Types of corrosion due to rusting of steel used in petroleum industries: A Review

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Abstract

Petroleum industry used different type of steel for various purposes. In this paper different types of steel with different type of corrosion have been discussed. Particularly petroleum industries faced a big problem due to rusting of materials. Rusting of materials due to gases like H_2S and CO_2 is explained. Acid corrosion is also a big problem faced in the petroleum industries due to several industrial applications like oil well process acid pickling process etc.

1. Introduction

The petroleum industry is additionally considered because the refining industry. the most function of petroleum industries is worldwide exploration extraction and refining of petroleum product and transportation and marketing of petroleum products. Mainly petrol and fuel are the most products of petroleum industry. it's also produced different sort of raw materials for several industries like pesticides pharmaceuticals and plastics [1]. Majorly this industry is split into three main components which are upstream, midstream, and downstream. Upstream deals with Drilling and Production mainly. To supply products to industrial distributors and prominent consumers, oil and gas companies should make proper arrangements. Different parts of the product should be durable to withstand the conditions so that maintenance and other repairments should not interrupt the provision of product [2]. There are many issue related to pipeline issues like corrosion, heat, and pressure both inside and out of doors piping to handle . Selection of correct materials create a big differences, Here are just a pair of the foremost common differing kinds of materials utilized within the oil and gas industry [3].

2.1 Type of steels used in petroleum industry

This is easily the foremost important material utilized within the oil and gas industry. Steel is the first requirement for all intents and purposes of each component of oil and gas pipelines and other purposes, from reaping and refining items to deliver them over the planet, utilizes .it is the most material utilized for channelling and outside parts since it's solid and very

strong against wear. Therefore, steel is regularly combined with little rates of different materials to support quality, strength, or other attractive characteristics [4-5].

2.1.1 Steel alloys

It is the combination of various existing materials which produces alloys. For instance, when matched with carbon, molybdenum, or nickel, steel becomes more grounded and progressively more potent against corrosion. Hence, it is a standard issue inside the oil and gas industry. In addition to the fact that it strengthens the steel it causes the metal to oppose the consequences of CO2 and hydrogen sulphide, and high temperatures. Titanium is additionally a favoured added substance on account of its quality and toughness. it is likewise verification against a determination of medication, including seawater [6].

2.1.2 Copper

It has very specific roles in petroleum industry. The main role of copper materials in petroleum industry is for valve and sealing techniques. This is frequently used because of properties like electrical and heat conductivity that help to move heat and cold without distorting, breaking, or flopping in any case [7].

2.2 Type of corrosion in petroleum industry

In the Oil and Gas Production Industries, the Major forms of Corrosion Include:

2.2.1 Carbon dioxide or sweet corrosion

Sweet erosion has always been an issue of concern in oil and gas refineries. CO2 acts as eroding operators inside the oil and gas creation frameworks. CO2 when broken in a flus tate is generally destructive than dry CO2 at the temperatures maintained in oil and gas refineries [8-9].

2.2.2 Corrosion due to hydrogen sulphide or sour corrosion

Harsh consumption is defined as metallic decay in presence of hydrogen sulphide (H2S) and dampness. It is the major source inducing destruction to bore pipes. In spite of the fact that H2S isn't destructive without anyone else, it turns into a seriously destructive specialist inside the nearness of water, prompting pipeline embrittlement. Hydrogen sulphide when disintegrated in water could likewise be a powerless corrosive. The iron sulphides (FeSx) and hydrogen are potentially corrosive. Iron sulphide acts as an obstruction to slow erosion. The sorts of sharp consumption are uniform, pitting, and stepwise breaking [10-11].

2.2.3 Oxygen corrosion

Oxygen disintegrated in boring liquids could likewise be a genuine clarification for drill pipe erosion. Oxygen entrance happens inside the well liquids through spilling pump seals, packaging, and procedure vents and open trapdoors [12]. The high-speed stream of penetrating liquids over the surfaces of a drill pipe keeps on creating oxygen to the metal and is damaging at focuses as low as 5 ppb. Oxygen increase the corrosive nature of acidic gas as corrosive environments (H2S and CO2). the kinds of corrosion associated with oxygen are mainly uniform corrosion and pitting-type corrosion. Oxygen could also be a robust oxidant and reacts with the metal very quickly [13].

2.3.4 Galvanic corrosion

This sort of erosion happens when two metallic materials with various nobilities (electrochemical potential) are present as a general rule and are presented to an electrolytic domain [14-15]. In such circumstance, the metal with less or the principal negative potential turns into the anode and corrosion initiates. Having the large ratio of cathodic are to anodic area creates a big problem [16-18].

