Corrosion mechanism and anticorrosion technology of oil and gas gathering and transportation pipeline

Sinan Cheng 1,*, Wei Yuan 2

1 Production and Operation Department of Heavy Oil Production Company, Xinjiang Oilfield Company, PetroChina, Karamay, Xinjiang, 834000, China
2 FengCheng Field Operation District, Xinjiang Oilfield Company, PetroChina, Karamay, Xinjiang, 834000, China

*Corresponding author e-mail: chengsn@petrochina.com.cn

Abstract: In the process of oilfield exploitation, the composition of crude oil is relatively complex, which may have strong corrosive medium, and the oil field gathering and transportation pipeline is distributed in various areas of the oilfield, which plays an important role. The corrosive medium of crude oil has a certain corrosive effect on the oil field gathering and transportation pipeline, and once the corrosion is serious, it will cause the leakage of the gathering and transportation pipeline. China's oilfields have experienced many years of continuous development, some oilfields have entered the middle and late stage of exploitation, and have made certain achievements in various stages of exploitation. We have conducted in-depth research and Analysis on the corrosion factors of oil gathering and transportation pipeline, which consumes a lot of manpower, material resources and financial resources. Therefore, we need to analyze and study the factors influencing the corrosion of oil gathering and transportation pipeline, formulate effective anti-corrosion measures according to the actual situation, extend the service life of oil gathering and transportation pipeline, and promote the long-term development of oil field exploitation and operation.

Key words: oil and gas; Gathering and transportation; The Conduit; Corrosion; mechanism; anticorrosive.

1. Introduction
At present, the oil and gas gathering and transportation pipeline still has some limitations, and the overall performance index needs to be improved. One of the more prominent problems is pipeline corrosion. Pipeline corrosion will not only affect the stability of transportation, but also cause greater economic losses, so relevant measures need to be taken to control.

2. Corrosion mechanism of oil pipeline
Generally speaking, oil and gas gathering and transportation pipelines are often laid underground, with the help of long-distance pipelines for transportation, so as to promote the economic performance of oil and gas transportation. Through the analysis of the specific situation of the production site, it can be seen that pipeline transportation is the best scheme, so it has been excellent promotion and application.
Because the pipeline is usually laid underground, there is a large degree of soil corrosion, as well as electrochemical corrosion, which causes the pressure bearing capacity and mechanical strength of the pipeline to decline, resulting in oil and gas leakage, and may bring fire and other accidents, and bring economic losses to the enterprise. Because of the existence of corrosive medium in the soil, the pipeline has the condition of forming galvanic cell, causing corrosion perforation and endangering the safety of the pipeline. In terms of pipeline quality, it will also have a great negative impact on the whole transportation work. Generally speaking, metal pipelines are often protected by cathodic protection technology. However, in the process of pipeline construction, if there is a lack of cathodic protection quality and good cathodic protection effect can not be achieved, it will be the main cause of serious corrosion of pipelines and greatly reduce the service life.

In the petroleum medium, there is a certain content of sulfur, which is a core factor causing pipeline corrosion, because crude oil often contains sulfur, which will cause a certain degree of sulfur precipitation compounds in the pipeline. In general, the above compounds will react with the iron element in the pipeline to further produce ferrous sulfate compounds. However, in terms of these ferrous sulfate compounds, they contain free acid, which will cause hydrolysis reaction. Based on the above, the corrosion is aggravated. In the process of natural gas transportation, there is often transportation stress. Once this aspect shows a certain degree of fluctuation, it will cause corrosion and some slight cracks. After a period of time, the small cracks will show the trend of expansion and expansion, resulting in the final large break.

![Fig. 1 Corrosion of oil and gas pipeline](image)

3. Corrosion protection technology of oil and gas gathering and transportation pipeline

On the whole, there are two main forms of pipeline corrosion, namely internal corrosion and external corrosion. Due to the difference of pipeline corrosion, the operation should be carried out with the help of targeted anti-corrosion measures. Nowadays, the inner coating technology has been widely used. Generally speaking, internal anti-corrosion technology can be divided into several types, mainly corrosion inhibitor technology, internal coating technology and composite pipe technology. As far as the inhibitor technology is concerned, the application of this technology is to mix the inhibitor and inject it into the pipeline, so as to achieve the purpose of corrosion mitigation. In terms of internal coating, the technology originated in other countries and has been widely used. However, due to the late entry into China, the technology has been stagnant in China, and there is a gap with advanced technology. Nowadays, the anti radiation inner coating of oil and gas gathering and transportation pipeline in China
mainly includes epoxy type, improved epoxy type, epoxy phenolic type and polyurethane type. In the third technology, composite pipe is mainly made of ceramic and other materials. By comparing with other technologies, it can be seen that glass lined composite pipe can play a great role. Firstly, it can ensure the strength of steel pipe, and secondly, it can promote the effective strengthening of anti-corrosion performance.

4. Analysis of corrosion protection measures for oil and gas gathering and transportation pipelines

4.1. Technical measures for cathodic protection

In order to reduce the corrosion rate of pipeline, cathodic protection must be carried out, and the protected pipeline should be treated as cathode to protect it, so as to avoid corrosion of metal pipeline. Detailed operation countermeasures are sacrificial anode cathodic protection measures and impressed current cathodic protection measures. According to the difference of pipeline system, targeted cathodic protection operation is carried out. Through the relevant field analysis, it can be seen that in terms of the implementation effect, regular maintenance and maintenance is the most effective countermeasure, and it is better used in oil and gas transmission engineering. In the selection of anode materials, we should use some of the best materials, such as graphite, so as to realize the efficient protection of the pipeline, avoid the corrosion of the metal pipeline, and thus cause potential safety hazards, the ultimate loss.

