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Natural Products Chemistry & Research

Material enhancement of expansion mandrel for oil and gas wells

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Abstract

Extraction of oil and gas from old and difficult reservoirs is quite challenging, both technically and economically. Some of these challenges have been successfully met through the use of Solid Expandable Tubular (SET) technology. Special petroleum tubular is expanded *in-situ* by forcing a conical mandrel through it, using hydraulic push or mechanical pull. SET technology has been used for cost reduction and efficiency improvement in well completion operations; separation of water producing and other undesirable zones from the production zone; profitable production from mature and abandoned wells etc. In collaboration with a regional petroleum development company, a full-scale expansion test rig has been designed, fabricated and commissioned at Sultan Qaboos University. The mandrel is made from special material (high-grade tool steel, such as AISI D6). High level of repeated thermo-mechanical stresses requires a specific set of properties for the cone material. This is achieved through an optimal heat treatment sequence, in conjunction with various types of mechanical testing. Heat treatment consists of annealing, hardening/austenitizing, air or oil quenching and single or double tempering. Testing includes hardness, tensile properties (Elastic modulus, yield strength, ultimate strength and ductility) and impact strength. Optimum material properties would ensure dimensional accuracy of the expanded tubulars and a longer mandrel life.

Biography

Sayyad Zahid Qamar is currently associated with the Mechanical and Industrial Engineering Department, Sultan Qaboos University, Oman. He has over 25 years of academic and research experience in different international universities. He has also worked as a professional Mechanical Engineer in the field for over six years in the heavy engineering and fabrication industry. His research area mainly focuses on Applied materials and manufacturing; Applied mechanics and design; Reliability Engineering and Engineering education. As part of the Applied Mechanics and Advanced Materials Research group (AM2R) at SQU, he has been involved in different applied research funded projects in excess of four million dollars. He has over 200 research/technical publications to his credit (two research monographs/books, two edited book volumes, six book chapters, 160 publications in refereed international journals and conferences and 36 technical reports). He is currently editing one volume (Renewability of Synthetic Materials) for the Elsevier Encyclopedia of Renewable and Sustainable Materials.

Citation: Sayyad Zahid Qamar, Material enhancement of expansion mandrel for oil and gas wells. Petro Chemistry 2020, International Conference on Petro Chemical Engineering and Natural Resources, June 8-9, 2020, 04

Nat Prod Chem Res 2020
ISSN: 2329-6836

Volume 8 | Issue 4| 04