Oil-Water Interface Level Detection

Overview

In the extraction of petroleum (oil) by hydraulic fracturing, oil flows to the well emulsified with fracturing water. As part of the extraction operation, oil and water are separated at the well site. Separation also occurs at the refinery, where crude oil from the well site contains water that must be removed before refining.

Separation vessels or separators are used for the process, with oil moving to the top and water to the bottom of the tank. The interface level between the oil and water is a critical measurement for the separation process. Continuous monitoring of the oil-water interface helps control and optimize the process, ensuring the maximum amount of oil is drawn and a minimum amount remains in the water for treatment. There are several advantages to optimizing the separation process, including:

- Reduction in water transported to the refinery
- Improved water quality for onsite or off-site water treatment
- Lower cost of water treatment
- Minimize the potential for fines associated with oil in water
- Greater volume of oil for refining through optimized separation

Oil-Water Interface Detection

Several methods are used to measure the interface between oil and water, from manual sampling and floats to capacitance sensors and guided radar sensors. Amongst the various options available on the market, non-contact radar level sensors are the most practical and effective.

Radar Sensor Technology

Non-contact radar sensors operate on the principle of microwave technology. An electromagnetic pulse transmitter stimulates the radar antenna and sends very short pulses to a target. The waves travel through the air, focused by the antenna. The waves reflect from the target and are received by the same antenna. The signal from the antenna is amplified and processed. The distance or level is calculated based on the time difference between the pulse sent and the pulse received.

For oil-water interface level detection, radar sensors are effective because of the different dielectric constant of oil (k 2.3) and water (k 80) that enables the sensor to determine the layers.

ABM Radar Sensor Operating Principle

ABM Sensor Technology manufactures non-contact radar level sensors with custom software for oil-water interface monitoring applications. ABM's advanced radar sensors operate on the following principle for oil-water interface detection:

1. When the radar is turned on, and oil is free of water, the radar gets a reflection from the oil-water interface that gives current output proportional to the oil-water interface level.
2. The echo from the oil-water interface is masked, and the radar is forced to go to a higher power to detect the echo from the top of the oil. The output current is proportional to the oil level.
3. A custom parameter in the software changes the alternation time between the top of the oil and the oil-water interface.
4. In the case of water in the oil, the radar does not penetrate the oil and shows the current output proportional to the top of the oil.
5. When heat is applied, and the separation happens, the radar shows two current values, one from the top of the oil and another from the oil-water interface.

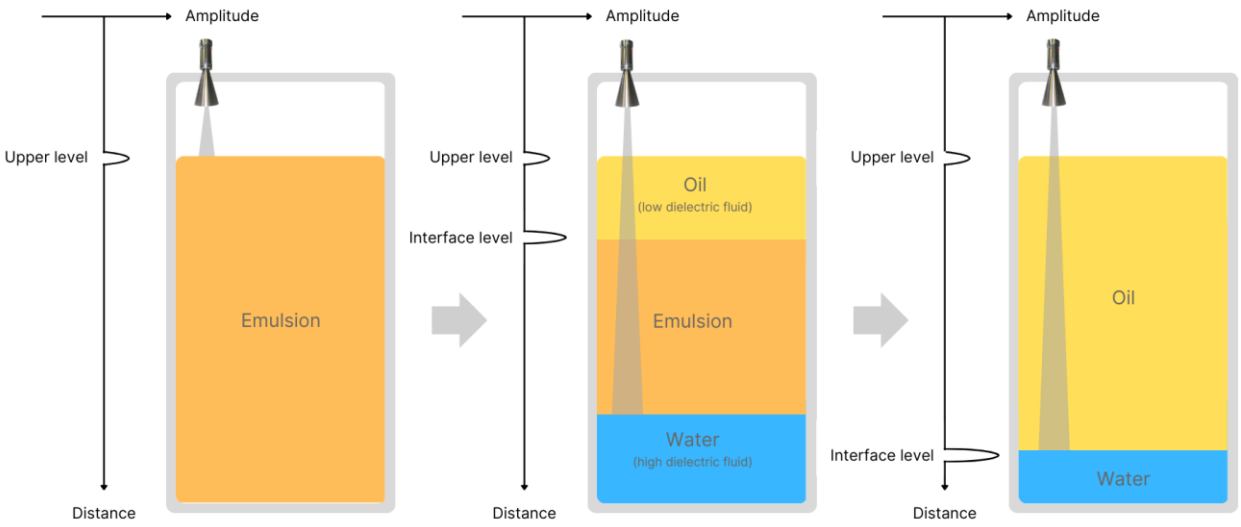

Figure 1: Radar level sensor interface measurement

ABM Technology Advantage

ABM's self-adjusting radar level sensors automatically adjust to any tank environment conditions without user interface, providing accurate and reliable level measurement. Due to the non-contact nature of the interface measurement and self-cleaning abilities, our radar sensors are maintenance free unlike alternative contact sensors that require regular maintenance and cleaning.

ABM's explosion-proof radar sensors are CSA/FM approved for Class 1 Division 1 applications. Our sensors are plug-and-play, simple to install and calibrate. The radar sensor is mounted on the top of the tank and can be connected to send a signal to the pumps to turn on and off based on the interface level, helping to automate and optimize the separation process.

In addition, ABM's Remote Monitoring Platform complements the radar sensor to gain real-time visibility into the process with full remote support from trained ABM technicians that virtually monitor the radar sensor 24/7 for support with remote setup, diagnostics and troubleshooting.