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Journal of Petroleum Science and Engineering 21 (1998) 129–139

JOURNAL OF PETROLEUM SCIENCE & ENGINEERING

Development of a flow injection analysis method for the determination of acrylamide copolymers in brines

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Received 7 October 1997; accepted 2 April 1998

Abstract

Two primary methods are available for the measurement of polyacrylamide concentration in oilfield brines. One of these is a flow injection analysis (FIA) method based on the reaction of acrylamides with bromine (the starch–iodide method). The FIA method provides rapid sample throughput and high reproducibility, but may be sensitive to interferences or changes in the sample matrix. In this work, systematic optimization of the FIA method was conducted to improve analytical stability, reproducibility, and sensitivity. The effects of potential sources of interference from brines were examined in detail. These included Na^+, Ca^{2+}, Cr^{3+}, Al^{3+}, Zr^{IV}, NH_4^+, Cl^-, OH^-, CO_3^{2-} ions, sample coloration, and commonly used surfactants. Since the FIA method measures amide group concentration, the linearity of response for a series of partially hydrolysed polyacrylamides was measured. The range of the method is 2 to 1200 mg/l. Sample throughput is 30 samples/h with triplicate analysis. Relative standard deviations of 0.2% are readily obtained from standard solutions and 0.5% from complex samples (at 1000 mg/l).

Keywords: analysis; polymers; enhanced-recovery; petroleum

1. Introduction

Acrylamide-based polymers are widely used in drilling operations, profile modification, and chemical flooding (Gao, 1987; Borchardt, 1989; Sorbie, 1991). These polymers can be used in brines which may contain a variety of multivalent cations in addition to sodium chloride, various surfactants, and alkaline materials. The resulting aqueous solutions may become turbid or highly colored due to the presence of surfactant-solubilized crude oil. All of these factors contribute to the difficulty in accurately measuring acrylamide polymer concentration in aqueous oilfield fluids.

An extensive review of methods for acrylamide copolymer determination was reported by Taylor and Nasr-El-Din (1994). Many methods have been used, but only two are suitable for oilfield samples. One of these is the starch–triiodide method, automated using flow injection analysis (Taylor, 1993). The other

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0920-4105/98/$19.00
PII S0920-4105(98)00042-4

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