AAPG Datapages/Search and Discovery Article #130000 © Petroleum Drilling Techniques, Issue 1, 2018

Hydraulic Jet Fracturing Technology Based on Archimedes Spiral Theory

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ABSTRACT

The multi-stage double-cluster hydraulic jet often encounters problems such as that of relative ineffectiveness,uneven erosion between the upstream and downstream by the injector,and sanding problems caused by the easy settlement of sands.To overcome these challenges,the theory of Archimedes double helix was utilized and integrated to a mathematical model of hydro jet fracturing,which provides the basis in the design of the double-helix hydraulic fracturing tubing string and injector.Then visualizations of the sand-carrying evaluation experiments were performed to evaluate the double-helix characteristics.In addition,kinetic equations of sand migration in sand-carrying fluid through straight pipes and double-helix pipes with the same diameter under hydraulic fracturing conditions were obtained based on Newton's second law,then transformed into the calculation models of the kinetic velocity of sands.As indicated in the research,the double-helix hydraulic fracturing pipe strings and injector can generate rotational flow,which help to balance double-helix hydraulic fracturing effects,and reduce erosion unevenness between the upstream and the downstream.The movement of sands can be described in a model by the accelerated movement equation with a constant accelerated velocity and varied accelerated velocity inside straight pipes and double-helix pipes,respectively.The research demonstrated that the double-helix hydraulic fracturing pipe strings and injector can function well,which are feasible evidently in balancing the multi-stage hydraulic fracturing effects and improving sand-carrying capacity of fluid along horizontal wellbores.