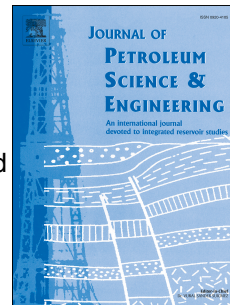


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Foam-EOR method in fractured-vuggy carbonate reservoirs: Mechanism analysis and injection parameter study

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1 **Foam-EOR method in fractured-vuggy carbonate reservoirs: Mechanism**  
2 **analysis and injection parameter study**

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10 **Abstract**

11 Fractured vuggy carbonate reservoirs in the Tahe Oilfield, China, have many diverse and  
12 unevenly distributed reservoir spaces. These spaces mainly consist of corrosion pores,  
13 high-density fractures, and large vugs. Reservoir development began with natural energy and  
14 pressure maintenance methods. However, a rapid rise of the water cut always led to poor oil  
15 production. Gas enhanced oil recovery (EOR) has shown notable improvement in the Tahe  
16 Oilfield; however, the recovery efficiency was limited by gas channeling. In this paper, a  
17 two-dimensional (2D) physical model was developed for a more detailed visual of the flow  
18 characteristics and the effect of the injection parameters (i.e., the injection rate, the injection slug  
19 size, the injection timing and the injection position) were evaluated. Water flooding can produce  
20 a certain amount of oil; however, the remaining oil types are the same as those found during the  
21 bottom water invasion period, that is, attic oil, bypass oil, and oil films. A better approach is N<sub>2</sub>  
22 flooding, which can replace the attic oil at the top of the vug by gravitational differentiation. An  
23 even better method is N<sub>2</sub> foam flooding. When the injection volume of N<sub>2</sub> foam reached a certain  
24 level, foams accumulated in the flow channels, decreased fluid mobility, inhibited the gas  
25 channeling, and expanded sweep efficiency. Moreover, the N<sub>2</sub> foam had excellent effects on oil  
26 film stripping, crude oil emulsification, and carrying oil droplets, thereby improving the  
27 microscopic displacement efficiency. In addition, the results of injection parameter effect can  
28 help researchers and reservoir engineers better understand and implement the foam-EOR method  
29 in the fractured vuggy carbonate reservoirs.

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