# Density measurement in multiphase flow meters with the new FMG50 from Endress+Hauser

**Endress+Hauser's new FMG50 offers the following USPs:**

- World's first 2-wire loop powered device
- Preventive maintenance through Heartbeat Technology – documented device verification without process interruption
- Safety by design – device developed according to IEC 61508 (SIL2/3)

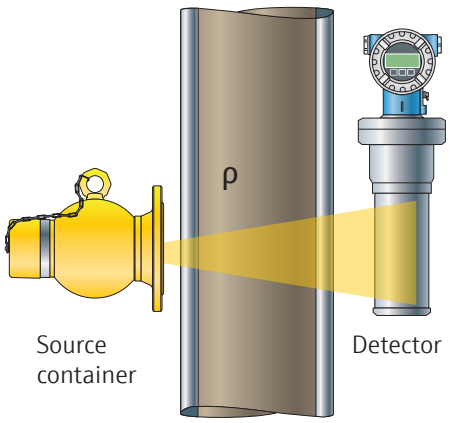
**Endress+Hauser's new FMG50 offers you additionally:**

- Bluetooth wireless technology for easy operation
- Intuitive user interface with guided wizards
- Reduced size of device
- Increased measuring range with one detector

Endress+Hauser's recently launched FMG50 is a right fit product for manufacturers of multiphase flow meter skids and stands out thanks to its SIL design and being 2-wire loop powered.

Oil well management and production optimization requires the throughput to be measured periodically. This is often done with three phase test separators which are vessels that separate the well fluids into gas, and liquids, either water or oil. It is often called a free-water knockout separator because its main use is to remove any free water.

Another possibility to test the yield of an oil well is using multi-phase flow meters to determine the flow rates of oil, water and gas. For this purpose, flow meters like venturis are combined with an additional set of sensors to find out the mixed fluid properties to determine the composition of the flow. The most widely used is radiometric, but capacitive, conductance and NIR probes are also used with different advantages and disadvantages.




**Advantages of radiometric measurement for the fraction measurement:**

- Measuring the density in the same cross-section as the flow
- Can deal with emulsion and foam
- Best accuracy across the board of conditions/ behaviours

Radiometric measurements are often used to obtain the density of the mixed fluid. The measuring principle is based on the absorption of radiation by the medium to be measured. A source emits radiation that is attenuated as it passes through a material and is then converted into an electrical signal on the opposite side by a detector.

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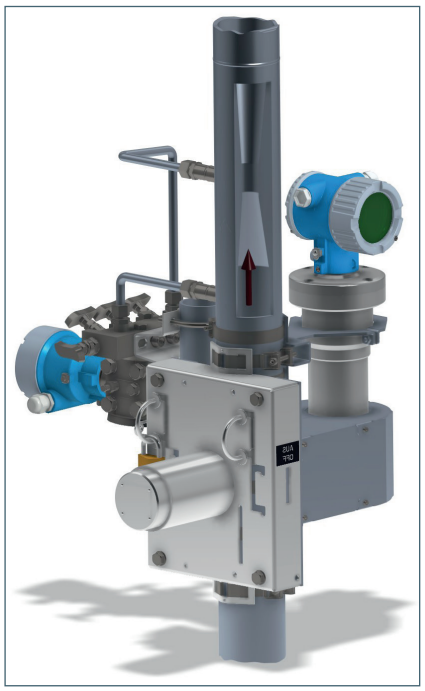

Figure 1: Possible multiphase meter configuration with Gammapilot FMG50 detector, FSG60 source and FQG60 source container, and Deltabar PMD75B.

Capacitive and/or conductive electrodes are often used to obtain the next part of the puzzle which is the dielectric values of the mixed (multiphase) fluid. Finally, individual densities or dielectric values must be known. This is achieved through offline measurements and calibration on crude oil samples in specialized Labs.

All this information is necessary to calculate the fluid fractions, and finally the individual flow rates. By solving the following three equation system using the density (x) and dielectric (y) values:

$$x = \alpha x_0 + \beta x_w + \gamma x_g$$

$$y = \alpha y_0 + \beta y_w + \gamma y_g$$

$$1 = \alpha + \beta + \gamma$$

Where $x_0/y_0$ are the density and dielectric value of oil, $x_w/y_w$ the ones of water and $x_g/y_g$ the values for gas, the fluid fractions of oil, water and gas can be obtained.

The total volumetric flow is multiplied times the fluid fractions to find out the individual flow rates as per the following equations:

$$Qo = \alpha Qv \; ; \; Qw = \beta Qv \; ; \; Qg = \gamma Qv$$

Where $\alpha$, $\beta$ and $\gamma$ are the fluid fractions of oil, water and gas.

In this way multiphase flow meters can replace three phase separators in oil wells. They have the advantages of being more compact, having lower CapEx and OpEx, and measuring real-time.

Deltabar PMD75B differential pressure transmitter

Gammapilot FMG50 detector

Source container FQG60

iTHERM ModuLine TM131 for harsh environment

Multiphase flow meter manufacturers can get all the instruments for their skids from Endress+Hauser: pressure, radiometric and temperature.

www.addresses.endress.com


**References:**

**Multiphase Flow Meters Targeting Oil & Gas Industries**

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