

Corrosion Effect on Ferrous Alloys in the Deep-Sea Water and Different Sea Areas

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Abstract—The paper prepares for corrosion of ferrous alloys in Deep-sea water. It is undergoing uniform corrosion without forming an acquiescent layer is related to the amount of dissolved complex mixture of 96.5 percent water, 2.5 percent salts, and smaller amounts of other substances are sodium, chloride, magnesium, sulphate, and calcium. Some atmospheric gases, inorganic and organic materials are also included with the water of Ocean. The performance of some ferrous alloys measured at the depths of 500, 1000, 3000, and 5300 m in the Indian Ocean, South China Sea & Western Pacific Ocean, the atomic integration qualitative analysis and found that the corrosion product present on mild steel Alloys. It has also observed in deeper waters, no macrofouling was visible, there for corrosion was not related to any biological product but mainly to the micro-chemical reaction of these alloys with sea water. Corrosion behaviour of metallic materials is of higher for Strong degradation of a permanent implant would lead to failure by loss of the device integrity; for high-corrosion resistant metals and alloys that are typically used in such applications, strong active dissolution is, however, not expected.

Keywords—Ferrous alloys; deep sea water; Shallow water; Indian Ocean; mild steel Alloys; stainless steel

I. INTRODUCTION

Estimating according to majority of the volume of ocean in the earth, the deep oceans are the largest geographical Oceans globally. Besides, these areas containing huge family are lives, geological features, and rich mineral resources. For example, the contents of Mn, Ni, Co, and Cu in the seabed are tens to hundreds of times higher with the consumption of land resources [1]. Not only that huge amount of oil and natural gas but also be available from the deep-sea water. Ther for its most essential to development oil and gas resources from ocean by minimizing corrosion of ferrous alloys [2]. The average daily production of oil and gas through the process of deep-water have been remarkably higher than the shallow-water process. So that we need to focus more exploration and development of oil and gas production through the deep-sea water Compared with the shallow water. The deep regions are still less explored because of the developing cost is high. But marine countries are doing great efforts to develop deep-sea technologies, such as underwater unmanned/manned submersibles [3]. Although, deep oceans have different environmental characteristics than shallow water technology and causing the unique corrosion activities of metals which are engage for boring oil from deep-sea water. As a result, the service of equipment in deep seas remains challenging, given the risk of corrosion failure. Therefore, we need develop great anti-corrosion performance for structure materials, like metals and alloys, in deep-sea environments [4].

II. ANALYSIS

There have many studies on the corrosion of ferrous alloys in deep-sea environments been carried out, and reported that the deep-sea technics are challenging of major cost for maintaining the corrosion equipment [5]. According to Naval Construction Battalion Centre conducted a program since 10 years in 19th century, were exposed about 475 alloys in the Pacific Ocean (at nominal depths from 2500 to 5500 feet) to investigate the effects of deep-ocean environments on materials. The corrosion behavior reported that the influence of water depth on corrosion cannot be generalized for different materials, and the pitting and crevice corrosion of aluminium alloys in seawater was more severe at depth than at the surface. In the year 1970, the Soviet Union the corrosion of steels, copper alloys, and aluminium alloys also examined in the Sargasso Sea in the North Atlantic Ocean, but it was observed different results due to the differences in the oceanic character. Venkatesan et al. performed deep-sea corrosion tests in the Indian Ocean from 400 to 5000 m. and reported that, the dissolved oxygen in oceans is a major factor, and the corrosion rate of mild steel was the highest at the depth of 500 m, at which the dissolved oxygen content reached the peak level. Whether, the measure of oxygen is low and stable above 500 m, and corrosion level is saturated after increasing the depth [6]. It is true that deep-sea environment is a complex system, including hydrostatic pressure, dissolved oxygen, and marine organisms are resulting in difficulty of analyzing the corrosion mechanisms. The laboratory experiments are carried out under controlled conditions, to study the corrosion mechanism in an artificial deep-water. Most of these studies investigated the role of hydrostatic pressure on the corrosion of alloys in 3.6% NaCl solution and occurring anodic and cathodic reactions under high pressure with respect to the atmospheric pressure by electrochemical measurements Fig. 1.

