

Study on Optimization of Anticorrosion Technology for Valve Pit Facilities in Tahe Oilfield

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Abstract. Due to the abundant underground water source, the structure of the valve pool, the non installation of water stop flange in the crossing pipeline and other problems, the leakage disease rate of the valve pool in Tahe oilfield reaches more than 80%. If it is not treated in time, the valves, pipe fittings and other facilities will be rusted, which will affect the normal operation and daily maintenance of the valves and cause serious potential safety hazards. According to the characteristics of the valve pool in Tahe oilfield, XinJiang, the performance and construction technology of different kinds of anti-corrosion materials are studied, and the best anti-corrosion materials are optimized. Through comparative research, it is found that the multi-layer petrolatum coating technology has excellent anti-corrosion performance and simple construction technology, which can completely solve the corrosion problem of the pipe fittings inside the valve pool.

Keywords: Valve pool, Anti-corrosion technology, Valve, Petrolatum coating, Thermal spraying, Anti-corrosion coating.

1. Introduction

Tahe block in XinJiang has developed vegetation, frequent farming operations and abundant groundwater. 80% of the valve pools outside the station in the block have been submerged by long-term infiltration of formation water. In recent three months, there have been more than 10 times of perforation and all the external anti-corrosion coatings have been damaged. The corrosion risk is very high. Once the leakage occurs, there is a great risk of safety and environmental protection hazards. Most of the valve basins are of brick concrete structure without anti-seepage and anti-corrosion measures. The pipe fittings in the valve basin are complex, including pipes, valves and flanges. The external anti-corrosion coating has oil layer separation failure after being immersed in the corrosive environment for a long time. It is urgent to carry out the application and evaluation of effective anti-corrosion and anti-seepage measures.

2. Anti corrosion technology status of valves and other facilities in the valve pool

Corrosion is one of the main reasons for the damage of metal facilities in the valve pool. There are many flanges, valves and other pipe fittings in the valve pool. Some valve wells have high underground water level and serious water accumulation in the wells, resulting in serious corrosion damage. Corrosion leads to early failure of valves, flanges, bolts and nuts, which greatly shortens the service life of the whole structure and the safety of the structure in service, becoming a serious safety hazard. In order to thoroughly solve the corrosion problem of pipe fittings in the valve pool, scholars and enterprises at home and abroad have made a lot of attempts and gained a lot of valuable experience.

Adopting the method of replacing materials (stainless steel, etc.) to prevent corrosion is difficult to bear the increase in cost. Therefore, using the anti-corrosion coating to isolate the steel from the corrosive environment such as water has become the most common basic means for the anti-corrosion of metal facilities in the valve pool. With the improvement of anti-corrosion requirements, the anti-corrosion coating is required to be able to adapt to the worse environmental and process conditions

and have a longer service life. The development of chemical industry has promoted the progress of anti-corrosion technology. New materials, new processes and new equipment are emerging. A multi variety and multi specification material system based on petrochemical products has emerged, forming a situation in which a variety of anti-corrosion materials coexist, providing the possibility for pipe fittings in different environments to be more effective in anti-corrosion. Asphalt anti-corrosion coatings, thermal spraying, anti-corrosion coatings etc.

2.1. Asphalt anti-corrosive coating

Due to the advantages of wide sources, low price, mature process and good insulation performance, most of the anti-corrosion and isolation materials for metal pipe fittings in China's early projects used petroleum asphalt. There have been many studies on the properties of this material, and its construction and acceptance have also been quite mature experience[1]. However, the asphalt anti-corrosion coating also has some disadvantages that can not be ignored. First, the aging speed is fast, and second, The surface strength is not high, which is prone to local damage. Thirdly, the adhesion with metal is low. Due to the above shortcomings, the asphalt anti-corrosion coating is gradually being eliminated.

2.2. Thermal spraying materials

In the past decades, thermal spraying technology has developed rapidly. It is mainly used in material surface treatment to strengthen the surface properties of materials. It plays a role in protecting materials by improving the abrasion resistance, corrosion resistance and high temperature resistance of the external surface of metal materials in contact with fluid media. There are many kinds of thermal spraying materials, and their performance is the key to restrict the application and development of thermal spraying technology[2]. At present, the research on thermal spraying materials is mainly focused on metal materials such as zinc, aluminum and nickel, ceramic materials with excellent high temperature resistance, organic polymer materials mainly used for the protection of metal structures in corrosive environment, as well as emerging nano materials and composite coating materials.

