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页岩气多级压裂水平井不稳定产量递减探讨

谢维扬，李晓平，张烈辉，王俊超，程子洋，袁淋　⌄

Transient Production Decline Analysis for Multi-fractured Horizontal Well in Shale Gas Reservoirs

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摘要/Abstract

摘要：

由于水平井钻井技术及水力压裂工艺的进步，页岩气藏已经可以开采得到工业气流。基于页岩气藏特殊渗流机理及解吸扩散规律，建立了在水平井钻井及多级压裂生产条件下综合考虑井筒储集、表皮效应、水力裂缝参数等多种因素影响下的双重介质页岩气多级压裂水平井不稳定渗流模型。通过运用点源函数法、Laplace变换、特征值法、正交变换法及Stehfest数值反演得到了双重介质页岩气多级压裂水平井产量递减特征曲线，分析了产量递减特征曲线对于表皮因子、吸附因子、裂缝条数、水平井长度以及裂缝渗透率的敏感性。该模型及研究可以用于更精确有效地预测页岩气多级压裂水平井产量动态变化。

关键词： 页岩气藏, 多级压裂, 水平井, 特征值法, 正交变换, 产量递减

Abstract:

Shale gas reservoirs can get industrial gas flow now due to the technical progress of horizontal well drilling and hydraulic fracturing.Based on the special flow mechanism and desorption phenomenon of shale gas reservoir,this paper presents a transient analysis model of multi-stage fractured horizontal well with the consideration of wellbore storage,skin effect and hydraulic fractures parameters of shale gas reservoirs.Accurate solution to this flow model was obtained by the use of source function theory,Laplace transform,three-dimensional eigenvalue method and orthogonal transformation.Production decline type curves were plotted by using the Stehfest algorithm.Seven different flow regimes were identified.The effects of influence factors such as skin coefficient,absorption index,fractures number,horizontal well length and fracture permeability were discussed.This research could be used to interpret the production decline behavior more accurately and effectively for shale gas reservoirs.

Key words: Shale gas reservoir, Multi-stage fracturing, Horizontal well, Eigenvalue method, Orthogonal transformation, Production decline

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