DOWNLOAD PDF CORROSION INHIBITORS PRINCIPLES AND APPLICATIONS

Chapter 1 : Corrosion Monitoring and Inhibitors for Production Tubing in Gas Wells

Chapter 16 Corrosion Inhibitors - Principles, Mechanisms and Applications Camila G. Dariva and Alexandre F. Galio Additional information is available at the end of the chapter.

Dariva and Alexandre F. Galio Additional information is available at the end of the chapter http: Introduction Corrosion processes are responsible for numerous losses mainly in the industrial scope. It is clear that the best way to combat it is prevention. Among the various methods to avoid or prevent destruction or degradation of metal surface, the corrosion inhibitor is one of the best know methods of corrosion protection and one of the most useful on the industry. This method is following stand up due to low cost and practice method. The focus of these researches has being the inhibitors applications in water and concrete for the protection of metals. However, many showed up as a secondary effect, damage the environment. Thus the scientific community began searching for friendly environmentally inhibitors, like the organic inhibitors. Is describes the mechanisms of action of inhibitors, main characteristics, environmental impact, technical analysis and calculation of efficiency. Mechanisms of actions of Rust inhibitors Inhibitors are substances or mixtures that in low concentration and in aggressive environment inhibit, prevent or minimize the corrosion. This is a paper distributed under the terms of the Creative Commons Attribution License http: Generally the mechanism of the inhibitor is one or more of three that are cited below: Historic review of rust inhibitors There are many industrial systems and commercial applications that inhibitors are applicable, such as cooling systems, refinery units, pipelines, chemicals, oil and gas production units, boilers and water processing, paints, pigments, lubricants, etc. On that time they were already used to protect metals in processes such as acid picking, protection against aggressive water, acidified oil wells and cooling systems. In they estimated that the market demand of inhibitors was divided on Due to high toxicity of chromate, phosphate and arsenic compounds, related to various environmental and health problems, strict international laws were imposed. Reducing the use of these and therefore increasing the need for the development of other inhibitor to supply the lack in this area. Should, however, present a similar anti corrosive properties similar than a chromate inhibitor. When extracts of Chelidonium majus Celadine and other plants were used on the first time in H2SO4 pickling baths. Successful developments of researches to obtain natural corrosion inhibitors are growing as quickly as the environmental consciousness is gaining ground. Also, drugs have been studied as corrosion inhibitors. Rust Inhibitors classifications classified by: The organics inhibitors have both actions, cathodic and anodic and the protective by a film adsorption. This chapter is subdivided in according to the classification of the inhibitors shown on the Figure 1 The corrosion inhibitors can be chemicals either synthetic or natural and could be Figure 1. Classification of inhibitors 2. Inorganic rust inhibitors 2. Anodic rust inhibitors Anodic inhibitors also called passivation inhibitors act by a reducing anodic reaction, that is, blocks the anode reaction and supports the natural reaction of passivation metal surface, also, due to the forming a film adsorbed on the metal. In general, the inhibitors react with the corrosion product, initially formed, resulting in a cohesive and insoluble film on the metal surface. The anodic reaction is affected by the corrosion inhibitors and the corrosion potential of the metal is shifted to more positive values. As well, the value of the current in the curve decreases with the presence of the corrosion inhibitor. From the hydrolysis of inhibitors results in OHâ€" ions. Illustration of anodic inorganic inhibitors effect and their mechanism of action. When the concentrations of inhibitor becomes high enough, the cathodic current density at the primary passivation potential becomes higher than the critical anodic current density, that is, shift the potential for a noble sense, and, consequently, the metal is passivated. The inappropriate amount of the inhibitors affects the formation of film protection, because it will not cover the metal completely, leaving sites of the metal exposed, thus causing a localized corrosion. In general can cause pitting, due reduction at the anodic area relative to cathodic, or can accelerate corrosion, like generalized corrosion, due to full breakdown the passivity. Cathodic rust inhibitors During the corrosion process, the cathodic corrosion inhibitors prevent the occurrence of the cathodic reaction of the metal. These inhibitors have metal ions able to produce a cathodic reaction due to