2.3. Anti corrosion coating

Painting anti-corrosion coating is a traditional protection method for steel structures, equipment and facilities. It has the advantages of economy and effectiveness, and simple and fast construction. The anti-corrosion coating is generally divided into conventional anti-corrosion coating and heavy-duty anti-corrosion coating. After the valve pool leaks, the corrosion environment of the pipe fittings in the pool is harsh. The anti-corrosion coating used for the valves and pipelines in the valve pool is mostly heavy-duty anti-corrosion coating. After years of use, certain problems have also been exposed. First, most of the existing anti-corrosion coatings are solvent based. These coatings contain volatile substances such as benzene and glycol ethers, which will cause pollution and endanger human health in the process of use; Second, it is difficult to clean the surface and ensure the construction quality of steel structure connecting parts, pipe interfaces, valves and other parts, so it is difficult to achieve long-term protection effect; Third, the heavy-duty anti-corrosion coating has poor impact resistance, and maintenance is required in a short time (about 1-2 years) after construction or maintenance[3]. At present, the heavy-duty anti-corrosive coatings commonly used for the facilities in the valve pool mainly include: flake heavy-duty anti-corrosive coatings, epoxy heavy-duty anti-corrosive coatings, modified phenolic heavy-duty anti-corrosive coatings, silicone resin anti-corrosive coatings, etc.

2.4. Coating and anti-corrosion

The coating anti-corrosion technology first appeared abroad. Domestic scholars have learned from foreign experience and formed a coating anti-corrosion technology with three-layer or four-layer structure through continuous research, development and improvement. The most important material is the anti-corrosion primer at the innermost layer, which can form a dense iron oxide film on the

steel surface to prevent oxidation and rust of the steel. The outer layer is coated with an anti-corrosion belt impregnated with anti-corrosion materials and an external protective belt with sealing performance. Corresponding fillers can also be filled between any two layers to make the special-shaped components round and easy to cover. The coating anti-corrosion technology has remarkable effect, which can adapt to special-shaped components such as valves, connecting flanges and pipe interfaces, and has been widely used in petrochemical, gas, port and other industries[4].

3. Performance of anti-corrosion coating

Based on the basic situation of the valve pool in Tahe Oilfield and the understanding of the more mature domestic anti-corrosion coating materials, three kinds of anti-corrosion coatings that are widely used and mature in technology are preliminarily selected: EP-86 epoxy zinc rich anti-corrosion coating, STAC petrolatum coating, ROGTS circulating organic gel thermal spraying, and the anti-corrosion properties of the three anti-corrosion coatings are tested and compared.

3.1. experimental instruments and materials

Instrument: Q-Lab neutral salt spray test chamber, R-3 thermal spraying machine.

Materials: ep-86 epoxy zinc rich coating, STAC petrolatum primer, petrolatum mastic, petrolatum oil belt, outer protective belt, ROGTS recycled organic gel, CNPC Engineering Technology Research Co., Ltd; 10% H₂SO₄ solution; 10% NaOH solution; 3% NaCl solution; 0 diesel; distilled water; 304 stainless steel corrosion test piece.

3.2. preparation of test pieces

Ep-86 test piece: mix the ep-86 anti-corrosive coating, curing agent and diluent in the ratio of 10:1:0.5, stir them evenly, and brush them on the surface of the dry 304 stainless steel corrosion test piece. The dry film thickness of the coating is 150-200 micron. And cured at room temperature for 3 days.

STAC test piece: Brush 70-100 micron thick petrolatum primer on the surface of the dry 304 stainless steel corrosion test piece, then coated with 1-3mm thick petrolatum mastic, then wrapped with two layers of petrolatum oil tape, and finally wrapped with the outer protective tape. The petrolatum oil tape and the outer protective tape shall be overlapped.

