地球物理学进展　2007 22 (5): 1533～1538　ISSN: 11-2982/P　CN: 1004-2903

注聚合物井井下温度分布数值模拟研究

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收稿日期 2007-1-10 修回日期 2007-5-20 网络版发布日期 2007-10-18 接受日期 2007-10-18

摘要　本文提出了一种计算注聚合物井井下温度分布的方法，该方法视井筒内的聚合物溶液为非牛顿幂律流体，考虑注入流体在井筒中同一截面上的速度变化，根据聚合物溶液在多孔介质中的流变性，依据广义达西定律求取渗流速度，基于能量守恒方程建立柱坐标系下注聚合物井井筒内流体、注入层及围岩的二维温度场模型.通过合理的边界条件，将三部分模型耦合起来，采用交替方向半隐式有限差分法求解建立的井下温度场模型.考查了注入量、注入时间、幂律指数和稠度系数、注入液温度等因素对井下温度场分布的影响，结果表明，当注入的聚合物溶液温度低于注入层的原始温度时，随注入量和注入时间的增大以及粘度的减小，注入层的温度降低；注入聚合物溶液温度与注入层原始温度差越大，注入层处的温度剖面异常越明显.本文数值计算结果可用于指导注聚合物井的井温测井应用.

关键词　注聚合物井,井下温度,聚合物溶液,多孔介质,数值模拟

分类号　P631

DOI:

Numerical simulation of downhole temperature distribution in polymer injection well

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Received 2007-1-10 Revised 2007-5-20 Online 2007-10-18 Accepted 2007-10-18

Abstract In the paper a new numerical simulation method is proposed to calculate downhole temperature distribution in polymer injection wells. Based on rheological property of polymer solution in porous medium and energy conservation equation, 2D temperature field models for wellbore fluid, injection zone and adjacent zone in cylindrical coordinates are developed with seeoage velocity derived from generalized Darcy Low. In the model injected polymer solution in the hole is considered as non-Newtonian fluid, and variation of its velocity is also taken into account. Three models are coupled by correct boundary conditions. An alternating direction implicit difference method (ADI) is used to solve the temperature models for downhole temperature distribution. We study the effects of injection rate, injection time, power law index and consistency coefficient, injection fluid temperature on downhole temperature distribution, and draw conclusion that temperature in injected zone decreases with increase of injection rate or injection time, and with decrease of viscosity of polymer solution while temperature of injected polymer solution is less than initial temperature in injected zone, and also the greater the temperature difference between injected polymer solution and injected zone, the more obvious deflection on temperature curve opposite the injected zone. The results can be used to instruct actual interpretation of temperature log in polymer injection wells.

Key words P631

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