

Xanthan biopolymers: A review of methods for the determination of concentration and for the measurement of acetate and pyruvate content

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(Received February 25, 1993; revised version accepted April 8, 1993)

ABSTRACT

Xanthan gum is used extensively for enhanced oil recovery as a mobility control agent, in drilling operations to increase the suspension capacity of the drilling mud, and in gels to improve the volumetric sweep efficiency. Flow properties, injectivity, and adsorption characteristics depend on acetate and pyruvate content of xanthan. This review discusses various methods and techniques available for measuring the concentration of xanthan and its pyruvate and acetate content in laboratory and field samples. It includes a description of the principles of each method, advantages, limitations, interferences, and other information necessary to understand the strengths and weaknesses of each.

Introduction

Xanthan gum has been used in many oil-field operations including drilling, polymer-augmented water flooding, alkaline flooding, micellar flooding and profile modification (Chatterji and Borchardt, 1981; Nisbet et al., 1982; Sutherland and Kierulf, 1987). Its structure has been reported in detail (Jansson et al., 1975). Accurate measurement of xanthan concentration is important both in field use and in laboratory studies. The pyruvate and acetate contents of xanthan have a large effect on the rheological properties of the polymer (Sandford et al., 1977; Smith et al., 1981, 1984; Callet et al., 1987a,b; Rochefort and Middleman, 1987; Kleinitz et al., 1989; Kulicke et al., 1990). Xanthan can be prepared with an absence of either acetate or pyruvate groups, or with neither, by chemical modifi-

cation (Sloneker and Jeanes, 1962; Holzwarth and Ogletree, 1979; Rinaudo et al. 1983; Cheetham and Punruckvong, 1985) or by genetic engineering (Hassler and Doherty, 1990).

Graham (1977), Hockwin (1974) and Jeanes et al. (1976) have published limited reviews of xanthan determination. These reviews are very limited in their scope, are no longer current, and do not include methods to measure acetate and pyruvate content. The present work reviews in detail methods for the determination of xanthan concentration and the measurement of acetate and pyruvate content. Principles and limitations of each method for use with oilfield samples are discussed.

Discussion

A. Determination of xanthan

Phenol-sulfuric acid method

The phenol-sulfuric acid method relies on the formation of a colored complex from the

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