ROGTS test piece: paint 60-100 micron thick matching bottom oil on the surface of the dry 304 stainless steel corrosion test piece, use R-3 thermal spraying machine to heat ROGTS circulating organic gel to 210°C, melt it and spray it on the surface of dry 304 stainless steel corrosion test piece, with a spraying thickness of 300-400 micron cool at room temperature.

Prepare 18 pieces of each test piece.

3.3. performance test of anti-corrosion coating

According to the national standard GB/T 9274-1988, the immersion test of 10% H₂SO₄ solution, 10% NaOH solution, 3.5% NaCl solution and 0 diesel.

3.4. results and analysis

Table 1. performance test results of three anti-corrosion coatings

Test Items	Test Result		
	EP-86	STAC	ROGTS
Resistance to 10% H ₂ SO ₄ (30d)	Intact anti-corrosive coating	Intact anti-corrosive coating	Intact anti-corrosive coating
Resistance to 10% NaOH (30d)	Floating rust on specimen surface	Intact anti-corrosive coating	Intact anti-corrosive coating
Resistance to 3% NaCl (30d)	Intact anti-corrosive coating	Intact anti-corrosive coating	Intact anti-corrosive coating
Salt spray resistance (1000h)	Corrosion of test piece	Intact anti-corrosive coating	Intact anti-corrosive coating

It can be seen from table.1 that the STAC petrolatum coated anti-corrosion coating and ROGTS circulating organic gel thermal spraying anti-corrosion coating have excellent medium resistance and salt spray resistance, meeting the anti-corrosion technical requirements; Ep-86 epoxy zinc rich anti-corrosive coating has good acid, salt and diesel resistance, but slightly poor alkali and neutral salt spray resistance.

4. Construction conditions of anti-corrosion coating

Table 2. construction related parameters of three anti-corrosion coatings

Test items	test result		
	EP-86	STAC	ROGTS
Surface treatment method	Sand blasting or pickling	Manual rust removing	Sand blasting or pickling
Surface treatment grade	St3	St2	St3
Construction method	Spraying or brushing	Wrapping	210°C Thermal spraying
Surface condition during construction	Dry, water free and rust free	No special requirements	No special requirements
Construction ambient temperature	≥-5°C	≥-20°C	≥0°C
Construction interval	≥8h	0	≥2h

It can be seen from table 2 that EP-86 epoxy zinc rich anti-corrosive coating and ROGTS circulating organic gel thermal spraying have high requirements on the treatment of the construction surface and construction environment during the construction operation. The original anti-corrosive coating and rust layer must be removed, and the surface must be in a dry state without water. During the construction in winter, the temperature is difficult to meet the requirements; The location of the site valve pool is remote, and the site conditions are difficult to meet the construction needs. The valves and other facilities are special components. Even if the construction conditions are solved, the edges and corners can not be thoroughly cleaned, resulting in poor anti-corrosion effect. STAC petrolatum coating anti-corrosion technology has low requirements for construction surface treatment. It can carry out construction with water and rust. There is no need to wait between processes. Petrolatum primer and petrolatum putty can be adhered to various special-shaped structural surfaces such as valves, so as to achieve good anti-corrosion performance.

5. Conclusion

The performance and construction process of the widely used anti-corrosion materials for special-shaped components such as valves are compared. It is found that the multi-layer petrolatum coating

technology has excellent anti-corrosion performance, low requirements for construction surface treatment, and simple construction process, which can meet the anti-corrosion requirements of special-shaped components such as valves in the valve pool, and form a more comprehensive, detailed and effective anti-corrosion protection for the protected objects, which is the design focus and inevitable development trend of the anti-corrosion industry.

References

- [1] Wang Youpeng, He Xiaorong, Wang Huanmei, et al. Development status of asphalt anticorrosive coatings[j]. Shanghai paint, 2010, 48(7):23-25.
- [2] Xu Binshi, Zhang Wei, Liang Xiubing. Application and development of thermal spraying materials[j]. Materials engineering, 2003(12):3-7.
- [3] Qu Ying. Current situation and development direction of heavy-duty anti-corrosive coatings at home and abroad[j]. Chemical industry, 2013, 31(8):25-34.
- [4] Bao Rongrong. Oxidation polymerization coating anti-corrosion technology for steel structures in atmospheric area[j]. Progress in materials in China, 2014(2):101-105.