reasonable matching of the dimensions of the sealing ring and the sealing ring groove is the necessary guarantee to prolong the life of the sealing ring without leakage.

4.2 Selection Method of Sealing Ring and Sealing Ring Groove

Assume that the diameters of hole and shaft are D、d，and the selected sealing ring is D_0×d_0. Determine the bottom diameter D_1 of the sealing ring groove. After the sealing ring is sleeved on the sealing ring groove, it generally has a certain amount of stretching, and its cross-section diameter d_0 becomes smaller, assuming it becomes d_1. According to the principle of constant volume, the volume of the sealing ring before and after installation is equal, that is[7],

$$\frac{\pi}{4}(D_0 - d_0)d_0^2 = \frac{\pi}{4}(D + \delta - d_1)d_1^2 \tag{2}$$

D0——Outer diameter of sealing ring, 23mm;

d0——Cross section diameter of sealing ring, 5mm;

D——Hole diameter, 25mm;

δ——Interference of sealing ring, 0.4mm; (Attached Table 2)

d1——Section diameter of sealing ring after stretching

To simplify the calculation, D+δ-d0 is used instead of D+δ-d1

$$d_1 = \sqrt{[(D_0 - d_0)d_0^2]/(D + \delta - d_0)} \tag{3}$$

In the formula, d_1——the cross-section diameter of the sealing ring after stretching, 4.697 mm.

There is a certain error in the value of d_1 calculated after simplification. Return d_1 to formula (3) to calculate d_2, namely

$$d_2 = \sqrt{[(D_0 - d_0)d_0^2]/(D + \delta - d_1)} \tag{4}$$

d_2—— In the formula is calculated as the cross-sectional diameter of the sealing ring after stretching, 4.662 mm.

Then the bottom diameter D_1 of the sealing ring groove is

$$D_1=D+\delta-2d_2 \tag{5}$$

In the calculated formula, D_1—— is the bottom diameter of sealing ring groove, 16.076mm

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Table 2 Recommendation value of relation between basic size and interference

Hole diameter D size range	Interference of the delta δ	
	Dynamic seal	Static seal
< 30	0.25~0.33	0.3~0.4
30 ~ 50	0.35~0.50	0.4~0.6
50 ~ 80	0.50~0.70	0.6~0.8
80 ~ 120	0.70~1.00	0.8~1.2
> 120	1.00~1.40	1.2~1.6

4.3 Stretching amount of sealing ring

After the sealing ring is installed in the sealing ring groove, it will generally have a certain amount of stretching[8].

$$a=(D_1+d_2)/(D_0-d_0) \quad (6)$$

In the calculated formula, a--Sealing ring tension, 1.152

The sealing ring can meet the tensile requirements of rubber hardness of 70~80HS in the working pressure range of 8~16Mpa [9]

To sum up, the seal ring meets the working requirements of medium-pressure gas pipeline, realizes the requirement that the operating pressure of the pipeline does not exceed the standard, eliminates the accumulated water in the pipeline, ensures the basic operation safety of workers, and at the same time eliminates the environmental pollution caused by gas leakage.

5. Application advantages of special parts

1). Avoid the step of stopping and reducing pressure in the dredging process, avoid the loss of gas and affect the gas supply of users, effectively improve the working efficiency, and dredge if blockage is found.

2). Save maintenance cost and reduce labor intensity. This special part can be used repeatedly for a long time. Save the cost of disposable articles such as warm boiled water at 70℃, water vapor or volatile methanol chemicals.

3). It is safe and effective, avoiding the leakage caused by the loose flexible interface caused by the expansion of pipeline with heat and contraction with water vapor at 70℃. Avoid the improper operation of crude protective tools during the operation with air, which will cause the sewage in the pipeline to spray out, thus causing harm to the construction personnel and the environment.

4). Easy to carry and easy to operate.

5). Low cost. From R&D to test, common pipes and fittings are used in this tool, and there is no high cost of fittings. When the fittings are damaged, they can be easily filled without purchasing. Workpieces have high strength, long service life and low processing cost.

6). It can also be applied to dredge the drainage pipe of low-pressure gas condensate tank.

To sum up, this special piece can safely and effectively remove various types of blockage of the drainage pipe of the medium-pressure gas condensate tank, and has obvious effects on freezing blockage, naphthalene accumulation and other impurities blockage. Moreover, it can reduce the procedures of digging operation pits and stopping depressurization, and save the loss of gas emptying and the consumption of manpower and material resources, which is worthy of wide application. Especially in high-risk pipeline industries such as gas, On the premise of ensuring safety, the work efficiency is effectively improved.

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