Cementing method enhances well killing

KILLING AND CEMENTING

DRILLING WITH CASING has been used in South Texas to reduce costs. Underbalanced drilling seems to have the potential to eliminate an intermediate casing string. By drilling underbalanced, it would be possible to drill with a mud weight low enough to prevent loss of circulation in the shallow weak zones while dealing with the gas from the pay zones below. Drilling with casing eliminates the necessity of trips. However, once TD was reached, it would be necessary to balance the well to allow cementing of the production casing string.

The challenge was to develop a way to kill the well so that the cement could be placed and allowed to set while at the same time not breaking down and losing circulation into the weak upper zones. This had to be done by having different equivalent circulating densities and equivalent mud weights up and down the hole throughout the circulating and cementing operation. This paper describes the development of the required methodology and its successful field application.

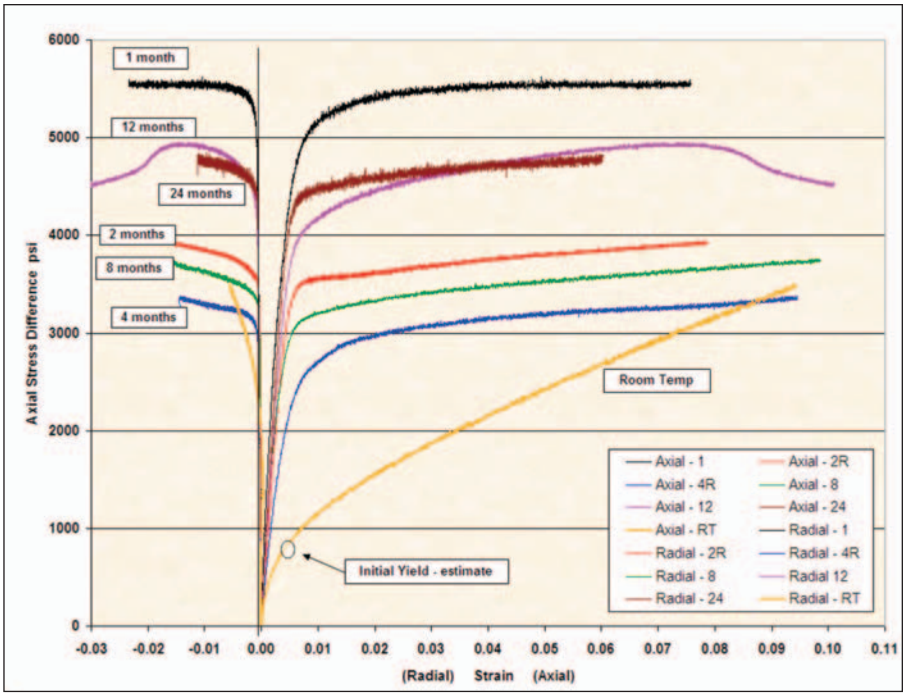
Simultaneous Dynamic Killing and Cementing of a Live Well (IADC/SPE 98440) PA Solano, Halliburton; R Strickler, ConocoPhilips; DD Moore, Signa Engineering Corp.

DEEP GAS WELL CEMENTING

This paper discusses the risk analysis and development plan that led to the selection of a liquid cement premix for large-volume jobs. The paper covers the design requirements of the jobs and addresses the risks associated with the available options. Information is provided on risks associated with boat and barge stability, draft limits at available bulk facilities, deck load limits and logistics of alternate designs.

The paper further covers the equipment requirements and mixing needs and compares the selected option to that of a conventional cement job.

Deep Gas Well Cementation: A Review of Risks and Design Basis for Use of a Liquid Cement Premix for Large Offshore Cementing Operations (IADC/SPE 98970) G Benge, JB Darby, M Peroyea, T Aguilar, ExxonMobil; DT Mueller, D Doherty, BJ Services.