alkalinity, thus producing insoluble compounds that precipitate selectively on cathodic sites. Deposit over the metal a compact and adherent film, restricting the diffusion of reducible species in these areas. Thus, increasing the impedance of the surface and the diffusion restriction of the reducible species, that is, the oxygen diffusion and electrons conductive in these areas. These inhibitors cause high cathodic inhibition. When the cathodic reaction is affected the corrosion potential is shifted to more negative values. The cathodic inhibitors form a barrier of insoluble precipitates over the metal, covering it. Thus, restricts the metal contact with the environment, even if it is completely immersed, preventing the occurrence of the corrosion reaction. Due to this, the cathodic inhibitor is independent of concentration, thus, they are considerably more secure than anodic inhibitor. The Figure 5 shows the illustration of mechanical effect of cathodic inhibitors to restrain the corrosion process. Illustration has shown the mechanism of actuation of the cathodic inhibitors. Some examples of inorganic cathodic inhibitors are the ions of the magnesium, zinc, and nickel that react with the hydroxyl OHâ€" of the water forming the insoluble hydroxides as Mg OH 2, Zn OH 2, Ni OH 2 which are deposited on the cathodic site of the metal surface, protecting it. It seen in hard waters a kind of this mechanism of inhibiting, due to the effect of the magnesium or calcium bicarbonate on it. When temporary hard water flows over the metal it can assist on the nucleation of carbonates, allowing the reactions near to the equilibrium and forming precipitations on the metal surface. These precipitations, like a CaCO3, cover the cathodic area, protecting the metal. So these cathodic inhibitor depends only on the chemistry of the water, is not due the metal composition, because of this they are applicable to all metals. These cathodic inhibitors minimize the release of hydrogen ions due to a phenomena that can difficult the discharge of the hydrogen, called overvoltage. Organic rust inhibitor Organic compounds used as inhibitors, occasionally, they act as cathodic, anodic or together, as cathodic and anodic inhibitors, nevertheless, as a general rule, act through a process of surface adsorption, designated as a film- forming. Naturally the occurrence of molecules exhibiting a strong affinity for metal surfaces compounds showing good inhibition efficiency and low environmental risk. They must be soluble or dispersible in the medium surrounding the metal. Theoretical potentiostatic polarization diagram: Is showed in Figure 7 the mechanism of actuation of organic inhibitors, when it is adsorbed to the metal surface and forms a protector film on it. Illustration of the mechanism of actuation of the organic inhibitor: Where the Inh represents the inhibitor molecules. The efficiency of an organic inhibitor depends of the: The polar function is usually regarded as the reaction center for the establishment of the adsorption process. Techniques for analysis of rust inhibitors The most usefully technique to analysis the effectiveness of an inhibitor are weight loss experiment and electrochemical measurements, like polarization curve method and the impedance measurement analyzing. In addition, microscopy techniques are used to characterize the corrosion process. Considerations to employ rust inhibitors For all types of inhibitors, we should consider some environmental actions factors because some elements such as metals, pH, composition, impurities, agitation, temperature, geometry of the system, the concentration of inhibitor and the mixture of one or more inhibitors may change the anti-corrosive mechanism. Four fundamental aspects must be analyzed to obtain a satisfactory result from the use of the inhibitor. Rust inhibitor efficiency The inhibitor efficiency could be measured by the follow equation: Industrial application Acid pickling: Prevent the attack in the metal due to the acid solution in which metal gets cleaned of mill scale bark lamination , and also prevented the subsequent hydrogen evolution inhibitors are added, typically organic, must be soluble or dispersed in the solution. Pipes for gasoline and kerosene are employed sulphonated oils, sodium nitrite. Oil well uses up fatty amines, fatty acids, imidazolines and quaternary ammonium salts. Internal pipe corrosion occurs in wet gas transportation due to condensation of water containing dissolved corrosive gases. Corrosion is caused by the dissolution of the corrosive gases, such as carbon dioxide and hydrogen sulfide as well as condensation of acid vapors [42]. Water transmission and distribution systems: To improve the durability of reinforced concrete structures, which are impaired due the high alkalinity, are used corrosion inhibitors, mixed with cement or concrete paste. An example is phosphate ion. Thermoelectric use, in general, Ammonia, Cyclohexylamine, alkanol and

