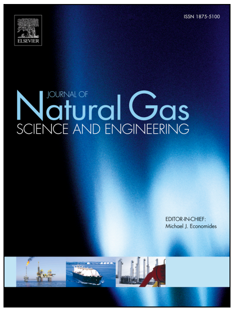
Accepted Manuscript



Comparative study of feedback control policies in water flooding production

Feng Zhou, Xiangyun Hu, Junrong Liu

PII: S1875-5100(15)30155-4

DOI: 10.1016/j.jngse.2015.09.020

Reference: JNGSE 1002

To appear in: *Journal of Natural Gas Science and Engineering*

Received Date: 21 November 2014

Revised Date: 6 September 2015

Accepted Date: 8 September 2015

Please cite this article as: Zhou, F., Hu, X., Liu, J., Comparative study of feedback control policies in water flooding production, *Journal of Natural Gas Science & Engineering* (2015), doi: 10.1016/j.jngse.2015.09.020.

Comparative study of feedback control policies in water flooding production

Feng Zhou[a, b,] *, Xiangyun Hu[b], Junrong Liu[c]

[a] *School of Mechanical Engineering & Electronic Information, China University of Geosciences, Wuhan 430074, PR China*
[b] *Institute of Geophysics & Geomatics, China University of Geosciences, Wuhan 430074, PR China*
[c] *School of Petroleum Engineering, China University of Petroleum, Qingdao 266580, PR China*

Abstract: Smart well feedback control policies enable real-time production optimization by linking downhole measurements to valve control. This is more practical than model-based optimization methods that require an accurate prediction of reservoir models or fluid behaviors. This study numerically investigates reactive, proactive, and combined feedback control policies for a water flooding scenario. Long- and short-term economic optimization is compared for different well configuration schemes. Quantitative comparisons suggest that feedback control production improves recovery efficiency in water flooding compared with conventional well production for both short- and long-term optimization. A production policy that combines both reactive and proactive controls can achieve greater economic returns than simple reactive or proactive control alone. Isochronous feedback controls on both injection and production wells are superior to control on a production well only.

Key words: Smart well, Feedback control, Water flooding

1 Introduction

Smart (or intelligent) wells incorporate novel technologies and have downhole sensors and control valves installed. It is thus possible to monitor the fluid status in reservoirs or wells and thereby control the injection or production behaviors in each independent segment or branch. Combined with an appropriate control policy, smart wells have the potential to improve recovery or net present value (NPV) (Aitokhuehi and Durlofsky, 2005). Figure 1 represents a typical smart wellbore structure. The well is divided into several relatively independent segments by packers installed between the casing and tubing. Inflow control valves (ICVs) are deployed to adjust segmental flow rates by choking in an on–off, discrete, or infinitely variable mode (Michael and Arashi, 2004). Sensors are installed in the downhole to monitor the fluid or reservoir status. Smart well hardware facilities have been developed and demonstrated in several oil-field trials (Rester et al., 1999; Erlandsen and Hydro, 2000; Netland et al., 2004; Dolle et al., 2005; Elmsallati et al., 2005).

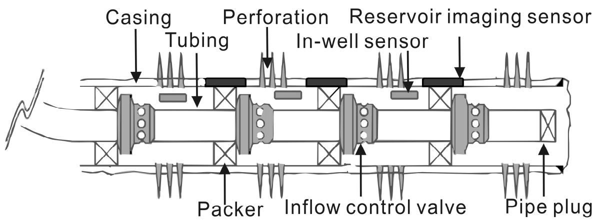


Fig. 1 Schematic of a typical smart wellbore (van der Poel and Jansen, 2004)

Early studies of smart well optimization focused on model-based methods. These methods are based on optimal control theory, by which a series of iterative

* Corresponding author: School of Mechanical Engineering & Electronic Information, China University of Geosciences, Wuhan 430074, China.
E-mail addresses: zhoufeng617@gmail.com (F. Zhou), xyhu@cug.edu.cn (X. Hu), liuxinghe_826@126.com (J. Liu).