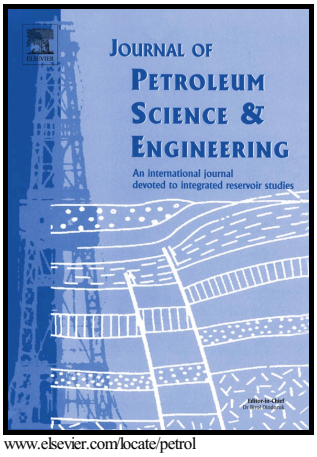

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Zehua Chen, Xiutai Zhao

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Enhancing heavy-oil recovery by using middle carbon alcohol-enhanced hot polymer flooding

Zehua Chen*, Xiutai Zhao

College of Petroleum Engineering, China University of Petroleum, Qingdao 266580, People's Republic of China

*Corresponding author: Tel: +8615275211632. chenzehua1210@163.com

Abstract

In this paper, the effects of middle carbon alcohol-enhanced hot polymer flooding for improving heavy-oil recovery were investigated by using several sandpack flooding tests. Before that, the effect of different middle carbon alcohols on viscosity reduction of heavy oil were examined. Then, a new method was developed to examine the diffusion of middle carbon alcohols from water to heavy oil and its effect on viscosity reduction of heavy oil. The results show that the effect of middle carbon alcohols on reducing heavy-oil viscosity increases with their carbon number; Besides, the middle carbon alcohols can diffuse from water to heavy oil to significantly reduce its viscosity, and the viscosity reduction effect increases with temperature, strring time in a certain range. Sandpack flooding tests show that injection of hot polymer and addition of middle carbon alcohols can both effectively enhance heavy-oil recovery; The effect of middle carbon alcohol-polymer flooding increases with the temperature of polymer solution and the injection rate of polymer solution.

Keywords: Middle carbon alcohols; hot water; polymer flooding; enhancing oil recovery

1. INTRODUCTION

The main techniques for enhancing heavy-oil recovery are mainly divided into two kinds: viscosity-reducing methods and displacement methods. Viscosity-reducing techniques include thermal methods(such as steam huff and puff, steam flooding and steam-assisted gravity drainage (SAGD)) (Wu et al., 2010; Zan et al., 2010; Mohammadzadeh, et al., 2010), chemical viscosity-reducing methods (by using thin oil, emulsifier etc) (Zhang et al., 2012; Osamah et al., 2013; Nguyen et al., 2013),and catalytic viscosity-reducing methods (Fan et al., 2004).Displacement techniques include waterflooding, chemical flooding and foam flooding etc (Zhang et al., 2010; Ding et al., 2010; Luo et al., 2013). Each kind of method has its own advantage and the two kinds of techniques are often used separately. The combination of the two methods has also been tried recently, which may combine their advantages and avoid their disadvantages at the same time (Taghavifar et al., 2014; Fortenberry et al., 2015).

Polymer flooding is an important method for enhancing heavy-oil recovery (oil H1 in thin reservoirs or in deep reservoirs or in bottom-water reservoirs) (Chang et al., 1978; Wassmuth et al., 2007; Delamaide et al., 2014). Polymer can partly control the adverse water-oil mobility ratio and weaken the viscous fingering, which usually occurs in waterflooding process. However, most polymer floodings were used in limited heavy-oil reservoirs in terms of heavy-oil viscosity. Previous literatures said the heavy-oil viscosity suitable for polymer flooding is no more than 200 mPa.s (Chang et al., 1978; Taber et al., 1997; Jewett et al., 1970; Du et al., 2004), besides, most