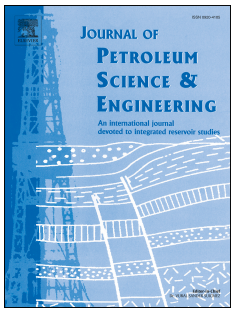
Accepted Manuscript



An innovative nitrogen injection assisted in-situ conversion process for oil shale recovery: Mechanism and reservoir simulation study

Shufeng Pei, Yanyong Wang, Liang Zhang, Lijuan Huang, Guodong Cui, Panfeng Zhang, Shaoran Ren

PII: S0920-4105(18)30646-6

DOI: 10.1016/j.petrol.2018.07.071

Reference: PETROL 5168

To appear in: *Journal of Petroleum Science and Engineering*

Received Date: 30 November 2017

Revised Date: 22 July 2018

Accepted Date: 26 July 2018

Please cite this article as: Pei, S., Wang, Y., Zhang, L., Huang, L., Cui, G., Zhang, P., Ren, S., An innovative nitrogen injection assisted in-situ conversion process for oil shale recovery: Mechanism and reservoir simulation study, *Journal of Petroleum Science and Engineering* (2018), doi: 10.1016/j.petrol.2018.07.071.

An innovative nitrogen injection assisted in-situ conversion process for oil shale recovery: mechanism and reservoir simulation study

Shufeng Pei, Yanyong Wang, Liang Zhang, Lijuan Huang, Guodong Cui, Panfeng Zhang, Shaoran Ren*

School of Petroleum Engineering, China University of Petroleum (East China), Qingdao, Shandong 266580, People's Republic of China

Abstract: In-situ conversion process (ICP) can be an effective technique for the development of oil shale and ultra heavy oils, in which kerogen or heavy components will be cracked into light oils and gases via underground heating and pyrolysis, and the retorted oil can be recovered via conventional extraction techniques. Heating of targeted formation can be conducted using electrical heaters installed in vertical or horizontal wells, while a slow heating rate and lack of driving energy for oil production are the main issues of the conventional in-situ conversion process. In this study, an innovative nitrogen injection assisted in-situ conversion process (NAICP) was proposed to increase formation heating rate and improve oil production from oil shale. Reaction models of kerogen pyrolysis at elevated temperature were established, along with models for the evolution of porosity and permeability of oil shale formation during the pyrolysis process. The performance of nitrogen injection on the effectiveness of the ICP was then investigated through reservoir numerical simulation. The simulation results show that additional nitrogen injection can improve the heating rate of the oil shale formation, enhance oil production and energy efficiency in comparison with the conventional ICPs, which can be attributed to enhanced heat convection, pressurization effect and gas driving mechanism. Nitrogen injection assisted in-situ conversion process can be a promising technique for the exploitation of oil shale.

Keywords: In-situ conversion process; Nitrogen injection; Oil shale; Reservoir numerical simulation; Kerogen pyrolysis

1 Introduction

Oil shale has been considered as a promising substitute to conventional oils due to its large reserves and wide distribution (Lee et al., 2015; Kang, 2008; Wang, 2014).