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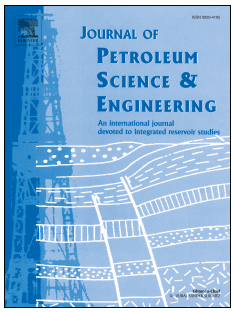

Enhanced oil recovery and natural bitumen production through the use of sinusoidal wells and solar thermal method

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Enhanced oil recovery and natural bitumen production through the use of sinusoidal wells and solar thermal method

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Abstract

Thermal enhanced oil recovery is known to be the most effective way of heavy oil production. This article discusses the application of sinusoidal wells to improve the efficiency of thermal enhanced oil recovery methods. As a result of numerical simulation of steam-assisted gravity drainage (SAGD) process, it has been shown that the application of sinusoidal wells allowed 8,990 m^3 of the incremental oil production during 10 years simulation period. However, the high cost of hot water and steam generation, as well as significant environmental impact, limit the application of thermal oil recovery methods. The article presents the concept of year-round generation of desalinated hot water and steam from sea and reservoir brine at low cost by the newly developed solar collector. The collector can be placed in the vicinity of injection wells to provide constant hot water, steam, and electrical power supply.

Key words: oil reservoir; water injection; steam; solar heat, sinusoidal well, oil recovery.

Introduction

The growing importance of petroleum production for the sustainable development of world economy is well known. Taking into the account the depletion of conventional oil resources, the production of hydrocarbons from shallow heavy oil reservoirs and oil sands becomes increasingly important (Zou, 2017). In fact, the estimated reserves of the discovered up to this day heavy and bitumen oil were estimated to be around 3.396 billion and 5.505 billion bbls respectively. This is at least 3 times as large as the conventional light oil reserves (Ohenhen et al., 2016).

Until now, the recovery rates of oils with viscosities around 1,000 cp have been around 10% of IOOP by cold production methods and 30% of IOOP by steam stimulation (Butler and Yee, 2002). Thus, new thermal oil recovery methods are being developed to ensure higher recovery of heavy oil.

In the resent years a number of thermal EOR methods have been proposed (Butler and Yee, 2002). For example, steam-assisted gravity drainage (SAGD) has been proved to provide 50% oil recovery from oil sands of Alberta (Canada) (Shin and Polikar, 2005). In this method, horizontal wells are applied to create a heated zone inside of an oil sand layer (Sood, 2016). However, as it was shown, due to a number of reasons, including inherent steam properties and reservoir heterogeneity, the injection profile of steam through horizontal wells is not always evenly distributed (Zhong, 2010). More importantly, the spatial configuration of production and injection wells is among the parameters that influence the intensity of reservoir heating and overall efficiency of thermal EOR process (Chang et al., 2009; Gallant et al., 1993).

In this paper, the application of sinusoidal wells for the improvement of conventional SAGD method is discussed. By means of numerical simulation, it is