4.2. Monitoring technical measures for oil and gas pipeline corrosion

In the process of oil and gas pipeline laying, it is often laid in different soil, so there are great differences in the corrosion. Generally speaking, even a gas pipeline may come into contact with many soils with different properties. In the aspect of pipeline, there are many physical and chemical properties in the surface layer, which will lead to the deepening of pipeline corrosion. If we want to face this situation, we should complete the corresponding anti-corrosion work. In this process, we should pay enough attention to the chemical reaction, and in this process, electrochemical reaction is one of the key components. In the analysis of electrochemical reaction, there should be not only the metal as the electrode, but also the electrolyte which can reflect the environment. Thirdly, there must be a conductive circuit. In general, when the pipeline laying operation, we must pay attention to the necessary detection work, especially the environmental corrosion work. If we want to achieve the effective completion of this work, we can carry out the active measurement of soil corrosivity. Through this work, we can finally have a more comprehensive and in-depth study and judgment on the actual corrosion of the pipeline. In view of the actual situation in China, a series of evaluation parameters and evaluation standards have been established to evaluate the internal corrosion degree of optical fiber based on soil corrosivity. For example, in the process of specific pipeline corrosion detection, the first work that technical personnel should complete is to scientifically and effectively grasp the soil corrosion situation in the area, including corrosion mode, corrosion law and other related contents. Next, focus on the soil in the area, and carry out effective measurement of the current, so as to achieve effective analysis and evaluation of the whole corrosion situation. In addition, study and judge the current service life of the pipeline. In the aspect of non excavation detection of external anti-corrosion coating, the monitoring operation is often carried out with the help of the situation that the external anti-corrosion coating of pipeline is damaged. Now this technology has been better developed and relatively mature. It should be noted that if this technology is adopted in the detection process, the staff should carry out the effective evaluation of current attenuation value, and also carry out the closely spaced potential test associated with it. Through the use of the above technology, the corrosion condition can be well studied and judged, So as to realize the analysis and evaluation of the overall corrosion status of oil pipeline and the stripping of anti-corrosion coating. In the aspect of cathodic protection monitoring, in the specific application process, the relevant staff must measure the potential of the oil pipeline and the potential along the pipeline. After obtaining the corresponding values, they should use the power-off measurement method and the near reference
method to realize the effective analysis of the falling off condition of the anti-corrosion coating inside the pipeline.

4.3. Improve the corrosion resistance of petroleum and gas pipelines with the help of different types of coating technology

In order to strengthen the corresponding anti-corrosion measures, technicians should also carry out coating operation, so as to promote the effective strengthening of anti-corrosion ability. In the whole anti-corrosion work of oil pipeline, coating technology is widely used. With the help of these special anti-corrosion materials, the service life of pipeline can be effectively extended, and the appearance and corresponding performance of pipeline will be better. For example, technicians use coal tar enamel coating technology to carry out the corresponding anti-corrosion work. The application of this material, especially in the surface layer of the pipeline, can well isolate the external water, so as to prevent the erosion of the pipeline, and the use of this material can also enhance the antibacterial property of the pipeline to a considerable extent. However, it should be noted that when using this type of coating material, we must pay attention to its pollution. Today, the technology is no longer widely used, slowly out of the market. In addition, technicians can also use epoxy powder to carry out the corresponding coating protection. When it is applied to the surface of the pipeline, it can promote the internal stress, at the same time, it can strengthen the anti-wear ability of the pipeline. As far as the epoxy resin material is concerned, it has a considerable degree of rigidity and can also play a good role in isolating water.

![Anticorrosion coating of oil and gas pipeline](image)

Fig. 2 Anticorrosion coating of oil and gas pipeline

4.4. Improvement of pipeline corrosion resistance with the aid of patching technology

If there is a corrosion gap in the pipeline, we should pay attention to this technology, so as to realize the effective repair of the corrosion gap, so as to strengthen the anti-corrosion performance and prolong the service life of the pipeline. In today's specific situation, the following two kinds of technology are often used in the pipeline joint repair operation: hot asphalt pouring joint repair technology and polyethylene material joint repair technology. For example, if the operation is carried out with the help of hot asphalt pouring and patching technology, the division of labor and cooperation should be carried out. First, the asphalt material should be melted, and then it should be poured to the corrosion notch. After the pouring, the technician must also carry out the covering operation, that is, the corresponding protection winding should be carried out on the outside of the pipeline, so as to prevent the entry of impurities. And avoid damage to the effect of the joint. However, in the application of this technology, the relatively old
pipeline is often used. In addition to the above technology, polyethylene material can also be used to carry out the relevant joint patching operation. In terms of this technology, when carrying out the joint repair operation, the primer should be used for the coating operation first, and then the corresponding winding operation can be carried out on the outside, so as to achieve effective protection, and the winding material must be polyethylene tape. With the help of polyethylene material, the external performance of the pipeline can be greatly improved.

5. Conclusion
In general, in order to strengthen the overall anti-corrosion ability and pipeline stress of oil and gas gathering and transportation pipeline, technicians must pay enough attention to some key points. Based on the analysis of the causes of pipeline corrosion, the corresponding protective measures are constructed. It can be seen from the above that the effective protection of the pipeline can be achieved with the help of pipeline inner coating technology. The application of scientific and feasible anti-corrosion measures can greatly extend the service life of the pipeline and effectively reduce the transportation cost.

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