Morpholine as inhibitors in boilers in various processes. The inhibitors, also, are added by the hydrochloric acid used for the solubilization of limescale to prevent the attack on pipes. Conclusion Inhibitors are a great method of preventing corrosion and are easy to apply. Has application in a wide range of sectors The knowledge of the method of the action, facilitates the choice of the inhibitors, improves efficiency, avoids the process is impaired and side effects. It is important in the choice of inhibitor, ascertain the subsequent effects of this towards the environment. The search for environmental friendly inhibitors has shown excellent results, outperforming conventional inhibitors. Reference organic inhibitors newly developed 7.

Chapter 2 : Corrosion by Terence Hong on Prezi

Corrosion Inhibitors, Principles and Recent Applications Edited by Mahmood Aliofkhazraei To protect metals or alloys from corrosion, some methods can be used such as isolating the structure from the aggressive media or compensating the loss of electrons from the corroded structure.

Email In oil and gas drilling, a crew drills the well and puts a casing large-diameter steel pipe into the well. The diameter of the casing pipe decreases as it goes further down the well. At the top is the largest diameter pipe, known as the conductor pipe, then the surface casing, intermediate casing, and production casing pipes. Cement is placed in the annulus outside the casing to improve its strength. The production casing is perforated at the bottom i. A smaller diameter tubing is then run through the casing from the wellhead to the production zone of the well downhole , and a packer is fixed in place to secure the production tubing above the perforations in the production casing. This packer allows the fluids to enter the production tubing, while preventing entry into the upper portions of the casing Figure 1. Importance of Production Tubing Corrosion Prevention In gas wells, production tubing material is selected by specialists based on the corrosivity of the producing fluids. A chemical treatment program may be combined with the selection of a tubing material that is resistant to corrosion. Corrosion prevention of production tubing is critical to avoid hampering production and incurring replacement costs. In addition, production fluids may enter into the annulus between the production tubing and the casing, resulting in corrosion of the casing, which is not designed to withstand contact with production fluids. This can render the well unusable. Typical Nature of Gas Well Production Tubing Gas well production tubing, from wellhead to downhole, is typically exposed to large changes in pressure, temperature, water condensation, surface wetting, liquid-to-gas ratio, and other factors. A decrease in pressure will result in the fluid stream being undersaturated with water vapor. Consequently, the dew point of water in the production tubing will occur at some distance from the bottom. From end to end, the condition of the tubing will change considerably, even though it is the same material throughout. When formation connate water is produced, the dew point occurs further down in the tubing, but liquid water is seldom found at the bottom. If the formation water evaporates in the region near the wellbore, it will leave behind any minerals it contained, which leads to scale formation. Selection of a Suitable Corrosion Inhibitor for Downhole Injection of Gas Wells Many downhole conditions typically change, including well-to-well, time-to-time, production rates, quantity of formation water, water condensation, pressure changes, and temperature changes. Consequently, conventional inhibitors might not work properly in downhole conditions. A tailor-made inhibitor is often prepared by simulating downhole conditions in a laboratory. Corrosion inhibitors should protect production tubing from gas and liquid phases of well fluids, as well as perform effectively under high-temperature and high-pressure downhole conditions. In addition, the inhibitor should be dynamic and able to rapidly distribute between liquid and gas phases as changes occur in production tubing fluids from the bottom of the hole to the wellhead. A high-pressure injection system is required to pump the corrosion inhibitor. Installing the injection facility at the time of well completion is essential, with the mandrel at the suitable level below the packer and the injection line running from wellhead to mandrel. Injection line flow without blockage must be confirmed at the time of well completion. Injecting the chemical at the required dosage is also critical. Injecting less than the prescribed amount will not provide corrosion protection, while injecting too much would be wasteful, cause increased expenditure, and could form a downstream emulsion with produced water. Corrosion Monitoring At a minimum, checking the concentrations of chlorides, total dissolved solids TDS , iron content, carbon dioxide CO_2 , and hydrogen sulfide H_2S ; the pH of the wellhead water; and the quantity of water production from the well is essential. Normally, iron content will give some idea about the corrosion activity of a pipeline in onshore conditions; but in production tubing of a gas well, there will be huge changes in the liquid to gas phases from the bottom of the hole to the wellhead. Water might condense in between or evaporate downhole, which can cause changes in the concentrations of TDS, chlorides, and other ions. Checking the corrosion inhibitor residuals to verify adequate protection is essential. Placing real-time corrosion rate monitoring probes and periodically monitoring corrosion coupons immediately downstream of the wellhead are important, too. Retrievable corrosion history instruments are also available for downhole corrosion monitoring and can provide data for the period between installation and retrieval. Table 1 lists types of monitoring tests, usage frequency, and type of data collected. A corrosion monitoring schedule is suggested based on experience with gas wells. Continuous monitoring or pressure alarms in the tube-to-casing annulus represent a proactive approach to corrosion monitoring, because a hole formed in the production tubing can cause production fluids to leak into the annulus with a corresponding increase in the annulus pressure. This can cause corrosion of the well casing, which can be severe. With early detection, corrosion damage can be limited to the production tubing, and the casing can be saved. Mallavaram, Tallarevu Mandal, E. He has more than 14 years of experience in chemistry and corrosion of oil and gas production operations, including experience establishing a chemistry laboratory and corrosion monitoring system. He has an M. He is the author of several journal articles and is a year member of NACE.

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