

InSitu Viscosity

Reservoir fluid viscosity sensor

APPLICATIONS

- Hydrocarbon viscosity measurement in up to 10% immiscible contamination
- Flow rate computation
- Permeability computation from transient tests
- Fluid compositional grading assessment
- Compartmentalization studies
- Determination of displacement efficiency and mobility ratio
- Input for reservoir simulation
- Evaluation of enhanced oil recovery (EOR) applications

Reservoir fluid viscosity measurement is a fundamental physical property that governs reservoir deliverability, injection, sweep efficiency, and EOR performance. However, viscosity often varies with depth and laterally within a field, which can significantly affect commercial viability.

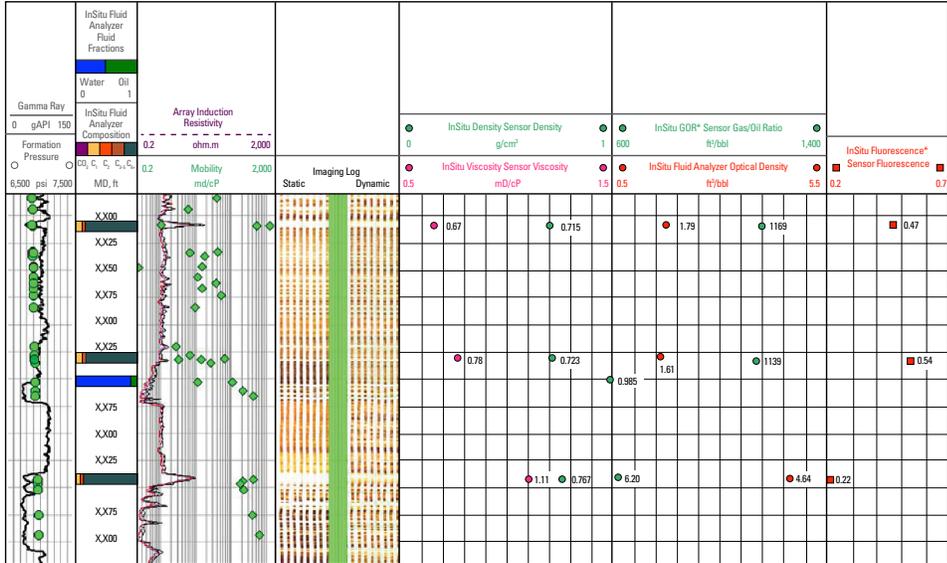
Accurate real-time viscosity measurement at reservoir conditions

The InSitu Viscosity* reservoir fluid viscosity sensor accurately measures hydrocarbon viscosity at reservoir conditions in real time. This newest member of the InSitu Fluid Analyzer* real-time downhole fluid analysis (DFA) system further expands the scope of the detailed fluid fingerprint delivered in real time, instead of waiting for discrete sample analysis from a laboratory. The InSitu Viscosity sensor is miniaturized to fit into the sensor slots of the InSitu Fluid Analyzer system to provide viscosity measurements that cover the range of light to heavy oil in downhole environments: from 0.2 to 300 cP at an accuracy of $\pm 10\%$.

Vibrating wire method

The sensor measures the viscosity of flowing fluid with a vibrating-wire (VW) method combined with well-established analytical equations. The measurement principle is based on the medium-dependent vibration characteristics of the sensing element. The more viscous the fluid, the more abruptly and rapidly the vibration of the VW sensing element lessens than compared with its behavior in a less-viscous fluid.

The oleophilic properties of the InSitu Viscosity sensor enable measuring the viscosity of formation hydrocarbons in the presence of up to 10% water, which makes representative measurement possible in immiscible contamination. Also incorporated in the InSitu Viscosity sensor is a platinum resistance-temperature detector thermometer for temperature measurement at an accuracy of ± 1.3 degF.



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Vibrating rod method

Viscosity measurement requires density input, which can be obtained from the InSitu Density* reservoir fluid density sensor's density-viscosity (DV) rod or manually entered. In addition to density measurement for any fluid type, the DV rod sensor measures viscosity in miscible systems (oil sampling in oil-base mud) with a range of 0.2 cP to 50 cP and an accuracy of $\pm 12\%$.

Both the InSitu Viscosity and InSitu Density sensors are high-pressure and high-temperature qualified, and the InSitu Density sensor is also qualified for corrosive environments.

The miniaturized InSitu Viscosity sensor fits into the InSitu Fluid Analyzer system without increasing tool length and weight.

Specifications

	InSitu Viscosity Sensor	InSitu Density Sensor
Output	Viscosity of oil with up to 10% water	Viscosity of oil
Physics of measurement	Vibrating wire	Dual-mode resonator
Range of measurement	Viscosity: 0.2 to 300 cP Temperature: -67 to 375 degF [-55 to 190 degC]	Viscosity: 0.25 to 50 cP
Measurement rate, s ⁻¹	1	1
Accuracy	Viscosity: $\pm 10\%$ Temperature: ± 1.3 degF [± 0.7 degC]	Viscosity: $\pm 12\%$
Temperature rating, degF [degC]	350 [177]	350 [177]
Pressure rating, psi	25,000	25,000
Mud type or weight limitations	Measurement in oil- and water-base mud at up to 10% contamination	Measurement only in oil-base mud for measuring miscible formation fluid
Special applications		NACE MR0175 compliant

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