SERVICIOS INTEGRALES LEIMAR C.A.
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Reservoir Analysis Sonde (RAS)

The Reservoir Analysis Sonde (RAS) is a logging tool based in a Pulsed Neutron Accelerator and multiple detectors. It's used to measure reservoir Fluid Saturation using measurement techniques of capture Sigma and Inelastic Carbon Oxygen. If it's operated in Activation Mode it can measure the water flow passing the tool or existing behind the production pipe or the casing.

DESCRIPTION

A generator contained in the tool and controlled by the tool's electronics emits 14 MeV neutrons with a total burst output of 10^8 neutrons per second. Several nuclear processes occur while the neutrons lose all their energy after the formation is bombarded with them. Among these processes and with considerable importance for the tool's operation there can be Activation, Elastic and Inelastic Collisions and Capture.

The activation processes occur when the neutrons induce radioactivity in different materials. This happens when the atoms' nuclei become heavier after capturing some of the free neutrons generated by the tool's source. These radioactive nuclei will exhibit half-lives ranging from a few fractions of a second up to several years. The activation of the oxygen molecules in the water is one of the activation processes that is very important to be measured because it will help us quantify the movement of water.

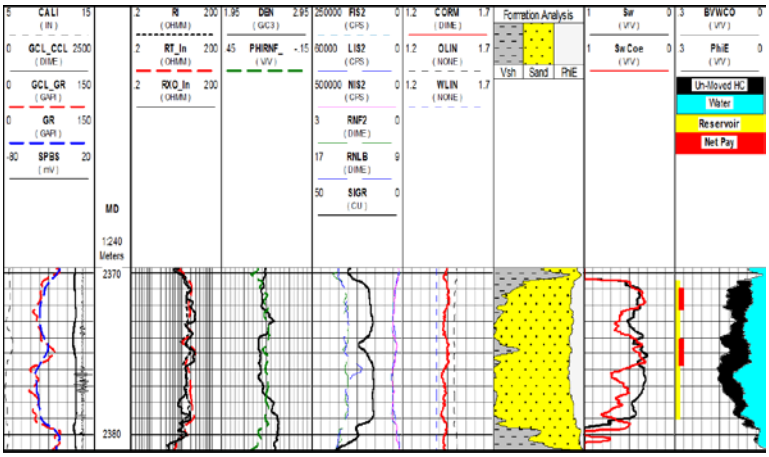
Inelastic Collisions are processes where part of the neutron's kinetic energy can change. These processes depend on the velocity (energy) of the neutron and on the effective cross section of the atom's nuclei they strike. Gamma Rays with a distinctive energy that depends on the nature of the stricken atoms are produced as a result of these collisions. The measuring systems quantify the energy spectrum generated from the collisions and it's used to obtain ratios of carbon to oxygen. These ratios are used to evaluate the fluid saturation in the pores of the formations.

Another important process occurs when the neutrons generated by the electronic source had collisions with surrounding atoms, causing their energy to decay to thermal levels where they can be easily captured by a nearby atom. The capture of a neutron generates gamma rays with a distinctive energy and by measuring its population we can identify formation water when the salinity of the formation water is high enough.

APPLICATIONS

- Reservoir Monitoring
- Water or gas flood advance
- Well Integrity effectiveness
- Hydrocarbon prospection in existing wells
- Evaluation of actual fluid saturation for comparison with original petrophysical estimations
- Reservoir base log for cases where open hole data can’t be acquired
- Pseudo Density computation emulating the open hole density curve using a density reference in nearby wells
- Thermal Neutron Porosity curve equivalent to the Open Hole Compensated Neutron
- Emulation of Resistivity using Sigma
- Field data correlation
- Detection of water flow behind the casing

EXAMPLE



7-5/8 in hole with 5-1/2 in casing. The lithology corresponds to a sequence of sandstone and shale. The formation water salinity is approximately 5 Kppm.

The hydrocarbon saturation calculated with the RAS can be compared with the original hydrocarbon saturation to estimate the remaining hydrocarbon in place.

SPECIFICATIONS

	RAS – Reservoir Analysis Sonde
General Specifications	
Maximum Pressure	15,000 PSI (100 MPa)
Maximum Temperature	320 ºF (160 ºC)
Diameter	1-11/16 Inches (43 mm)
Length	132 Inches (3.57 Metros)
Length with GR, CCL and Telemetry	183 Inches (4.65 Metros)
Measuring Point on Long Spaced Detector	101 Inches (2.56 Metros)
Weight	44 Lb. (20 Kg)
Maximum Logging Speed (Sigma)	18 Ft./min
Maximum Logging Speed (C/O)	7 Ft./min
maximum Hole Size	9-5/8 Inches
Minimum Hole Size	4-3/4 Inches
Hardware Features	
Type of Source	14.1 MeV Electronic Generator
Near Detector	$LaCl_3$ Scintillation Crystal
Far Detector	$LaCl_3$ Scintillation Crystal
Long Detector	NaI Scintillation Crystal
Firing Rate in C/O Mode	30 µSeg pulse @ 6.25 Hz
Firing Rate in Sigma Mode	200 µSeg pulse @ 500 Hz
Combinability	Hunter Data Bus and Sensors
Measurement	
Vertical Resolution	24 Inches (610 mm)
Depth of Investigation (Sigma)	9 a 12 Inches (229 a 305 mm) *
Depth of Investigation (C/O)	5 a 6 Inches (127 a 152 mm) *
Precision for Sigma	< 0.5 udc **
Precision for C/O	5% a FS

* Depende del hoyo y de la porosidad de la formación

** Resultados preliminares con revestidor de 5-1/2 Pulgadas y arenisca de 22 udp

udc: Unidades de Captura, también equivalentes a Barn/electrón

udp: Unidades de Porosidad, equivalente a porcentaje (%) de porosidad