



SPE 110237

Technology for Confecting Polymer Solution With Desalted Produced Water

Shumeng Liu, Daqing Oilfield Company, Shanghai Jiaotong University; Xigui Dong, Hui Ban, Tao Wang, Wenlong Pan, Haijun Yu, and Cuiling Guo, Daqing Oilfield Company; and Chunlei Suo, Yinhe Science & Technology Company

Copyright 2007, Society of Petroleum Engineers

This paper was prepared for presentation at the 2007 SPE Annual Technical Conference and Exhibition held in Anaheim, California, U.S.A., 11–14 November 2007.

This paper was selected for presentation by an SPE Program Committee following review of information contained in an abstract submitted by the author(s). Contents of the paper, as presented, have not been reviewed by the Society of Petroleum Engineers and are subject to correction by the author(s). The material, as presented, does not necessarily reflect any position of the Society of Petroleum Engineers, its officers, or members. Papers presented at SPE meetings are subject to publication review by Editorial Committees of the Society of Petroleum Engineers. Electronic reproduction, distribution, or storage of any part of this paper for commercial purposes without the written consent of the Society of Petroleum Engineers is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of where and by whom the paper was presented. Write Librarian, SPE, P.O. Box 833836, Richardson, Texas 75083-3836 U.S.A., fax 01-972-952-9435.

Abstract

Polymer flooding technology has been widely used in Daqing oilfield of China in recent years. To maintain the viscosity of polymer solution, fresh water was used to confect polymer solution instead of produced water. Then, a problem was generated that the produced water could not be injected into the stratum totally. The superfluous produced water must be treated to meet the requirement of discharge, which increased the cost of production. In this paper, we try to desalt the produced water using electrodialysis principle. A set of experimental equipments that could generate desalted produced water 300 m³/d, was operated at a produced water treatment station of Daqing Oilfield. The experimental results indicated that the total salinity of desalted produced water less than 1000 mg/L. Comparing with fresh water, the polymer solution confected with desalted produced water has a sound character, its viscosity increases 63.5%, and the recovery ratio increases 4.5 percentage points. This experimental study has an important significance for the balance of oily water of production and injection in Daqing Oilfield. This produced water desalination technology would have a better application prospect in polymer flooding production.

Nomenclature

<i>TS</i>	total salinity, (mg/L)
<i>UF</i>	ultra filtration
<i>C_o</i>	oil concentration, (mg/L)
<i>C_s</i>	suspended particles concentration, (mg/L)
<i>C_p</i>	polymer concentration, (mg/L)
<i>V</i>	viscosity (mPa.s)
<i>MWCO</i>	molecular weight cut-off, (kDa)
<i>EC</i>	electrical conductivity, (μs/cm)
<i>RF</i>	resistance factor
<i>RRF</i>	residual resistance factor
<i>RR</i>	recovery ratio, (%)

1. Introduction

In crude oil extraction, water can be injected into the stratum to drive the crude oil out of the ground, which is often termed as water flooding process. The oil content would decrease after water flooding is operated for some time. In order to improve the oil recovery, polymer flooding (injected water containing polymer) would subsequently be used, which is often called as enhanced oil recovery (EOR)^[1]. Polymer flooding technology has been widely used in Daqing oilfield of China in recent years. The oil production by polymer flooding in Daqing oilfield reached 10,000,000 tons in 2006, which was about 1/4 of the total annual oil production.

In water flooding production, the oily water produced from oil wells (namely, produced water) was used to inject into the stratum again. It was beneficial to maintain the balance of water injection and production. The produced water has a high total salinity (*TS*), usually from 4000~5000 mg/L in Daqing oilfield. The metallic ions dissolved in the produced water, such as Ca²⁺, Mg²⁺, Na⁺, K⁺, would result in the degradation of polymer, and then decrease the polymer solution's viscosity. So, the produced water could not be used to confect polymer solution. To maintain the viscosity of polymer solution, fresh water was used to confect polymer solution instead of produced water. Then, a serious problem was generated that the produced water could not be injected into the stratum totally. The superfluous produced water must be treated to meet the requirement of discharge, which increased the cost of production. Furthermore, the expense on buying fresh water was another cost burden for the petroleum company^[2].

In this paper, we try to desalt the produced water using electrodialysis principle. A set of experimental equipments that could generate desalted produced water 300 m³/d, was operated at a polymer flooding produced water treatment station of Daqing oilfield. The performance of experimental equipments was tested. The quality of polymer solution confected with desalted water, was analyzed at Lab.

2. Equipments

The experimental equipments include two units, one is the produced water pretreatment unit, and the other is the desalination unit.

2.1 Produced water pretreatment unit The pretreatment unit is a set of ultra filtration(*UF*) membrane system, which could make the polymer flooding produced water purified by removing oil, suspended particles and residual polymer. The *UF* membrane is a type of polyvinylidene fluoride (PVDF) tubular membrane. The inner diameter of single tubular mem-