EFFECT OF SOME INHIBITORS ON THE CORROSION BEHAVIOUR IN OIL FIELD PRODUCTION

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بسم الله الرحمن الرحيم

بسم الله الرحمن الرحيم

قالوا سبحانك لا علم لنا إلا ما
علمتنا إنك أنت العليم الحكيم .

صدق الله العظيم
البقرة - ٣٢ -

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The theoretical curricula for the Degree Beside the work carried out in this thesis the student has accomplished successfully the post graduate studies for the partial fulfillment of the M.Sc. degree in the following topics:

1. Electrochemical Methods of Analysis.
2. Advanced Electrochemistry.
3. Molecular Structure.
4. Computer Science and its Application in Chemistry.
5. Group Theory and its Application.
6. Nuclear and Radiation Chemistry.
7. Molecular Spectroscopy.
8. Advanced Separation Techniques.
9. Organometallic Chemistry.
10. Inorganic Reaction Mechanism.

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INTRODUCTION

1. INTRODUCTION

1.1. Corrosion and Corrosion Control:

In its broadest sense, corrosion can be defined as the deterioration of a substance (usually a metal) or its properties because of a reaction with its environment[1].

The driving force that causes metals to corrode is a natural consequences of their temporary existetence in metallic form. To reach this metallic state from their occurrence in nature in the form of various chemical compounds (ores), it is necessary for them to absorb and store up for later return by corrosion, the energy required to release the metals from their original compounds. The amount of energy required and stored varies from metal to metal. It is relatively high for metals such as magnesium, aluminium and iron, and relatively low for metals such as copper and silver[2].

Practically all environments are corrosive to some degree. Some examples are: air and moisture; fresh, distilled, salt and mine waters, rural, urban and industerial atmospheres, steam and other gases such as chlorine, ammonia, hydrogen sulfide, sulfur dioxide, and fuel gases, mineral acids such as hydrochloric, sulphuric and nitric, organic acids such as naphthenic, acetic and formic; alkalies, soils, solvents; vegertable and petroleum oils and variety of food products.

In general, the "inorganic" materials are more corrosive than the "organics". For example, corrosion in the petroleum industry is due more to sodium chloride, sulphur, hydrochloric and sulphuric acids, and water than the oil, naphtha, or gasoline[3].

1.1.1. The Nature of Metals:

Commerical metals are not homogeneous but contain inclusions, precipitates, and perhaps several different phases. When the metal is placed in an electrolyte, potential differences exist between these phases, resulting in corrosion cells on the metal surface. For example, steel in an alloy of iron and carbon. Pure iron is a relatively weak, ductile material. When it is alloyed with small amounts of carbon (usually 0.2 to 1.0%) a much stronger material is created. However, as a result of reacting part of the iron with carbon, we now have a metal composed of two materials: Iron containing dissolved carbon and iron carbide (Fe_3C), the product of the iron-carbon reaction. The iron carbide is distributed within the iron as tiny microscopic islands.[1,4]

1.1.2. Forms of Corrosion:

Destruction by corrosion takes many forms, depending on the nature of the metal or alloy; the presence of inclusion or other foreign matter at the surface; the homogeneity of its structure; the nature of the corrosive medium; the incidental environmental factors such as the presence of oxygen and its uniformity, temperature; and velocity of movement; and other factors such as stress (residual or applied, steady or cyclic); oxide scales (continuous or broken); porous or semiporous deposits on surfaces, built-in crevices; galvanic effects between dissimilar metals; an occasional presence of stray electrical currents from external sources[2].

The eight forms of corrosion may be divided into three categories:

Group I - Those readily identifiable by visual examination.

Group II - Those which may require supplementary means of examination.

Group III - Those which usually should be verified by microscopy of one kind or another (optical, scanning electron, etc.). These are sometimes apparent to the naked eye[4].

Group I:

1. Uniform corrosion. This type of general corrosion is characterized by an even, regular loss of metal from the corroding surface. All metals are subject to this type of attack under some conditions. It is the most desirable form of corrosion in so far as it lends itself most easily to predicting the life of equipment[5].

