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World's First Metal PCP SAGD Field Test Shows Promising Artificial-Lift Technology for Heavy-Oil Hot Production: Joslyn Field Case

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Abstract

Finding a reliable artificial lift pumping system for heavy oil thermal recovery has been a challenge mainly due to the high operating temperatures (>150˚C). Available options such as Rod Pumps and **E**lectrical **S**ubmersible **P**umps (ESP), which are well proven in the industry, are not particularly well suited to thermal production. While Rod Pumps offer high temperature service, they are limited in the flowrate they can deliver. ESPs on the other hand, can handle high volumes of low viscosity fluids, but are still limited in terms of maximum operating temperature.

Progressing **C**avity **P**umps (PCP), with elastomeric stator, is economic to run and have done well in heavy oil cold production. These elastomers are however limited in temperature (<150˚C). Through research work conducted by PCM and TOTAL, Metal PCP technology has been developed to meet the high temperature requirement of SAGD and other thermal recovery processes. Three models of the Metal PCP are now available to cover a wide range of flow rates for heavy oil production.

This paper presents an update on the Metal PCP development and the results of the world's first SAGD field trial of this type of pump currently on-going in Canada in the Joslyn field. Field performance data are discussed comparing high temperature ESP and metal PCP in actual LP-SAGD conditions.

Four SAGD well pairs were initially equipped with high temperature ESP. Another well pair was equipped with metal PCP. This well has been running since mid October 2006 without problems, in spite of low pressure at pump intake, close to steam flashing conditions. Production rate reached 200m^3/d of liquid at 340rpm, giving a volumetric efficiency of 53%. Intake temperature is 160^{o}C due to the LP-SAGD condition of the field. However, this pump is rated up to 350^{o}C.

This first field trial shows the metal PCP as a promising artificial lift technology for hot production. Following this encouraging trial, a second metal PCP has been installed with success in the same field and more installations were decided eventually. Thus, all ESP initially installed were replaced by PCP and nine wells are producing with Metal PCPs currently.

Introduction

Recovery of the worlds huge reserve of extra heavy oil (mainly found in the oil sands of Canada and Venezuela) by thermal processes have been on the increase thanks to the high oil price. Key to this recovery process is artificial lift, which is required due to the very high density and viscosity of the crude and relatively low reservoir pressures. Although gas-lift remains an artificial lift option when high-pressure gas is available, pumping techniques are more popular due to their relatively higher efficiency and ability to generate more head at surface for delivery to treating plant.

The main challenge however with hot pumping is the rather high temperatures often required (up to 260°C for SAGD and 350°C for Cyclic Steam Stimulation (CSS))

The dominant pumping technologies available are Beam/Jack Pumps, Electric Submersible Pumps (ESP) and Elastomer Progressing Cavity Pumps. But all these pumps have their peculiar limitations for hot production: while Beam Pumps offer high temperature service, they are limited in the flowrate they can deliver. ESPs on the other hand, can handle high volumes of low viscosity fluids, but are still limited in terms of maximum operating temperature. For the PCP, the limitation is operating temperature of the elastomer (maximum 150°C).

Through research work conducted by PCM and TOTAL, Metal PCP technology has been developed using hydro-forming technology to meet the high temperature requirement of SAGD and other thermal recovery processes. This paper presents the world's first SAGD field trial of this type of pump in Canada in the Joslyn field and compares their operating performance to high temperature ESP.

Metal PCP Description

PCPs are known for their simplicity of design and operation. The heart of the pump is composed of two parts: the stator and the rotor (see Figure 1). The stator has dual helical