

SPE 110205

Successful Application of Chemical Injection Rate Control Valves

H.J. Duhon, SPE, and K.M. Annadorai, SPE, Gibson Applied Technology and Engineering

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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.

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Abstract

This paper presents an overview of a systems approach to the design and troubleshooting of IRCVs (Injection Rate Control Valves) used in deepwater chemical injection systems. The inherent problems associated with these simple flow regulators stem largely from the failure of design engineers to take a systems view in design. Along with the application of lessons learned from previous IRCV system failures, this systems approach provides a design method which will allow users to avoid many of the pitfalls inherent in design, installation, testing, commissioning and operation of IRCV systems.

Introduction

The conventional approach to injection of specialty/commodity chemicals is to use a separate chemical injection pump for each injection point. For topsides injection at low to moderate pressures, these pump systems are small and relatively inexpensive. In certain applications, such as in deepwater where injection pressures are high, these pump systems can be large, heavy and expensive. In deepwater and high pressure applications, a common alternative is to use distributed delivery systems featuring Injection Rate Control Valves (IRCVs). IRCVs are simple flow regulators which are designed to control flow to the individual users. It is easy to appreciate why these devices are being used with increasing frequency. Systems featuring them are cheaper, lighter, smaller and more flexible.

However, many operators have little confidence in them. Many IRCV installations have failed and some have been made to work only after significant effort. While it can be difficult to definitively determine the particular reasons for their failure in many cases, it is not hard to picture why so many systems fail; there are multiple number of things that can go wrong with these systems.

Failure to take a systems view explains many of the IRCV system failures. This paper presents a systems approach to the design and troubleshooting of IRCV systems. Our model of IRCV systems consists of two governing equations; 1) the injection system flow equation (pressure drop) and 2) the force balance across the IRCV piston. The force balance across the piston is important because the position of the piston determines the pressure drop and flowrate through the IRCV.

Solving the system pressure drop equation simultaneously with the IRCV piston force balance is analogous to determining the operating point of a pump as the intersection of the pump curve and the system curve. Solving the system equations simultaneously is important because the design of the injection system impacts the operation of the IRCV. For example, system pressure drop impacts IRCV turndown and proportional offset.

This paper includes:

- Descriptions of IRCVs
- Development of the system model
- A list of lessons learned, and
- A proposed design methodology.

IRCV Description

There are two main IRCV designs available in the GoM market today – Haskel valves (needle valve type) and SkoFlo valves (fixed orifice type).

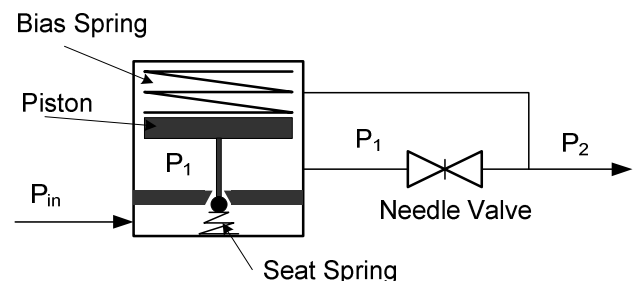


Figure 1: Schematic of the Needle Valve Type IRCV

Figure 1 is the schematic of a typical needle valve type IRCV. Flow enters the inlet port at pressure P_{in} . The regulator valve takes a pressure drop resulting in pressure P_1 below the piston. The needle valve takes a pressure drop resulting in pressure P_2 . Pressure P_2 is ported to the IRCV above the piston.