NACE TM0194-2014
Item No. 21224

Standard Test Method

Field Monitoring of Bacterial Growth in Oil and Gas Systems

Revised 2014-03-08
Revised 2004-11-15
Approved 1994
NACE International
15835 Park Ten Place
Houston, Texas 77084-5145
+1 281-228-6200

ISBN 1-57590-192-7

Foreword

This standard describes field test methods that are useful for estimating bacterial populations, including sessile bacterial populations, commonly found in oilfield systems. The described test methods are those that can be done on site and that require a minimum of laboratory equipment or supplies. The described test methods are not the only methods that may be used, but are methods that have been proved to be useful in oilfield situations. This standard is intended to be used by technical field and service personnel, including those who do not necessarily have extensive or specific training in microbiology. However, because microbiology is a specialized field, some pertinent and specific technical information and explanation are provided to the user. Finally, the implications of the results obtained by these test methods are beyond the scope of this standard. The interpretation of the results is site and system specific and may require more expertise than can be provided by this standard.

This standard is loosely based on a document produced by the former Corrosion Engineering Association (CEA). CEA operated in the United Kingdom under the auspices of NACE and the Institute of Corrosion (Icorr).[(1)] This NACE International standard was originally prepared in 1994 by NACE Task Group T-1C-21 under the direction of Unit Committee T-1C, "Corrosion Monitoring in Petroleum Production." It was revised in 2004 by Task Group 214, "Bacterial Growth in Oilfield Systems—Field Monitoring: Review of NACE Standard TM0194," which is administered by Specific Technology Group (STG) 31, "Oil and Gas Production—Corrosion and Scale Inhibition," and sponsored by STG 60, "Corrosion Mechanisms." It is issued by NACE under the auspices of STG 31.

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*. The terms *shall* and *must* are used to state a requirement, and are considered mandatory. The term *should* is used to state something good and is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.

(1) Institute of Corrosion (Icorr), P.O. Box 253, Leighton, Buzzard Beds, LU7 7WB, England.

Standard Test Method

Field Monitoring of Bacterial Growth in Oil and Gas Systems

Content

Section 1: General

1.1 Scope

1.1.1 This standard describes field test methods for estimating bacterial populations commonly found in oil and gas systems. Although these techniques have been successful in the oil field, they are not the only methods that are used. Regardless of the method chosen, all techniques should be applied in a consistent manner. It should be recognized that transportation of samples from the field before analysis may significantly change the viability of the bacteria and therefore, whenever practical, analysis should be initiated in the field. It is not the intent of this standard to exclude additional techniques that can be proved useful. However, caution should be exercised with any technique that is at variance from those outlined here.

1.1.2 The presence of bacteria in a system does not necessarily indicate that they are causing a problem. In addition, bacterial populations causing problems in one situation, or system, may be harmless in another. Bacterial population determinations are one more diagnostic tool useful in assessing oilfield problems.

1.1.3 A glossary of terms used in this standard is provided in Appendix A (Mandatory).

1.1.4 This standard deals only with oilfield bacteria generally recognized as harmful in oilfield systems and does not consider other organisms that may be found in oilfield fluids, such as phytoplankton (algae), protozoa, or marine organisms such as zooplankton (copepods).

1.1.5 Emphasis is given to sampling methods that are suitable for use in oilfield conditions because effective sampling is essential to any successful analysis.

1.1.6 Not all bacteria and archaea species can be cultured, and newer molecular microbiology methods are provided in Appendix B (Nonmandatory) to help in identifying microorganisms that cannot be cultured and assessing their roles in the oilfield. Media formulations for enumerating some oilfield bacteria commonly recognized as harmful are given in Appendix C (Nonmandatory).

1.1.7 This standard describes dose-response (constant concentration versus time-kill) testing for evaluating biocides used in oilfield applications. *Minimum inhibitory concentration* testing versus biostat inhibitor concentration needs to be addressed. Minimum inhibitory concentration refers to the amount of inhibitor required to create the desired result. In some cases, the desired result is simply to retard the activity and/or growth of the bacteria in the system. In this case, a biostat may be used with more efficiency than a biocide. In cases in which the desired result is for there to be as few viable bacteria available as possible, a biocide may be necessary. There may be cases in which a biostat and a biocide are the same chemicals applied at different dosages. The minimum inhibitory concentration should be determined by testing using the methods outlined in this and other standards. The minimum inhibitory concentration varies with the required result, type of inhibitor, and required dosage to accomplish the objective.

1.1.8 Methods for evaluating surface attached (sessile) bacteria are addressed in Section 3. The importance of these bacteria in oilfield problems is usually not adequately considered. Attached bacterial populations are often the most important component of a system's microbial ecology.[1]

1.1.9 Methods for the rapid enumeration of bacterial populations' activity are addressed in Appendix B. The user must determine the applicability of these methods to the site/system. Similarly, there are a number of commercially available "test kits" for detecting various types of microorganisms that are not discussed in this standard; however, the user could use this standard to evaluate the suitability of these test kits for any particular situation.

1.1.10 Additional information on the corrosion problems associated with bacterial growth in oilfield systems is given in NACE Standard TM0106 and NACE Standard TM0212.[2,3]