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Some Information about the Corrosion in Engines

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Abstract

Hazardous causes of some of the harmful compounds in the fuel system that cause corrosion on the material of the fuel system. Therefore, the operation and assurance of smooth operation of the system is a requirement. One of the major causes of operator headaches is erosion. The protection and detection of corrosion is the number one requirement. In this paper, the main causes and proposed anti-corrosion measures are proposed to overcome corrosion in the engine.

Keywords: engine corrosion, fuel system, corrosion protection

Introduction

First, we can understand metal corrosion is the self-destruction of metal by its chemical and electrochemistry with the external environment. Or a definition of metal corrosion is the spontaneous destruction of metals caused by chemical or electrochemical processes that occur on the surface of metals exposed to the external environment (eg, atmospheres, seawater, environmental reaction, etc.). The most common type of metal rust is rust. Rust (with $Fe_2O_3 \cdot nH_2O$ content) is unstable and spongy, so it does not protect the iron from corrosion. Every year about 10% of exploited metal is corroded, unusable. There may be resist metal erosion by coating, glazing, protective film, plating of hard-to-corrosive metal such as chromium, nickel or by using a brush. Corrosion is a kind of damage to the piping system, which accounts for about 20-25% of recorded defects, and is often dangerous. Measures should be taken regularly to prevent corrosion or stop the use of hazardous gas to avoid disasters. Damage caused by the impact of external forces such as digging, anchoring, improper installation or material errors are evaluated more important. However, the corrosion of the pipe system will reduce the resilience of these external forces or exacerbate weaknesses in the material or structure. Preventing corrosion should be taken into consideration throughout the process: from design, installation, testing and during operation. Once the erosion has occurred, minimizing its impact on the integrity of the system is very difficult.

Often the separation between project and operation makes it difficult to control corrosion. The project often tries to create a pipeline system capable of working within the time frame and financial need. As such, the process of operation may require a non-optimal system and a high cost of corrosion protection. There is always a balance between capital and operating costs, so careful analysis is needed to select the best anti-corrosion method to achieve the best economic equilibrium. The biggest difficulty in assessing the economy is uncertainty about its longevity and operating history. Normally, corrosion costs account for 10-20% of total project cost and 0.3-0.5% of operating costs.



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Image 1: Some corrosion phenomenon

Classification

Pipeline corrosion is divided into two types: internal corrosion and external corrosion.

The internal corrosion process depends on the operation of the pipe, which is divided into the following categories:

Sweet corrosion: Caused by the presence of solute carbondioxide, also known as carbonic acid corrosion, mainly localized corrosion and erosion of the hole.

Sour corrosion: Due to hydrogen sulphide, this process can cause very rapid failure due to cracking of the steel layer of the pipe.

Water in the pipeline: The process of erosion due to oxygen and water,

Erosion by organisms: Due to the development of organisms in the pipeline,

The process of external corrosion is mainly electrochemical corrosion,

Local corrosion: Very common corrosive form, it is a process of erosion that occurs due to changes in environmental conditions. This process is easy to control and prevent. However, it may be difficult to locate the measurement.

Corrosion holes: The difference between local erosion and whole erosion is sometimes confusing. Corrosion of the hole is actually due to completely isolated corrosive sites, most of the metal around is not affected. For carbon steel, these holes tend to grow in the hemispherical shape and several holes overlap each other, creating large clamshell erosion. For anti-corrosion alloy steel, these holes are usually small but deep in diameter and often form clusters. Intergranular form is very rare for carbon steel unless there is inhomogeneity in the locations of the welds, usually caused by sulphide and nitrate, but the alloy type is very sensitive to corrosion.



Image 2: Engine corrosion

Corrosion combined with cracking stresses: a very widespread form of corrosion that can be limited and prevented by careful and proper selection of materials, installation and operation. Corrosion occurs with a combination of stresses occurring and special environmental conditions. Pipelines may be cracked in acid or hydrogenated soils. Anti-corrosive alloys can be cracked in chloride.

