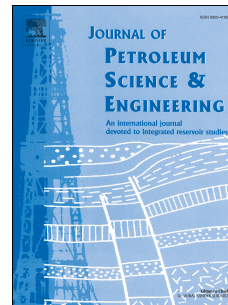


Accepted Manuscript

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PII: S0920-4105(16)30667-2

DOI: [10.1016/j.petrol.2017.06.047](https://doi.org/10.1016/j.petrol.2017.06.047)

Reference: PETROL 4059

To appear in: *Journal of Petroleum Science and Engineering*

Received Date: 12 October 2016

Accepted Date: 15 June 2017

Please cite this article as: Jafariesfad, N., Geiker, M.R., Gong, Y., Skalle, Pål., Zhang, Z., He, J., Cement sheath modification using nanomaterials for long-term zonal isolation of oil wells: Review, *Journal of Petroleum Science and Engineering* (2017), doi: 10.1016/j.petrol.2017.06.047.

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Cement Sheath Modification Using Nanomaterials for Long-term Zonal Isolation of Oil Wells: Review

Narjes Jafariesfad¹, Mette Rica Geiker², Yi Gong², Pål Skalle¹, Zhiliang Zhang², Jianying He^{2,*}

1. *Department of Petroleum Engineering and Applied Geophysics, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway*
2. *Department of Structural Engineering, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway*

* jianying.he@ntnu.no

Abstract

Well cementing is an important operation during drilling and completion of oil wells. The cement sheath must maintain well integrity behind the casing and provide long-term zonal isolation to ensure safety and prevent environmental problems. Despite recent technological advancement in smart polymeric materials, fibers and self-healing materials, it is still a big challenge to provide adequate long-term zonal isolation in severe oil well conditions. This review provides an overview of challenges faced in oil wells compromising the long-term ability of the cement sheath to provide zonal isolation. Factors controlling the long-term performance of cement sheath are discussed, in terms of shrinkage, tensile strength and flexibility. The use of nanomaterials as cement additive to fabricate flexible, high-tensile strength, and low-shrinkage cement system are reviewed. Introduction of nanomaterials into the cement system is a promising approach to design a sealant for the entire life of the well, thereby avoiding potential remedial costs and environmental impacts.

Keywords: Oil well cement; Shrinkage; Tensile Properties; Young's modulus; Nanomaterials

1 Introduction

Nanotechnology applications have pierced through oil industry in the four general petroleum disciplines: exploration, drilling, production and reservoir. The possibility to produce tailor-made nanomaterials with specific properties is expected to play a leading role in dealing with challenges encountered in different areas of the oil industry (Li et al., 2013). For example, nanoparticles may provide sophisticated measuring and imaging tools to improve field characterization techniques in oil exploration (Krishnamoorti, 2006; Pourafshary et al., 2009). Nanosensors compatible with hostile environments in deep wells are being developed for reservoir management (Zhang et al., 2011). Also, there has been a great focus on Enhanced Oil Recovery (EOR) using nanotechnology.

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