Contents lists available at ScienceDirect

Chemical Engineering Research and Design

journal homepage: www.elsevier.com/locate/cherd

# Analysing gas well production data using a simplified decline curve analysis method

*Alireza Bahadori**

*Environmental Innovations Research Centre, School of Environmental Science & Management, Southern Cross University, PO Box 157, Lismore, New South Wales, Australia*

ABSTRACT

Decline curves are one of the most extensively used forms of data analysis employed in evaluating gas reserves and predicting future production. The parameters determined from the classical fit of historical data can be used to predict future production and the most popular and widely accepted method is Arp's equation. In the present work, simple-to-use method, which is easier than existing approaches, less complicated with fewer calculations, is formulated to arrive at an appropriate estimation of nominal (initial) decline rate, and the Arp's decline-curve exponent. The results can be used in follow-up calculations for analysis of past trends of decline in production performance for gas wells as well as reservoirs. Using this method is quite simple and accurate to generate the coefficients of the equations instead of opting for ready-generated coefficients with uncertainty. The engineers can easily develop their own computer program to compute the coefficients and hence obtain the solution for gas reserves and production performance in reservoirs.



*Keywords:* Decline-curve analysis; Arp's decline-curve exponent; Cumulative gas production; Gas reservoir

## 1. Introduction

Estimating reserves and predicting production in reservoirs has been a challenge for a long time (Khanamiri, 2010). Decline curve analysis (DCA) is a method to fit observed production rates of individualwells, group of wells, or reservoirs by a mathematical function in order to predict the performance of the future production by extrapolating the fitted decline function (Khanamiri, 2010).

Many of the existing decline curve analysis models are heuristic and are based on the equations of Arps (1945) who proposed that the curvature in the production-rate-versus-time curve can be expressed mathematically by the hyperbolic family of equations. Existing decline curve analysis techniques, include three Arps (1945) models (exponential, hyperbolic, and harmonic). Fetkovich (1980) introduced decline curve analysis by type curves. Type curve matching is essentially a graphical technique for visual matching of production data using preplotted curves on a log–log paper.

Fraim and Wattenbarger (1987) introduced a normalized time function that linearizes the rate decline against normalized time for gas reservoirs producing at constant bottom-hole pressures during boundary-dominated flow. The calculation of the normalized times involves an iterative process (Khanamiri, 2010).

Palacio and Blasingame (1993) addressed the issue of variable, non-constant bottom-hole pressures in gas wells. They introduced methods, which use a modified time function for analyzing the performance of gas wells. They have also presented a new algorithm along with the modified time function to compute gas in place, which are capable of modeling the behavior of production data for variable rate and/or variable pressure drop conditions. Like normalized time, the calculation of pseudo-equivalent time is an iterative process (Khanamiri, 2010).

Arps' models are still the preferred method for forecasting oil and gas production and proven reserves. These methods have played a very important role in the exploration and development of oil and gas fields worldwide (Arps, 1945, 1956; Fetkovich et al., 1987, 1996; Marhaendrajana and Blasingame, 2001; Pratikno et al., 2003; Li and Horne, 2005, 2007). The main characteristics of these decline curves can be used to select

* Tel.: +61 2 6621 2669.
E-mail addresses: Bahadori.alireza@gmail.com, al.bahadori@gmail.com
Received 28 May 2011; Received in revised form 7 August 2011; Accepted 12 August 2011
0263-8762/$ – see front matter © 2011 The Institution of Chemical Engineers. Published by Elsevier B.V. All rights reserved.
doi:10.1016/j.cherd.2011.08.014