Floating foam: occurs in acidic environments, due to the heterogeneous metal structure in steel, mainly occur in tanks. The corrosive reaction releases hydrogen atoms and some can penetrate the structure of the steel, which then forms a hydrogen gas molecule. This gas cannot escape, so it concentrates to create high pressure causing the foam to appear on the surface.

Fatigue: less in the pipeline. Any cyclic stress formation becomes dangerous if there is a corrosive agent present. Sulphide environments are particularly dangerous for this type.

Corrosive sweetness: The main reason for the assessment of corrosion in multi-phase systems is the transport of untreated gas, moist air, and gaseous liquid to offshore piping systems. Especially with the development of satellite systems, the gases are not processed immediately but are transported to a separate processing center, possibly onshore or offshore. So the point to consider here is that pipes that can be made with carbon steel are often designed with a much more expensive corrosion-resistant material.

Sweet corrosion is mainly in the form of erosion holes and local erosion, the bottom of the pipeline is strongly influenced. Metallic surfaces are covered by a layer of film siderite but are often broken locally, at locations where the film is broken. The erosion process is much faster than in areas with stable film. Factors affecting the sweet corrosion process:

- The amount of water present in the oil and gas.
- Metal area exposed to water
- Presence of H₂S

Chlorite content (high salt content increases the rate of corrosion but quickly becomes saturated).



Image 3: The chemical-electronic corrosion

For oil-water systems: When the water-oil ratio is low, and the movement speed of the oil is large enough, the water is swept upstream of the oil and not wetted on the steel surface, so there is no corrosion. As the velocity is lower than the nominal value, the water and oil separate and start to erode. This velocity can be calculated based on many factors such as surface tension of oil and water, viscosity. With most crude oil, this velocity is about 0.8m / s. The

limited amount of water that can be brought into the oil prior to becoming a continuous phase is estimated according to the type and nature of the oil, about 20-30% of the water in the oil does not produce erosion.

For gas-liquid systems: Over 600C the presence of CO₂ leads to the formation of a protective carbonate layer, which prevents further erosion, but this layer is susceptible to erosion, if the rate of erosion is low, steel will create another carbonate substitute. However, when the velocity of erosion is high, the replacement carbonate layer does not form in time, the process of erosion occurs, this phenomenon is called erosion - corrosion. From practical experience, the flow velocity can reach up to 20m/s.

Causes

Corrosion of solids in pipelines: The presence of solids in pipelines, especially metals, has a great impact. As it breaks down the siderite layer, the process of erosion occurs more quickly and can cause perforation for several weeks, the process known as erosion-erosion. For the given flow, the damage is best seen at curved locations or areas with high turbulent flow. Therefore checking the level of sand in the flow at different speeds is necessary. A small amount of sand about 3-5 lb/1000lbs can be ignored, when the amount of sand is greater than that it should be minimized. For gas pipelines, the presence of sand also increases the rate of corrosion and is similarly calculated.



Image 4: Diesel engine corrosion

Sour Corrosion: Sour erosion occurs in piping when it contains hydrogen sulphide, the level of sulphide to be sour is not precisely defined but generally accepted when its partial pressure is 0.05psi (0.34Kpa). Sulfide-induced corrosion has the following forms:

- + Erosion hole from deposition of solid cathodic acid
- Corrosion of the hole at the film/sludge layer is broken
- + Cracking due to sulphide corrosion
- + Fracture - foam caused by hydrogen pressure

Erasing point: Solid sulphides are formed from the reaction of the fluid with iron during corrosion or reaction with heavy metals in the fluid, mainly iron sulphide, some magnesium sulphide (MnS) and zinc sulphide, these solid sulphides become anode relative to iron and form the electrochemical corrosion process as they bind to the surface. Each iron sulphide molecule is only destructive to a certain mass of metal, after which they become active. This is partly explained by the absorption of H₂ into sulphide crystalline lattice, and partly based on the formation of sulphide-coated hydroxides.