2. Localized corrosion. In localized attack, all or most of the metal loss at discrete areas. Pitting may occur an freely exposed surface of a metal or all where the surface of a metal or all where the surface in non-homogeneous [has local cells set up by metallurgical differences (composition and structure of the metal)] under deposits of foreign matter or at imperfections in a film or coating[5].

   A particularly notorious form is crevice corrosion in stainless steel which, like corrosion underneath sludge, deposits, must be attributed to differences in aeration of the metal surface. In fact, crevice corrosion may be considered as a special form of pitting corrosion(6,7).

3. Galvanic corrosion. This type of attack is occasioned by electrical contact between dissimilar conductors in an electrolyte (e.g., copper and steel in water). The intensity of corrosion depends primarily on the difference in solution potential between the materials - the furthur apart in the galvanic series, the greater the possible corrosion of the anodic member of the galvanic couple- and secondarly on the effects of relative area and geometry. Conductive film may also cause a galvanic effect on metals (e.g., Fe_3O_4 "magnetite" or "mill-scale" on steel, lead sulphate films on lead in sulfuric acid), and conductive non metals like carbon can function as cathodes to metallic anodes.

Group II

1. Velocity effect. Erosion-corrosion is attack accelerated by high velocity flow, either washing otherwise protective films or mechanically disturbing the metal itself. The true nature of the attack, especially the differentiation of the effects of particular matter in the stream, may require supplementary microscopy, despite the characteristic flow patterns visible to the nacked eye.

   Cavitation is a special form of attack damage caused by the collapes of bubbles formed at areas of low pressure in a flowing stream.

   Fretting is caused by vibratory relative motion of two surfaces in close contact under load. The nature of the wear and determination of the presence of minute oxidation products may require microscopic examination.

2. Integranular corrosion, preferential attack of small areas at the grain bounderies in the metal structure may permit physical removal of whole grains, although only a small amount of metal actually dissolved[4]. Media favouring this attack are chiefly acid solutions, but also neutral chloride solutions such as sea water[8]. This may be apparent to the naked eye, but more often optical microscopy at least is required to confirm the mode of attack[5].

3. De-alloying corrosion. This type of corrosion is the selective dissolution of one component of an alloy, for example, zinc from yellow brass. This may occur layer wise but also plug wise, and then leads to pitting corrosion[5]. Selective corrosion occurs only in alloys, in which two or more metals form a solid solution. In the corrosion process only the less noble component is dissolved to a noticeable extent, while the remainder appears in metallic form even after the corrosion, although with a greatly reduced strength[8].

Group III:

1. Cracking phenomena. These include both corrosion fatigue, a mechanical phenomenon enhanced by non-specific corrosive environments, and environmental cracking, in which a brittle failure is induced in an otherwise ductile material under tensile stress in an environment specific for the alloy system[4]. If static

stress are present in a metal, for example as a result of construction and/or use, and the metal is situated in the electrolyte, this may lead to stress corrosion cracking[9].

2. High temperature corrosion (Chemical corrosion). In which gases at high temperature act on material, can lead to scaling, the formation of thick oxide layers, or in the case of hydrogen gas, to cracking as a result of decarburization[6].

3. Microbial effects. Certain types of bacteria or microbes can influence corrosion when their metabolism produces corrosive species in an otherwise innocuous environment, or when they produce deposits which can lead to electrochemical attack.

1.1.3. Corrosion Control:

There are basically five forms of corrosion control. Total prevention is rarely achieved, although it can be specific instances, and the concept of corrosion control includes a broad spectrum of techniques ranging from acceptance of finite life (in the case of optimum materials in a selected process) to some quantitative diminution of the rate of attack.

(A) Materials selection:

The most common method of preventing corrosion is the selection of the proper metal or alloy for a particular corrosive service.

The corrosion resistance of a pure metal is usually better than that of one containing impurties or small amounts of other elements. However,