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Cement Sheath Evaluation in Nonconventional Environment—Case History

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Abstract

Sonic and ultrasonic tools have been widely used for cement sheath evaluation along the last decades. The evaluation main goal is the definition of the presence of cement in the annulus and its ability of promoting hydraulic isolation among different permeable zones, regardless of its density, compressive strength or even quality of the slurry. The challenges interpreting those logs are enormous because the influence of many variables in the acoustic signal. The difficulties increase dramatically if the well configuration is not conventional. In those cases, huge mistakes can occur requiring from the interpreter experience, understanding of the tools and acoustic principles, and detailed information about the well, casing, cement, and so on. The paper describes in detail three well documented cases histories where non-conventional conditions in the wellbore prevailed and required extreme care and experience to obtain the correct log interpretation. The first case reports the evaluation of an annulus with cement between two concentric casings; the disturbances caused by reflections from the second interface in the CBL signal are discussed and recommendations presented to bypass this obstacle. In the second case, the challenges to evaluate the cement sheath in a fiber glass casing are presented; usually in this case, the first signals arriving at the receiver do not come from the casing. Finally, the last case history describes the difficulties to come up with the right evaluation logging a liner cemented with lightweight slurry. For all cases, guidelines and recommendations are suggested to avoid misinterpretations and assure correct decisions about cement sheath evaluation.

Introduction

The cement sheaths play an important role in the integrity of a well throughout its life. To guaranty cement sheaths integrity one should consider the cement sheath properties, taking into account the effects of well operations, the cement slurry design and testing, the cement slurry placement, and the

cement sheath evaluation (CSE)¹. This paper focuses CSE in nonconventional environment from the end users point of view. After a section defining and making some considerations about nonconventional environments, a section on the CSE process, and a brief refreshment section about sonic and ultrasonic logs interpretation, three case histories are presented. The CSE in the Brazilian State Owned Operator (BSOO) fields is based on thorough analysis of the drilling and cement operations reports, including well conditioning, and the interpretation of sonic and ultrasonic logs outputs. Alternative techniques, including inter-zonal communication tests, are rarely performed in Brazil.

All the case histories focus land wells and are related to zonal isolation. The first case is about a casing in casing CSE. It illustrates the CSE process in the BSOO land operations in the year 2001 and an initial misunderstanding in the interpretation of the log outputs. Nowadays there are strict corporative standard procedures, including check-lists for cement logging planning, logs quality control and logs interpretation, for CSE in the BSOO. The second case focuses a project just started in Argentine, that makes use of fiberglass production casing to deal with water injection corrosion. This case has a bit of innovation as the fiberglass CSE demands modifications of the logs processing and interpretation procedures. The third and last case reports the first CSE of a lightweight cement slurry with hollow ceramic microspheres in Brazil, in 1996. It illustrates the case of an important cement evaluation of a nonconventional slurry, in a remote area from the point of view of gas and oil exploration and production, in the south of Brazil.

It should be mentioned that most of the wells drilled offshore Brazil, in the last decade, are horizontal ones completed with open hole gravel packs. Thus the horizontal sections are covered with sand control screens. However, there are a few cases of cemented horizontal sections for multiple fracturing purposes, which CSE has not been easy. In all the horizontal offshore wells the production casings land at the tops of the reservoirs close to the horizontal, making their cementation an important issue. Many times a thorough analysis of the drilling and cement operations is sufficient for the CSE of these production casings. When the drilling and cement jobs reports show any significant abnormality, and in geomechanical sensitive area, cement logs are run. As large casings and lightweight slurries have been used, the CSE is more complex. This paper doesn't present offshore wells case history.