98896: In tests measuring the mechanical parameters of five cement formulations after exposure to a temperature of 645 degrees Fahrenheit, the temperature conditions to which the cement was exposed was found to have a significant impact on the mechanical parameters. The mechanical parameters of systems exposed to 645 degrees varied significantly from systems exposed to an ambient temperature of 77 degrees.

CEMENT DESIGNS

Pressure events that occur after surface casing cementation impose stress on the cement sheath. If pressure testing takes place early in cement curing, the tangential stress imposed may exceed the tensile strength of the cement, thereby inducing cement sheath failure.

In most wellbore pressure scenarios, the cement sheath fails in tension. The proportionality between the compressive strength and the tensile strength of set cement is generally assumed to be a 10:1 ratio. In surface casing applications, the time at which induced pressure events occur may be as low as 8 to 12 hours after the cementing operation.

In this time frame, the cement will have a compressive strength ranging from that required for the commencement of drilling operations (500 psi) to upwards of 1,500 psi. Accordingly, conventional wisdom would hold that the tensile strength of the cement would be in the range of 50 to 150 psi. Is this assumption correct?

This paper characterizes the early state physical properties and mechanical behavior of accelerated Type I, Class A, G, and H cement designs during the 12 hours after placement.

Characterization of the Early Time Mechanical Behavior of Well Cements Employed in Surface Casing Operations (IADC/SPE 98632) DT Mueller, RN Eid, BJ Services.

ULTRA-HIGH TEMPERATURES

The ability of a cement sheath to remain intact when exposed to changing wellbore stresses is highly dependent on the parameters of Young's Modulus, Poisson's Ratio and tensile strength of the cement and the surrounding rock.

Wells subjected to Cyclic Steam Stimulation (CSS) for heavy oil recovery undergo extreme temperature changes. During CSS, wellbore temperatures can fluctuate between 77 deg F and 645 deg F.

Various Finite Element Analysis models require input of cement mechanical parameters. But no mechanical parameters are made after long-term exposure of the cement to the ultra-high temperatures encountered in CSS wells.

This paper presents a test methodology for measuring the mechanical parameters of five cement formulations after exposure to a temperature of 645 deg F.

Effects of Long Term Exposure to Ultrahigh Temperature on the Mechanical Parameters of Cement (IADC/SPE 98896) D Stiles, ExxonMobil.

EXTREME STRESSES

The deep Bossier formations of the East Texas Hilltop Field encounter low permeability gas bearing formations at over 15,000 psi and 400 deg F. Wellbore temperature variations occurring between stimulation and production operations are extreme. Two of the first three wells completed in this area failed via casing collapse.

Analysis confirmed that the extreme stresses being applied to these wells rendered the previous casings and cement sheaths as underdesigned. Detailed thermal and mechanical modeling of all wellbore operations resulted in redesigned casings.

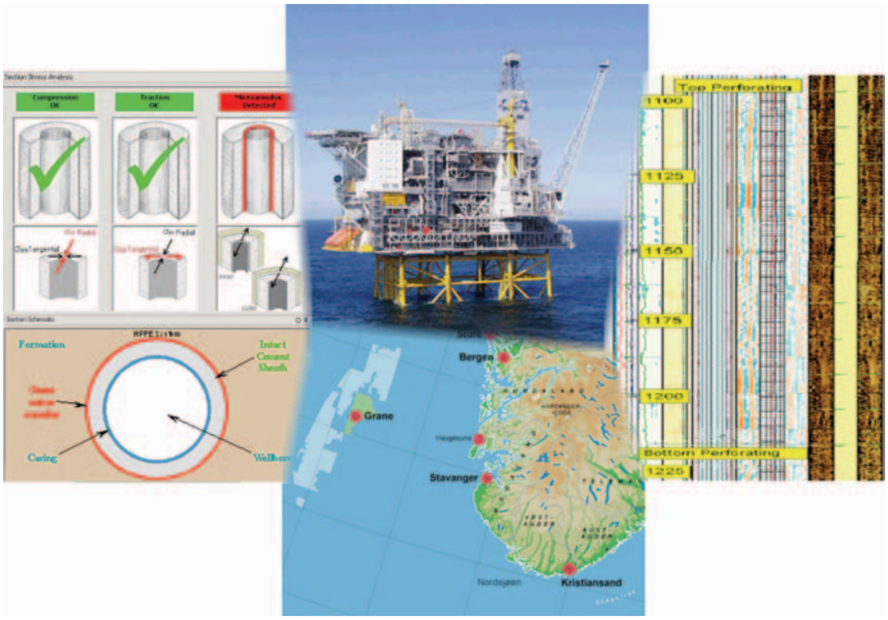
High-strength, corrosion-resistant casings and specialty cement designs were successfully used. All of the wells have withstood stimulations at treating pressures exceeding 14,000 psi, production drawdowns of over 13,000 psi, and temperature changes estimated at over 300 degrees F.

