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Physical Simulation of In-situ Combustion of Sensitive Heavy Oil Reservoir

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Block Z, one of reservoir of Shengli Oil Field, is a sensitive heavy oil reservoir with high content of kaolinite and illite. From 1992 to 2002, more than ten-years water drive and steam huff and puff has seen poor production performance. In 2003, in-situ combustion pilot test with 1 injector and 11 producers was carried out to improve development performance and, simultaneously physical simulation is designed to evaluate the pilot test. The paper will detail the physical experiments of in-situ combustion, its experiment apparatus, its process, and its results. Also, it will briefly introduce production history and performance of pilot test.

Several experiments have been carried out and the results show that air injection rate is the key factor to influence the fire flooding, the higher injecting rate and the higher the advancing speed of combustion front. For complete combustion with plentiful air supply, no coke comes into being and the formation remains undamaged without permeability decrease. For the sensitive reservoir, the component of rock has changed after burning, and the reservoir has turned into low sensitive to water and steam. In front of burning zone, high oil saturation bank is formed, in which pressure decreases greatly during fire flooding. When the bank is away from the producer, the producer shows low productivity. Once it goes near to the producer, productivity increases step by step.

Experiment results have been successfully used to evaluate the pilot test and to improve the performance. Up to now, the pilot test has been lasting for more than 3 years and more than 140,000 barrel oil has been produced.