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非线性有效压力计算

肖文联, 李闽, 赵金洲, 赵世旭*

西南石油大学油气藏地质及开发工程国家重点实验室, 成都 610500

Calculation of non-linear effective pressure

XIAO Wen-Lian, LI Min, ZHAO Jin-Zhou, ZHAO Shi-Xu*

State Key Laboratory of Oil and Gas Reservoir Geology and Exploitation, Southwest Petroleum University, Chengdu 610500, China

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摘要

根据Robin关于有效压力的定义,结合Bernabé推测的孔隙压p_p和围压p_c图中的渗透率等值线变化形态,提出了一种新的非线性渗透率有效压力计算方法.用新方法和Bernabé切线有效压力计算方法对以往和本次实验的12块低渗岩芯的实验数据进行了处理分析,结果表明新方法和Bernabé方法计算得到的有效压力在p_p和p_c图中的渗透率等值线为直线时才相等.当等值线为曲线时,二者计算得到的有效压力不一样.新方法计算出的测试点的有效压力与渗透率的关系表现出更好的一一对应关系.为了进一步验证文章计算有效压力方法的有效性,用指数和乘幂两种函数分别拟合二种有效压力计算方法得到的有效压力与渗透率之间的关系.拟合结果表明,新方法得到的有效压力与渗透率的拟合效果优于用Bernabé方法计算得到的有效压力与渗透率拟合效果.

关键词　有效压力,　非线性,　割线,　切线,　渗透率

Abstract：

Based on Robin's concept of effective pressure and Bernabé's permeability-isograms (k-isos) characteristics in pore fluid pressure (p_p) and confining pressure (p_c) figure, a new method for calculating the non-linear effective pressure (the secant effective pressure) is developed. Meanwhile, the new method and Bernabé' method for calculating tangent effective pressure were used for analyzing the data of 12 samples in the present and previous researches. Two kinds of effective pressures were calculated. The results reveal that just as k-iso is linear, the secant effective pressure is equivalent to the tangent effective pressure. Otherwise, the two kinds of effective pressure laws are not the same. Moreover, it is found that the points describing the relationship between permeability k and the secant effective pressures are less scattered than the ones between permeability k and the tangent effective pressures. To assess the validity of the new method, two kinds of curves between permeability and effective pressures were fitted by power function and exponential function respectively, and it is observed that the secant effective pressures present the better fitting results than those done by the tangent effective pressures, suggesting a more feasible way of effective pressure calculation.

Keywords Effective pressure,　Non-linear,　Secant,　Tangent,　Permeability

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