

Flexible Cement Improves Wellbore Integrity for Steam Assisted Gravity Drainage (SAGD) Wells. *Gunnar DeBruijn, Don Reinheimer, Sarah Whitton and Dwayne Redekopp, Schlumberger, Carlos Siso, ConocoPhillips.*

Well integrity is a key requirement for continuing heavy oil development and production. Cement sheath integrity is crucial to maintaining zonal isolation, which prevents unwanted fluid migration, especially oil, gas and steam, outside of the wellbore. Several commercial production techniques use steam to provide heat to mobilize heavy oil and allow production. These production techniques apply significant stress to the cement sheath which could lead to cement sheath failure. Cement will undergo strength retrogression when exposed to temperatures above 110 °C. Typical SAGD wells experience temperatures in excess of 150 °C and the cement system must be thermally stable and maintain the mechanical properties when exposed to these temperatures so that zonal isolation may be maintained. In addition to the temperature exposure, the injection of steam will cause the inner casing of a well to expand and contract with changes in pressure and temperature and can induce stresses in the cement causing cracking, which, in addition to destroying the cement to casing bond, can cause the loss of zonal isolation in the annulus. This ever-changing environment can also cause a breakdown in mechanical properties, potentially resulting in a loss of zonal isolation.

This paper presents a computer simulation to assess the stress in the cement sheath and help the design of cement systems that can withstand the expected stresses during the life of the well. A flexible cement system, characterized by a low Young's modulus, provides a solution for steam injection applications, as it has mechanical properties that allow the set cement to expand and contract with the inner casing without losing zonal isolation. Preventing cement breakdown can be further helped by improving the installation practices and by assessing and reducing the stresses imposed on the cement during the life of the well.

A case history detailing the installation of a flexible cement system in a SAGD production well in Alberta is also presented. Once a flexible cement system has been selected, careful planning and process control is required to deliver the system with the desired properties. Best practices must be used for placement of the system in the annulus. Industry best practices, especially the use of centralizers, viscous fluid spacers and pipe movement were employed. Excellent zonal isolation is achieved with the flexible cement system.