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Standard Practice

Monitoring Corrosion in Oil and Gas Production with Iron Counts

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Foreword

This standard practice describes the use of iron counts as a corrosion-monitoring method and some common problems encountered when using this method. For several years, NACE Task Group (TG) T-1C-7, "Iron Determination," examined the problems and successes experienced by oil-producing companies and service companies using iron counts as a corrosion-monitoring method and determined that iron counts on wellhead samples may provide information on the existence of downhole corrosion and the effectiveness of inhibitor treatments. Iron counts may also give information on the corrosion activity in flowlines in waterflood systems and oil-production operations. This standard is a guide for those designing corrosion-monitoring programs as well as those carrying out the programs in the field.

This standard was originally prepared in 1992 by TG T-1C-7, a component of Unit Committee T-1C, "Detection of Corrosion in Oilfield Equipment." T-1C was combined with Unit Committee T-1D, "Corrosion Monitoring and Control of Corrosion Environments in Petroleum Production Operations." This standard was revised by TG T-1D-55 in 1998, and in 2012 by TG 373, "Monitoring Corrosion in Oil and Gas Production with Iron Counts." This standard is issued by NACE International under the auspices of Specific Technology Group (STG) 31, "Oil and Gas Production—Corrosion and Scale Inhibition."

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Section 1: General

1.1 The anomalies experienced when using iron counts as a corrosion-monitoring method result mostly from the varying, usually uncontrollable, conditions found in almost every production system. Because the term iron count refers to the concentration of iron dissolved in the water expressed as milligrams per liter (mg/L), milligrams per kilogram (mg/kg), or parts per million by weight (ppmw), those monitoring corrosion using iron counts must specify whether the iron content is based on the total fluid produced and whether the iron is reported as soluble iron, ferrous iron, or total iron. The usual oilfield iron count is total iron content of an acid-treated sample. When iron counts are used to monitor corrosion trends, the same species must be determined consistently for a given sampling point in a system. For comparison of systems producing varying amounts of water, a more meaningful tool is the iron production rate that takes into consideration the water flow rate at the time of sampling. The iron count is converted to an iron production rate, usually expressed in kilograms of iron per day (kg/d) or pounds of iron per day (lb/d).

1.1.1 The analyst should evaluate available test methods for iron content to determine the most suitable method regarding detection limits, accuracy, precision, and interferences. Specific analytical procedures are not addressed in this standard. The exact method of sampling and sample treatment required to separate and analyze for ferrous, ferric, soluble, and total iron content of a water sample are adequately covered in the analytical procedures described by Rydell and Rodewald,1 Eaton et al.,2 and ASTM[(1)] D1068.[3] If techniques are used to analyze for the individual species of iron, the final report must indicate the form of iron being reported. If only the typical total acid-soluble iron content is determined, the final report should indicate that the result is "total iron."

1.1.2 For the purposes of this standard, it is presumed that iron counts are performed on aqueous samples. Analysis of hydrocarbon samples for iron content is possible and the technique is practiced by some corrosion engineers. One suggested technique for "iron in oil" is described by Rydell and Rodewald.[1]

1.2 The mechanical arrangement, physical conditions, and chemical environment in almost every system or part of a system must be evaluated under comparable conditions before the iron content of each sample can be correctly interpreted. The iron counts measured are not of any value if these variables are not considered in the interpretation.

1.3 Monitoring corrosion by the use of iron counts may be done easily, inexpensively, and quickly in the field. Iron production rates, unlike test specimen corrosion rates, may give some indication of corrosion upstream or downhole from the sampling point. Iron counts are useful when surface-monitoring devices, such as test specimens, may not reflect downhole conditions, such as when paraffin forms on test specimens and when downhole conditions are greatly different from surface conditions. The principal reason for the historical popularity of iron counts as a standalone corrosion-monitoring method is that in many small production facilities other forms of corrosion-monitoring facilities have not been installed. However, iron count measurements should be combined with other corrosion-monitoring methods whenever possible.

1.4 Generally, iron counts from fluids containing dissolved sulfides or dissolved oxygen are not reliable because of precipitation of iron sulfide or iron oxide solids that may deposit on metal surfaces as well as remain suspended in solution. Although the iron counts may vary over time as temperature, hydrogen sulfide (H_2S), or oxygen levels vary, the iron count value actually represents the solubility of iron and not the severity of corrosion upstream from the sampling point. Therefore, the use of iron counts as a corrosion-monitoring method must be validated for each specific use.

1.5 Proper safety precautions when dealing with sour systems are addressed in API[(2)] RP 54.4 Appendix A (nonmandatory) covers safety considerations when handling H_2S, and information on the toxicity of this gas.

Section 2: Sampling

2.1 Iron counts are used for monitoring the iron content of the water phase at different points in a flowing system, thereby indirectly indicating the effectiveness of corrosion control. The results are useful if they are representative of the iron content of the flowing fluid. Solids, including old or fresh corrosion products in the form of iron compounds, may accumulate in a sampling point or trap under static conditions. Corrosion of the sample point may also contribute to the iron count.

[(1)] ASTM International (ASTM), 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.
[(2)] American Petroleum Institute (API), 1220 L St. NW, Washington, DC 20005-4070.