In sour liquors with low concentrations of heavy metals, hydrogen sulphide reacts with the metal on the surface forming a sulphide layer. This film prevents further corrosion of the metal inside, but if the film is extruded and exposed to metal, it will form a galvanic battery with a metal cathode when exposed; the anode is the entire film sulphide layer, causing the speed of erosion to occur very quickly, the new film layer is not capable of forming. In mildly acidic environments, the film is made up of a mixture of siderite and iron sulphide, the percentage of sulphide in the mixture increases as the hydrogen sulphide level increases and reaches 100% when the hydrogen sulphide concentration reaches 100 ppm, and in the concentration. This type of corrosion, such as cracking due to hydrogen or foam, becomes severe. When low sulphide levels have the potential to reduce sweet corrosion due to increased toughness of the siderite layer, this protection is well appreciated at high temperatures, however it is unreliable and can lead to erode holes. The factors that affect the stability of the film include salt concentration, temperature cycles and metal structure.



Image 4: Hydrogen corrosion

Hydrogen sulphide corrosion cracking: Sulfide stress corrosion cracking (SSCC) is a type of corrosion cracking. The SSCC is formed by the action of metal hardening of hydrogen, which combines the effects of stress and the acid environment on hard materials. This problem occurs when acid reacts with metal to release hydrogen at the metal surface. Hydro forming follows these steps:

Diffuse ions to metal surfaces

The hydrogen ion receives an electron and forms a hydrogen atom

Atomic hydrogen enters the surface

The combination of hydrogen atoms makes up hydrogen molecules. The hydrogen atoms penetrate the steel and concentrate in the void in the steel, which is the defect of the metal crystals. Most of the holes appear at high stresses due to the overlapping of metal atoms. Hydrogen penetrates and makes the steel hardened by preventing stress release. When curved bending locally, if the stress exceeds the standard value, the steel becomes crispy and the stresses are not dissipated by the crystal lattice.

The fracture process is divided into two phases: the beginning and the wide spread, both of which are not quantifiable. The standard procedure for the level of hydrogen sulphide that causes the SSCC is about 0.05 psia (partial pressure).

Hydrogen Fracture: This is a form of foam, also called a hydrogen cracking process, cracking the stairs. The hydrogen atom diffuses into the steel and is adsorbed by manganese sulphide in the steel. There the hydrogen atoms combine to form molecules, which cannot escape, concentrating and causing enough pressure to form cracks in the steel. Small cracks grow and join together into large cracks.

Once the HIC process is in place, the SSCC can penetrate the metal's structure leading to larger cracks. This corrosion-resistant pipeline could still operate until the new pipeline system was replaced, but the pressure was reduced to reduce the corrosion rate.

Water from pipeline water: Water is often pumped into the oil field to maintain pressure, while also facilitating the flow of oil to the mine. The main corrosive component in seawater is oxygen. If using groundwater, there is no oxygen, but CO₂ or H₂S may be present and may lead to corrosive or abrasive wear.

The product from the steel corrosion process is very much and can seal the pump water into the mine, the oxygen is removed from the water to minimize the erosion. If the mine has excess gas can be removed by gas stripping or can be removed by mechanical means. For gas separation process, water and gas flow in opposite directions. This method is highly effective in eliminating oxygen but can lead to acidification of water if carbon dioxide is highly adsorbed. In mechanical gases, water is injected under vacuum, which is less effective than gas separation and requires the aid of chemical treatment (such as ammonium bisulphide NH₄HS). Seawater is often separated from gas to reduce oxygen levels, the desired concentration is 5-10ppb, but at such a low level the rate of corrosion is still very fast. **Microbial corrosion:** Oil and water pipelines can suffer from corrosion from the development of sulfur reducing bacteria (SRB). This bacterium grows along with many other bacteria. SRB is an anaerobic bacterium that utilizes the fatty acids found in water and uses oxygen in the sulphate base to oxidize fatty acids. These bacteria stimulate the action of sulphide radicals and enhance sulphide corrosion. During bacterial growth, the pH of the medium increases as the sulphide is combined with water to form hydrogen sulphide, which moves and creates an acidic environment elsewhere. So although bacteria grow in one place, they can cause problems elsewhere.

