Proceeding

Some novel recognition of variable mass flow during horizontal well steam stimulation

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Lei Wang, Huiqing Liu, Zhanxi Pang, Xueqi Cen
Department of Petroleum Engineering, China University of Petroleum, China

Correspondence: Lei Wang, Department of Petroleum Engineering, China University of Petroleum, China, Email jzwanglei10508@163.com

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Horizontal well steam stimulation has strongly been proved to be a valuable and remarkable recovery technique for developing heavy oil reservoir. However steam flow rate distribution in both reservoir and horizontal wellbore is in non-uniform which usually leads to uneven flooding in the reservoir. Therefore it becomes necessary to explore types and influencing factors of variable mass flow during steam stimulation.

A series of 3D physical simulation experiments were carried out with different oil viscosities and different steam injection rates during steam stimulation. Temperature distributions in the model were measured every 10 seconds by means of a fixed array of thermocouple. Produced liquids during each step of these experiments were measured accurately. The horizontal and vertical temperature distribution profiles of the model reservoir can be obtained by using the Kriging interpolation method.

Different types of variable mass flow in the horizontal wellbore and reservoir were observed. The steam injection rate has a very significant effect on steam flow rate uneven distribution. The greater the steam injection velocity is the bigger steam flow rate distribution asymmetry is. Then the comparative performance tests are conducted and the results show that the effect of different steam injection velocities on the type and the degree of non-uniform distribution in both reservoir and horizontal wellbore are dissimilar at various viscosity conditions. When the crude oil viscosity is relatively low the type of variable mass flow in horizontal wellbore was independent on the steam injection rate which was constant with mass flow rate declining from tip to end. When the crude oil viscosity is relatively high the injection velocity deeply influence the type of variable mass flow :

i. If velocity is slow mass flow rate decreases first and then increases along horizontal wellbore and the distribution shows as an irregular dumbbell.

ii. If velocity becomes fast the type of mass flow rate distribution is the same as the crude oil with low viscosity.

Some novel understanding of variable mass flow is observed through a series of physical simulation experiments. At various viscosity conditions there present different type of steam flow rate uneven distribution. Thus, these basis understandings can provide the guidance for the design of horizontal well steam stimulation and the following steam flooding effectively.

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Conflict of interest

The author declares no conflict of interest.

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