

## Asphaltenes, waxes, emulsions, and oil suspensions: Inline particle and droplet measurements in dark crude oil

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Liquid, solid, and gaseous hydrocarbon pipeline flow is typically a complex multi-phase system comprised of particles and droplets including waxes, asphaltenes, gas hydrates, emulsions, inorganic particles, and bubbles. Safe, reliable, and cost effective transportation and separation processes play a critical role in petroleum R&D, drilling, and production efforts.

Multiphase pipeline flow often occurs under extreme temperature and pressure conditions making offline sampling and analysis difficult or impossible. Ensuring that a sample is representative is difficult and time consuming. Samples are often manipulated through dilution or dispersion which can alter or destroy multiphase components. Offline measurements often cannot be applied to make real-time process optimization and control decisions.

With the advent of *in situ* particle characterization technology such as FBRM<sup>®</sup> and PVM<sup>®</sup> one can quickly measure the particle phase behavior *in situ* without pulling samples. This paper reviews the

application of real time, in-process particle and droplet measurement tools to avoid processing problems in the following applications:

- Understanding asphaltene precipitation and deposition in crude oil
- Improving oil-water and water-oil separation through in-process droplet characterization
- Visualizing gas hydrate formation to ensure consistent flow-rates
- Studying inorganic precipitation to prevent scaling

### References

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