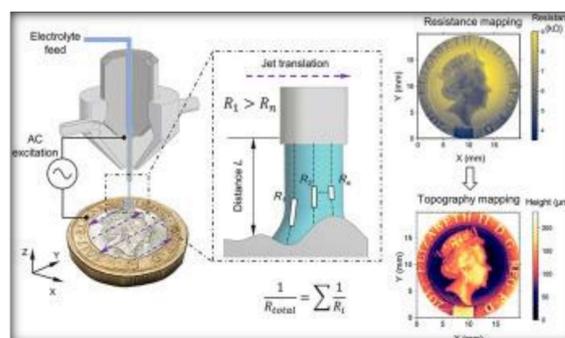


Fig. 1. Electrochemical measurement

Further research on corrosion of Fe-20Cr, Ni-Cr-Mo-V high strength steel reported that, both the growth rate of pitting on the material surface and the bonding rate of adjacent pitting increase with the increase of hydrostatic pressure due to the interaction between electrochemical corrosion and elastic stress. Fig. 3 shows Corrosion curve of high strength steel immersed in different pressure for different time: (a) weight loss; (b) corrosion rate. It shows that hydrostatic pressure developed the corrosion process on ferrous metal, whether the metals are active or passive metals, although different alloys have various sensitivities to corrosion under Deep Sea water. The anode of the steel shows to active dissolution and the cathode doing oxygen diffusion control characteristics at the initial stage of corrosion by hydrostatic pressure. Accordingly, the hydrostatic pressure effect on the divergent corrosion procedure is great work, including dissolution, passivation, pitting, and stress corrosion. The water pressure is below 20 MPa, the stepping formation are appearing in the anode zone. Due to the rapid reaction, the corroded metal's surface has poor protection performance and dissolves, there for no obvious passivation occurrence. Scientists spend more focus to the active dissolution of passive metals, such as aluminum alloys, stainless steels, and titanium alloys, and mainly focus on the implementing of hydrostatic pressure on pitting process. A lot of work on the 6061-T6 Al alloy and a series of stainless steels in the simulated deep-sea environment. The aluminum alloy was found in the passive layer of deep-sea water [6][7][8].

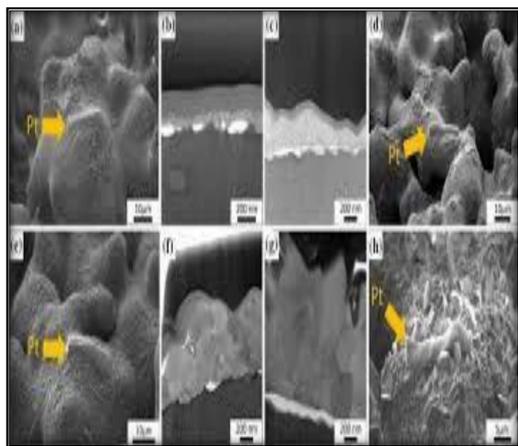


Fig. 2. Some images of the corrosion effect by high temperature

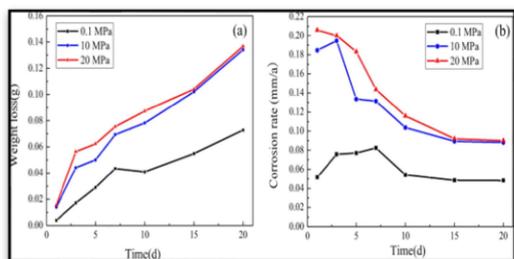


Fig. 3. Shows Corrosion curve of high strength steel immersed in different pressure for different time: (a) weight loss; (b) corrosion rate

III. RESULTS

From the above discussion, adjusting the metal/liquid interface may be a basis for the protection of metals or the design of anti-corrosion alloys in extreme environmental issue in the future, and how to succeed in this goal remains challenging. But It was proved that, the most efficient to

obstruction for corrosion on ferrous metal is carbon steel But when it was observed that the carbon steel is corroded in the deep sea water than examined on stainless steels 304 and 316. It was observed that, its relevance as a multipurpose obstructor at the same operating conditions. It is revealed that to obstruct the pitting corrosion of both the stainless alloys. The chemical composition of SS-316 & SS-304 are given below.

MATERIAL	COMPOSITION (%)						
	SS-316						
Austenitic Stainless steel	SS-316	67.42	16.03	12.1	1.7	0.58	0.08
	SS-304	69.008	18.15	8.46	-	1.78	0.55
	Fe%						
	Cr%						
	Ni%						
	Mo%						
	C%						

TABLE I. PERCENTAGE OF DIFFERENT MATERIAL (FERROUS & NON FERROUS) IN STAINLESS STEEL

IV. CONCLUSION

This paper actually provides for a comprehensive review of the corrosion behavior on ferrous metals in artificial deep-water environments. Analyzing the relationship between hydrostatic pressure and corrosion establishing on the ferrous alloys In extreme deep-sea environments. More recently, researchers have found the effect of hydrostatic pressure on the high graded stainless-steel metal is less and it's utilized for long time. A bundle of deposition tests has been carried out in liquid Pb-55Bi containing austenitic 316L and martensitic 56T5 steel tubes (SS- 316 & SS-304) under thermal gradient and oxygen concentrations of around 5×10^{-7} wt.%, in the temperature of 450°C (approx.). It has been found that the 316L specimen surface is covered by a layer of porous ferritic corrosion. At temperatures below 360 °C deposits composed of iron and chromium were found. Based on this review, it can be concluded that the preparation, strategies and corrosion protection performance have seen remarkable progress.

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