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Marangoni对流启动残余油微观机理

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Micromechanism of residual oil mobilization by Marangoni convection

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摘要

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摘要

Marangoni对流可以有效地剥离油膜、乳化油滴的现象已经引起关注,研究Marangoni对流启动残余油的机理对提高石油采收率有着重大意义。在此背景下,选用了能产生Marangoni对流的季铵盐和OP7两种表面活性剂,设计了微观膜状残余油和喉道残余油启动实验,分别对比了强和弱Marangoni对流启动残余油的现象并分析了机理。结果表明:油膜在Marangoni对流引发的界面扰动作用下拉伸聚集小油滴,同时界面扰动与浮力做功之和超过了油的黏附功,油膜收缩成油滴后从表面脱离。Marangoni对流产生的界面扰动在低界面张力条件下使喉道处的残余油自发乳化为粒径小于喉道尺寸的小油滴,使滞留油滴能够克服贾敏效应所产生的毛细管压差顺利通过喉道。Marangoni对流对启动残余油有着重要作用。

关键词 : 残余油, Marangoni对流, 油膜, 喉道, 乳化油滴

Abstract :

Some attention has been attracted to the fact that Marangoni convection is able to effectively remove oil film and emulsify oil droplet. The research on the mechanism of residual oil mobilization by Marangoni convection has a great significance for enhancing oil recovery. On this background, two surfactants that are able to generate Marangoni convection, i.e., quaternary ammonium salt and OP7, were selected to design mobilization experiments of residual oil at pore throat and micro-membrane residual oil. Then a comparison was made on the phenomena of residual oil mobilization by strong and weak Marangoni convections, as well as analysis on the mechanism. Results have shown that oil film can be stretched and gathered into small oil droplets under interface perturbation caused by Marangoni convection. Meanwhile, the combined work of interface perturbation and buoyancy is greater than the adhesion work of oil, and oil film will be extracted into oil droplets and detached from the surface. Under the low interfacial tension and interface perturbation caused by Marangoni convection, residual oil at pore throat can be self-emulsified into small oil droplets with grain size less than throat size. As a result, the detained oil droplets are able to overcome capillary pressure difference caused by Jamin effect and go through the throat smoothly. Marangoni convection plays an important role in the mobilization of residual oil.

Key words : residual oil Marangoni convection oil film throat emulsified oil droplet

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