Münster, Germany

Solution Mining Research Institute Fall 2017 Technical Conference

Münster, Germany, 25 - 26 September 2017

Electromagnetic wall thickness and multifinger measurements - a contribution to well and cavern integrity monitoring

Gunther Baumann and Frank Hasselkus

Bohrlochmessung Storkow GmbH, Schützenstraße 33, 15859 Storkow, Germany

Socon Sonar Control Kavernenvermessung GmbH, Windmühlenstraße 41, 31180 Giesen, Germany

Abstract

Due to the shortened injection and production periods especially in underground gas storage facilities the thermodynamic and mechanical stress has increased on the casing and cementation. Moreover a rising number of salt caverns have reached their operational age in Germany. Therefore well and cavern integrity evaluation using wireline logs has become an important tool to ensure a safe operation during the lifetime of a salt cavern.

The integrity of the cavern itself can be evaluated with sonar measurements. For the inspection of the casings and tubing, as well as the cementation different well logging methods exist. Cement evaluation is done using acoustic tools. Additionally some ultrasonic tools can recognize the inner casing wall thickness from its resonance frequency. The problem is that all acoustic methods need a liquid filled well, which makes the work over operations to perform such logging methods very expensive. Moreover acoustic methods can be strongly affected by scales or paraffin located at the internal casing wall as well as changing liquid densities, resulting in poor measurement results.

Multifinger measurements are highly accurate in determining the internal casing diameter, but are also affected by deposits on the internal casing wall. Furthermore casing thickness calculations based on the multifinger measurements are always related to the nominal outer casing diameter and do not take into account manufacturing uncertainties or corrosion on the outside of the casing.

In contrast electromagnetic wall thickness tools work in gas as well as in liquid filled wells and are unaffected by scales or paraffin. Using defined electromagnetic impulses ring currents are induced in the steel casing material. These ring currents produce a electromagnetic field, which induces a voltage in the transmitter/receiver coil system of the electromagnetic wall thickness tool. Time domain analysis of the voltage decrease, corresponding to a multi frequency excitation, is related to the casing diameter, the casing thickness, the electrical conductivity as well as the magnetic permeability of the steel material. Since the electrical conductivity and the magnetic permeability of the commonly used casing materials only vary in a narrow range and the casing diameter is known, the main parameter controlling the logging signal by a power of 3 is the casing thickness. In a dual casing setting the logging signal can be split into the components of the inner and the outer casing, making a quantitative wall thickness evaluation possible. The casing diameters which can be examined range from 2.5” to 20.5”.

Combining the results of the electromagnetic wall thickness tool with multifinger measurements is a complementary combination for well integrity inspections, especially in a dual casing setting. The methodical background of electromagnetic wall thickness and multifinger measurements as well as practical measuring results are presented.

Key words: multifrequency electromagnetic wall thickness log, multifinger caliper log, casing inspection, corrosion, well integrity, well logging