2.3.5 Crevice corrosion

Fissure corrosion is typically a limited erosion occurring inside the restricted clearances or cleft inside the metal thus the liquid getting dormant inside the hole [19]. This is frequently brought about by focus contrasts of corrodent over metal surface. Electrochemical potential contrasts end in specific fissure or pitting erosion assault. Oxygen broke down in oil advances hole and pitting assault of metal inside the protected territories of drill string and is that the basic clarification for wastes of time and material destruction [20].

3. Conclusion

After the discussion regarding the type of steel used in petroleum industry and various type of corrosion happening in petroleum industry, it is not difficult for say that corrosion is a very big and economical problem faced by petroleum industry. Acid corrosion and corrosion due to gases is the main problem of rusting the material in the petroleum industry. So we have to find out the solution for this problem.

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References

1. S. Jafarinejad, "Control and treatment of sulfur compounds specially sulfur oxides (SOx) emissions from the petroleum industry: a review". *Chem. Int*, vol. *2*(4), pp.242-253, 2016**.**
2. L. Herkenhoff, "A profile of the oil and gas industry: Resources, market forces, geopolitics, and technology", Business Expert Press, 2018 Apr 16.
3. M. Singh, T. Markeset, U. Kumar, "Some philosophical issues in modeling corrosion of oil and gas pipelines", International Journal of System Assurance Engineering and Management, vol.5(1), pp.55-74, 2014.
4. G. Schmitt, "Global needs for knowledge dissemination, research, and development in materials deterioration and corrosion control", World Corrosion Organization, vol.38, pp.14, 2009.
5. M.L Ross, "The oil curse: How petroleum wealth shapes the development of nation", Princeton University Press. 2013.
6. A. Bahadori, "Corrosion and materials selection: a guide for the chemical and petroleum industries", John Wiley & Sons,2014.
7. G.P. Brandãode R.C. Campos, E.V.R. de Castro, H.C.de Jesus, "Determination of copper, iron and vanadium in petroleum by direct sampling electrothermal atomic absorption spectrometry". Spectrochimica Acta Part B: Atomic Spectroscopy, vol.62(9), pp.962-969, 2007.
8. C. De Waard, U. Lotz, D.E. Milliams, "Predictive model for CO2 corrosion engineering in wet natural gas pipelines". Corrosion, vol.47(12), pp.976-985, 1991.
9. R. Nyborg, "January. Overview of CO2 corrosion models for wells and pipelines", CORROSION Nace International,2002.
10. B.D.B. Tiu, R.C. Advincula, "Polymeric corrosion inhibitors for the oil and gas industry: Design principles and mechanism", Reactive and Functional Polymers, vol.95, pp.25-45, 2015.
11. L.T. Popoola, A.S. Grema, G.K. Latinwo, B. Gutti, A.S. Balogun, "Corrosion problems during oil and gas production and its mitigation" International Journal of Industrial Chemistry, vol. 4(1), pp.35, 2013.
12. Y.M. Chen, Y. WU, L. Tian, "Control of the Oxygen Corrosion in the Thermal Equipment", Shanxi Chemical Industry, 2006.
13. J.N. Breston, "Corrosion control with organic inhibitors". Industrial & Engineering Chemistry, vol. 44(8), pp.1755-1761, 1952.

14. A.A. Khadom, A.F. Hassan, B.M. Abod, "Evaluation of environmentally friendly inhibitor for galvanic corrosion of steel–copper couple in petroleum waste water", Process Safety and Environmental Protection, vol.98, pp.93-101, 2015.

15. B.O. Oyelami, A.A. Asere, "Mathematical modelling: An application to corrosion in a petroleum industry". National Mathematical Centre, pp.48-56, 2005.

16. L. Garverick, "Corrosion in the petrochemical industry", ASM international, 1994.

17. Z. Foroulis, "Corrosion and corrosion inhibition in the petroleum industry", Corrosion Inhibitors, vol.4, pp.1029-1056, 1980.

18. Jr C.J. Bitely, L.D Dromgold, Jr, W.S.Murray, "Galvanic corrosion prevention coupling", U.S. Patent 4, 868,1980.

19. L. Garverick, "Corrosion in the petrochemical industry", ASM international, 1994. .

20. Z. Foroulis, "Corrosion and corrosion inhibition in the petroleum industry", Corrosion Inhibitors, Fifth., vol.4, pp.1029-1056, 1980.