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Laboratory Screening Tests to Determine the Ability of Scale Inhibitors to Prevent the Precipitation of Calcium Sulfate and Calcium Carbonate from Solution (for Oil and Gas Production Systems)

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ABSTRACTS

Provides a relative and quantitative measure of the abilities of scale inhibitors to prevent the precipitation of solids, a necessary and critical stage in the formation of scale. Describes static laboratory screening tests designed to give a measure of the ability of inhibitors to prevent the precipitation of calcium carbonate and calcium sulfate from solution at 71 °C (160 °F). The test methods are recommended only for ranking the performance of different chemicals under laboratory conditions set by these methods. They are not intended to provide actual field treating rates.

KEYWORDS

calcium carbonates, calcium sulfates, scale inhibitors, screening testing

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Foreword

In NACE standards, the terms shall, must, should, and may are used in accordance with the definitions of these terms in the NACE Publications Style Manual, 4th ed., Paragraph 7.4.1.9. Shall and must are used to state mandatory requirements. The term should is used to state something considered good and is recommended but is not mandatory. The term may is used to state something considered optional.

Scale is an adherent deposit of inorganic compounds precipitated from water onto surfaces. Most oilfield waters are brines containing large amounts of calcium salts. When calcium is deposited as calcium sulfate or calcium carbonate scale, a loss of production and increased maintenance expenses can result; therefore, effective scale inhibition is of primary importance to the oil producer.

Scale inhibitors can be used in many circumstances to control scale formation, thereby reducing production difficulties. Scale inhibitors are commercially available and are widely used in oil and gas production systems. The test methods in this standard are designed to provide a relative and quantitative measure of a scale inhibitor's ability to prevent solids precipitation, a necessary and critical stage in scale formation. The laboratory screening tests described in this standard cannot and do not allow for the wide variation in water chemistry and system properties seen in field operations. As such they must only be regarded as a starting point in the scale inhibitor evaluation. This method allows for a uniform mode of screening test results and facilitates discussion of the results by interested parties.

The test methods in this standard have been selected as a means of comparing scale inhibitor effectiveness in preventing calcium sulfate and calcium carbonate precipitation from solution.

This standard was originally prepared in 1974 by Task Group T-1D-9 and was revised in 1990 by Task Group T-1D-31, a component of Unit Committee T-1D on Corrosion Monitoring and Control of Corrosion Environments in Petroleum Production Operations. It was reviewed and reaffirmed in 1995 by members of T-1D, and it was reaffirmed in 2001 and 2007 by members of Specific Technology Group (STG) 31 on Oil and Gas Production—Corrosion and Scale Inhibition. It was revised by TG 493—Review and Revise as Necessary TM0374-2007 in 2015. It is issued by NACE International under the auspices of STG 31.

Laboratory Screening Tests to Determine the Ability of Scale Inhibitors to Prevent the Precipitation of Calcium Sulfate and Calcium Carbonate from Solution (for Oil and Gas Production Systems)

Section 1: General

1.1 The test methods described in this standard are static laboratory screening tests designed to measure a scale inhibitor's ability to prevent calcium sulfate and calcium carbonate precipitation from solution at 71 °C (160 °F).

1.2 These test methods are recommended only for ranking the performance of different scale inhibitors under laboratory conditions set by these methods. They are not intended to provide actual field treating rates.

1.3 Many factors, such as reaction kinetics, solution chemistry, fluid velocity, temperature, pressure, scale adherence, and solids dispersion can affect scale deposition under field conditions. These factors are outside the scope of this standard. Field conditions, field brine composition, and other variables noted above should be considered at some point in scale inhibitor evaluation prior to final inhibitor selection and use.

1.4 Tests should be conducted at multiple scale inhibitor concentrations to obtain a more complete understanding of performance under laboratory conditions set by these methods. The scale inhibitor concentration required for a field application is likely to be different from that determined under these laboratory conditions.

1.5 This standard lists the necessary apparatus, reagents, and procedures for conducting these laboratory screening tests.

Section 2: Calcium Sulfate Precipitation Test

2.1 This section describes the apparatus, solutions, and procedure for conducting the calcium sulfate precipitation screening test.

2.2 **Apparatus and Solutions**

2.2.1 Constant-temperature water bath or forced-draft oven with the capability of maintaining the specified temperature within ± 1 °C (± 2 °F).

2.2.2 Clean and dust-free glass test cells (approximately 125 mL bottles with positive seals).

2.2.3 Synthetic brines prepared with distilled or deionized water and ACS[1] reagent grade chemicals as follows:

2.2.3.1 Calcium-containing brine: 7.50 g/L NaCl and 11.10 g/L $CaCl_2 \cdot 2H_2O$. This creates a 0.0755 mol/L (3027 mg/L) calcium-containing brine.

2.2.3.2 Sulfate-containing brine: 7.50 g/L NaCl and 10.66 g/L Na_2SO_4. This creates a 0.0751 mol/L (7207 mg/L) sulfate-containing brine.

2.2.3.3 Note: Very small quantities of insoluble materials may remain after the specified reagents have completely dissolved. For consistency of results, solutions shall be filtered through a 0.45 μm filter.

2.2.4 Apparatus for reproducibly delivering 50 ± 0.5 mL of the calcium- and sulfate-containing two brines (e.g., graduated cylinders or volumetric pipets).

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[1] American Chemical Society (ACS), 1155 16th St. NW, Washington, DC 20036.