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Søren Forne & Svein Erik Gregersen, Roxar Flow Measurement

Developing a New Salinity Measurement System to Improve Wet Gas Meter Performance

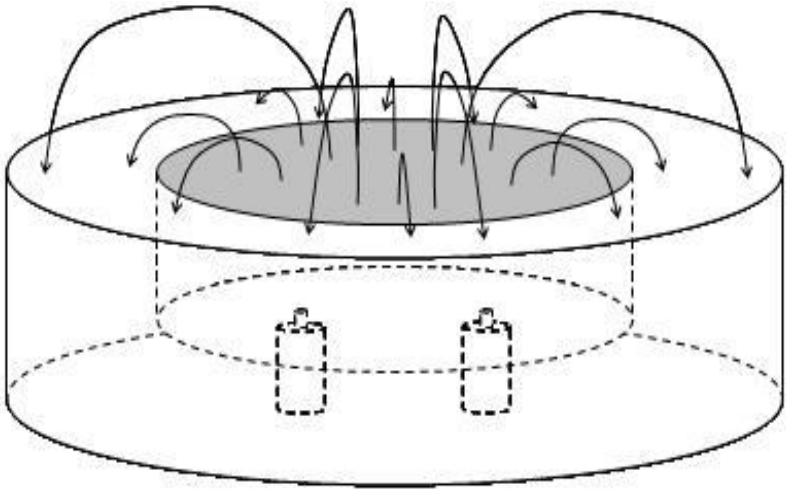
With the growth in deepwater offshore fields and, in many cases, subsea tie-backs, and as operators look to tie in smaller fields to existing infrastructure through such tie-backs, the accurate detection of formation water has rarely been more important. Such formation water, if not detected, can lead to hydrate formation and corrosion, and can have a detrimental effect on subsea equipment and flow assurance.

In wet gas fields, in particular, water detection is critical with even small amounts of saline water leading to large and rapid scaling problems and hydrates. The detection of the onset of formation water production through the monitoring of the salinity of the produced water is therefore a crucial element of effective reservoir management today, with the early detection opening up the possibility of early remedial action, such as adjusting the choke setting for or instigating zonal isolation, or injecting corrosion and hydrate inhibitors.

It is against this that Emerson and its Roxar business unit have developed a separate salinity measurement system based on a microwave-based salinity sensor (see illustration). The sensor will be used to improve wet gas meter performance as a complementary measurement to the current formation water detection function.

With salinity measurement a crucial indicator to the reservoir engineer on whether formation water is entering the flow as well as helping determine the injection rates of scale and corrosion inhibitors, Emerson expects the new salinity measurement sensor to have a major impact in wet gas fields.

In development since 2006 and in accordance with DNV-RP-A203, the new sensor is a dielectric cavity resonator, which is mounted in the wall of the meter body with one end facing the flow. The resonator is shorted in the back end and is open at the end facing the flow, with the coupling probes integrated into the housing at the back of the dielectric material. The illustration below shows the sensor with the direction of the electromagnetic field represented by lines.



In a wet gas flow, the liquid fraction is small. Here, the portion of the liquid being carried by the gas as droplets, compared to travelling as a film on the wall, depends on flow speed, pressure, and other factors. In such circumstances, performing measurements based on the full cross section of the flow leads to limitations in measurement sensitivity.

With a surface sensitive sensor, such as the new probe, however, engineers are able to perform measurements on this part of the liquid with a higher sensitivity to the liquid compared to the gas than the full cross section measurement principle can provide.

As the local volume fraction of water is for most operating conditions higher at the wall, the new sensor achieves a higher sensitivity compared to wet gas meters, due to the Q factor of the cone resonator being limited to roughly 200 through the usually poor conductivity of the special steel qualities used in the meters. The ceramic sensor, on the other hand, will have a far higher Q factor, making it possible to detect smaller changes in the salinity.

Finally, the new sensor is far less sensitive to the permittivity of gas compared to that of liquid. This is not the case with existing wet gas meters where, while the permittivity of gas is predicted to a high degree of accuracy from known gas compositions and PVT models, there may still be some uncertainty due to poor composition data which is directly seen as an offset in the measurement of the WVF. When the measurements from the cone resonator (in the wet gas meters) and the salinity sensors are combined, however, the uncertainty is reduced significantly making the wet gas meter far less dependent on the PVT composition data.

At a time where wet gas, deepwater fields are pushing the requirements for performance and functionality in wet gas metering, the new salinity measurement system is likely to play a key role in bolstering the capabilities of wet gas metering and contributing to a seamless flow of hydrocarbons from reservoir to refinery.

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