Electrochemical corrosion: Electrochemical corrosion is a chemical phenomenon that is closely related to metal, the process of corrosion occurs in the electrolyte environment, ie the presence of water such as oil emulsion. Electrochemical corrosion occurs mainly at the outer surface of the pipe.

Caps are working in high pressure, high pressure, unevenly distributed. This is often caused by damage such as warping, rupture of combustion chamber buried in soot, corrosion of the cavity due to water in the presence of many contaminants. Latches are broken due to incorrect installation and technical process. The cushions are broken due to long working days.

All these failures result in leakage, leakage, oil loss and reduced compression ratio of the engine. Water enters the combustion chamber causing piston breakage, breakdown for the crankshaft-lever mechanism. Coal combustion on the combustion chamber will cause detonation, soot falls down to scratch the cylinder - piston, tear clamping. As a result, the engine will not work.

The body cracks, breaks due to piston rod problems, or by pouring cold water on hot engine. Reducing the power of the motor or motor will not work.

Water pipes, water bodies are often chemically abrasive. Clogging or puncturing the cooling water pipeline, resulting in lack of or absence of cooling water when the engine is working, causes the engine to heat up rapidly, reduce engine power, and reduce engine life.

Lubricating oil lines are dirty, clogged by long working days. Causing lack of lubricating oil or lubricating oil to work surfaces makes these components wear out quickly, leading to reduced engine power, decreased engine life. Corrugated holes are damaged due to unplugging, improper installation, making it difficult to repair, maintenance.

To avoid being corrosion in engine, it is necessary to use some methods, such as:

Austenitic stainless steels are non-magnetic steels used primarily in processing plants and gas plants, with relatively high levels of stainless elements ranging from 18% Cr, 8% nickel to 27% Cr., 30% nickel and 3% molybdenum, high corrosion resistance, but susceptible to cracking under corrosion stress if chlorine is present (limit of chlorine is about 50-100ppm at 600C). It is used primarily as a surface coating for pipes, tanks or small details of carbon steel. Austenitic stainless steel is susceptible to cracking, which is very susceptible to damage on a large scale as corrosion resistance deteriorates. Cost is about four times that of ordinary carbon steel, which is easy to weld. However, carburization of welds and surrounding areas should be avoided as high temperatures reduce corrosion resistance, enhance stability by reducing the carbon content by about 0.05% and adding an integer Stabilizers such as titanium or niobium.

Duplex Stainless Steel: Component C: 0.03-0.05%; Cr: 22-25%; Ni: 5-6%; Mo: 3-6%, 6 times the cost of conventional carbon steel, the steel is almost a mixture of ferrite and austenitic, good rust resistance, weldability and durability than austenitic steel.

High nickel alloy steel: The cost of this material is relatively high compared to other types, mainly due to the high anti-rust properties. The content is as follows: Ni: 28-56%; Cr: 21-22%; Fe: 5-22%; Mo: 3-9%; Cu 2%; Nb 4%; Ti 1%. Excellent corrosion resistance, commonly used in the manufacture of strong acids. Offshore pipelines are usually coated with a high grade of alloy steel, with relatively lower costs, ranging from 7-10% of conventional carbon steel.

Conclusion

The effect of corrosion in piping is a quite complex matter. It is essential to protect the system against unfortunate damage, as the failure of the system not only results in economic losses, but also in environmental pollution. In this article, information is limited to identifying the cause and specific anti-corrosion behavior.

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