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Enhancing the inhibition potential of sodium tungstate towards mitigating the corrosive effect of *Acidithiobaccillus thiooxidan* on X-52 carbon steel

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ABSTRACT

Microbial corrosion of the external surface of carbon steel pipes was investigated using sodium tungstate, sodium nitrite and zinc nitrite as individual and combined inhibitors. The study involved carbon steel pipes in contact with *Acidithiobaccillus thiooxidan*. Inhibitor efficiencies were determined and the optimum inhibitor concentration required to effectively limit the corrosive effect of the microbe was 51–52 g/L for the best inhibitor. Also, despite the limiting effect of sodium nitrite in its other inhibitor formulations, its presence in the mixture of all three components, improved the performance of the other two chemicals giving the best inhibition efficiency of 85.68%.

1. Introduction

Corrosion of pipelines by microbes is prevalent in pipes carrying fluids which lie on the earth surface. In some cases, the pipes are buried in the ground or in contact with ground water which serves as a carrier of microbes that aid pipe corrosion. Microbial corrosion can be controlled via chemical inhibition. One very good chemical for impeding this form of corrosion on carbon steel is sodium tungstate. Several prior studies have revealed the corrosive nature of some microbes in soils where underground pipes are situated. Al-Jaroudi et al. [1] studied the failure of a 28-inch diameter, 25.5 km long underground pipeline transporting wet sour Arab-light crude caused by microbial corrosion. The ultrasound testing results showed localized pitting at failed locations while experimental investigations revealed that the failure was as a result of microbial corrosion favoured by low flow velocities, high water cut and the presence of sulfur in the crude. Anglish et al. [2] gave insight into oil fields was studied by Carsten et al. [4]. New views on corrosion of iron by sulfate reducing bacteria were presented by Dennis and Julia [5] where they mentioned a few additional mechanisms for corrosion of iron by sulfate reducing bacteria. Hector et al. [6] carried out an extensive review on bio-corrosion and biofouling of industrial equipment where real time monitoring concepts of environmentally friendly approaches for understanding and mitigating metal decay were itemized. Accelerated cathodic reaction of a metal stimulated by the uptake of electrons by Sulfate Reducing Bacteria was studied by Hendrick et al. [7], in which they asserted that, an inhibitor may be added to the surface of the metal or alloy in order to decrease or mitigate its corrosion rate/microbial corrosion tendency [8]. According to Iversion [9], an example of microbe-aided/microbiologically induced corrosion (MIC) is one caused by the production of sulfuric acid by the action of *Thiobacillus* in some buried steel pipes. Lin and Ballim [10] investigated