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The Motor Jacket: An Innovative System for ESP PCP Efficiency Improvement in Heavy-Oil Reservoirs

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Abstract

Production of heavy oil with an artificial lift system is a puzzling problem due the hydrodynamic conditions prevailing inside and surrounding the pumping system. The aim of this paper is to present an application on ESP PCP of a system that has an impact on the oil viscosity surrounding the ESP PCP unit and as a consequence improving the production performance, the ESP PCP pump efficiency and run-life. The theory is based on the impact of convection currents on the diffusion of the temperature in high viscous oil inside a pipe. A case history will be presented on the ZAM-408ML, a TAML6 multilateral well producing from level B of the Zatchi field, offshore Congo.

Introduction

Zatchi Marine is an offshore field located about 25 km from the Congolese coast (fig.1). The field, developed in 1980 presents 5 oil bearing levels named A, B, C, D and E. Level A has currently no economical value since it is gas bearing. While the oil bearing levels C, D, E are producing from several years, level B, after very short episodes of production in the past was put in production in 2007 via the multilateral well ZAM-408ML. The level B, object of the paper, is a complex heavy oil reservoir with a primary gas cap and the presence of a bottom aquifer. The oil has a very high density (15°API) and is very viscous (13000 cP @ 34.5°C) probably due to the low reservoir temperature (about 35°C). This level is composed of sand, shaly sand, dolomite and shale (fig.2). The average reservoir permeability is greater than 1Darcy.

Three wells have been drilled in the B level since 1991: the first one, ZAM-116 (vertical well with conventional completion), produced a maximum of 130 bopd (lifted by a sucker rod pump with a surface motor); thereafter, the ZAM-406 (horizontal well) produced at the beginning 440 bopd but the oil rate dropped rapidly due to a severe gas coning phenomena; the last one, ZAM-111ST (horizontal well), peaked briefly up to 285 bopd. This brief overview depicts the reservoir B production complexities which in summary:

- the heaviness and the viscosity of the oil,
- The severe problems of gas coning and cresting which reduced drastically the progressive cavity pump efficiency.

The multilateral well ZAM-408ML represents the forth well which is attempting the production of such reservoir. The well architecture and trajectory was designed to optimize reservoir recovery, productivity index while reducing the drawdown at the wellbore to avoid gas coning phenomena. In parallel, it has been decided to develop an innovative system to improve the ESPCP performances by increasing and homogenising the temperature distribution around the artificial system planned to be installed. The original scope was not to improve the well productivity, but only to have a better handling of the flow at the pump interface and maximizing the pump efficiency.