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Integrating Quantitative & Qualitative Reservoir Data in Sand Prediction Studies: The Combination of Numerical & Geological Analysis

Abstract

The methodology for predicting sand production is in general constant across the industry. That is the determination of formation strength and field stresses and the application of them to a failure model. However, the variety of models available and their applicability and accuracy can be confusing with the results not always representing what is experienced under production conditions.

This paper introduces a more holistic approach to sand production prediction which not only utilises numerical analysis, but also includes a qualitative approach using geological information. With respect to the numerical analysis the determination of various parameters used in modelling sand production and their effectiveness for different reservoir and production conditions is discussed. An overview of the various tests considered useful in calibrating these parameters is also presented. The geological approach discusses the impact of mineralogical, depositional, structural and diagenetic factors which can impact on the propensity for sand, but which are not fully taken into account by a purely numerical approach.

The advantages and disadvantages of each of these aspects are presented and synergies identified between numerical and qualitative analysis. Case histories are presented which show that each of these methodologies, when used independently, can present dissimilar results. This may ultimately lead to recommendations which can result in costly operations and unnecessary equipment deployment. However, when numerical modelling and geological methods are used in conjunction with one another, the results present a more realistic and practical view of the formation sands and their potential for solids production during the life of the well.

Introduction

As an increasing number of fields around the world enter their mature stages of production, the impact of depletion and increasing water cut is having a dramatic effect on their propensity for sand production. It is estimated1 that by 2010, half of all production wells and one third of injectors will produce sand. There is continuing demand for improved technologies to mitigate solids production as the industry strives to extract hydrocarbons from deeper, hotter wells in increasingly hostile environments. This is being met by improved gravel pack placement techniques and advanced expandable technologies as well as the proven methods of sand control.

If the factors which contribute to sedimentary rock strength were few and constant, then all sandstones would be of similar strength and a reliable and universally applicable methodology for sanding prediction would now be in place. This is, of course, not the case and is what makes the accurate prediction of sand behaviour somewhat unpredictable.

However, there remains uncertainty as to the accuracy of geomechanics work utilised in qualifying and quantifying a given well's propensity for sanding. This process is widely acknowledged; that is, the determination of the formation strength and impact of the in-situ stresses identifying the conditions under which failure of the rock will occur. A typical sand prediction model structure is shown in Fig 1.