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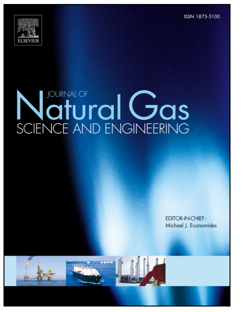

Theoretical analysis of characteristics and influencing factors for channel fracturing conductivity

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Article

Theoretical analysis of characteristics and influencing factors for channel fracturing conductivity

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Abstract: Channel fracturing is a novel hydraulic fracturing technology that is gaining increased attention, and the conductivity optimation involved in this technology is becoming a hotspot. However, for channel fracturing, recently presented conductivity models are derived based on Darcy flow under idealized conditions. This limitation motivates the development of the models that consider the new governing flow equations to describe the real flow status in channel fracturing. In this work, a generalized conductivity model is established by considering the embedment and pillar geometry of the proppant. The interrelationships and interactions among embedment, permeability, conductivity models are derived analytically. Based on evaluation with previously published experimental data, theoretical analysis and comparison are performed. Results show that the models can accurately describe the embedment, permeability, and conductivity change in channel fracturing. The factors that influence changes in fracture conductivity are further investigated by numerical simulations and we find that the theoretical conductivity model can be used to characterize flow behavior under different conditions in channel fracturing. This paper provides a theoretical basis for evaluating the critical factors governing conductivity, thereby providing a reference for the optimization of construction in channel fracturing design.

Keywords: embedment; power–law model; permeability; conductivity; channel fracturing

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1. Introduction

As an essential stimulation technology in the petroleum industry, hydraulic fracturing has been widely applied in extensive reservoirs by pumping into the wellbore with fracturing fluid mixed with proppant to generate fractures in the target formations for oil or gas to flow (Adams and Rowe, 2013; Golshani and Tran_Cong, 2008). Proppants are often homogeneously distributed within fractures to resist the confining stress, support the fracture, and reach desirable conductivity; thus, the production of hydrocarbon can be enhanced remarkably (Cipolla et al., 2009; Warpinski, 2010; Warpinski et al.,2009). However, during the production, the proppant gradually embeds into the rock formations under the confining stress and fluid damage, which will result in a significant decrease in conductivity (Kunnath et al., 2013; Zou et al., 2015; Weaver et al., 2010). Individuals have considered several measures and techniques, such as improving proppant strength and deformation capacity, developing new fracturing fluid system, or optimizing the combination of different types of proppant, to stabilize fracture conductivity (Saldungaray et al., 2013; Kayumov et al., 2012). Even so, the effectiveness of conductivity still cannot meet the expected requirements. Thus, additional measures, such as refracturing, need to be considered to ensure production and economic benefit (Pournik et al., 2010; Elbel et al., 1993; Araque et al., 2013). Under these circumstances, the emergence of a novel fracturing technology is urgently needed to reduce the cost of reservoir development and bring it back to economic level, especially under the depression of the petroleum industry (Todd et al., 2015).