Finite Element Analysis Couples Casing and Cement Designs for HT/HP Wells in East Texas (IADC/SPE 98869) JF Heathman, Halliburton; F Beck, Gastar Exploration Ltd.

PREVENTING CO2 MIGRATION

A leaking wellbore annulus can be a pathway for CO2 migration into unplanned zones.

With the lack of industry standard practices dealing with wellbore isolation for the time scale of geological storage, a methodology to mitigate the associated risks is required. This requirement led to the need and development of a laboratory qualification of resistant cements and the long-term modeling of cement sheet integrity.



98891: A dedicated injector well was chosen as an application for stress modeling and a novel new sealant. Stress modeling indicated that as wellbore temperature decreased from bottomhole static to injection temperature, and bottomhole pressure cycled between static and dynamic conditions, conventional cement would fail in tension and create a microannulus. In view of these challenges, the team in charge of cementing the well decided to redesign the cement program incorporating stress analysis calculations and mechanical properties testing to provide a sealant material that would resist failure due to excessive wellbore stresses.

This article presents the results of a comprehensive study on the degradation of cement in simulating the interaction of the set cement with injected supercritical CO2 under downhole conditions.

Mitigation Strategies for the Risk of CO2 Migration Through Wellbores (IADC/SPE 98924) V Barlet-Gouedard, TS Ramakrishnan, Schlumberger; G Rimmele, B Goffe, ENS/CNRS.

CEMENT DURABILITY

It's estimated that 40 percent of the world's remaining gas reserves contain a CO2 content higher than 2 percent and/or a H2S content higher than 100 ppm. Therefore, special attention has to be paid to the design of well materials.

This paper addresses the problem of durability of oilwell cement in different hydrogen sulphide environments.

In this paper, we present the methodology implemented under HP/HT conditions for aging tests of materials in H2S-containing fluids and results obtained on cement-based materials.

Durability of Oilwell Cement Formulations Aged in H2S Containing Fluids (IADC/SPE 99105) E Lecolier, A Rivereau, A Audibert-Hayet, X Longaygue, Inst Francais du Petrole.

CEMENTING DISPOSAL WELL

This paper will discuss the design, execution and evaluation of a dedicated injector well in the Grane field in the Norwegian North Sea for an application for stress modeling and a new sealant.

Stress modeling indicated that conventional cement would fail in tension. The team redesigned the cement program incorporating stress analysis calculations and mechanical properties testing to provide a sealant material that would resist failure due to excessive wellbore stresses. The chosen sealant material incorporated flexible and expanding materials within an optimized particle size distribution blend.

The well has been logged with sonic and ultrasonic tools and has indicated an excellent bonding response.

Cementing of an Offshore Disposal Well Using a Novel Sealant That Withstands Pressure and Temperature Cycles (IADC/SPE 98891) CR Johnson, E Therond, Schlumberger; C Scheie, Hydro; R Pedersen, Hydro.