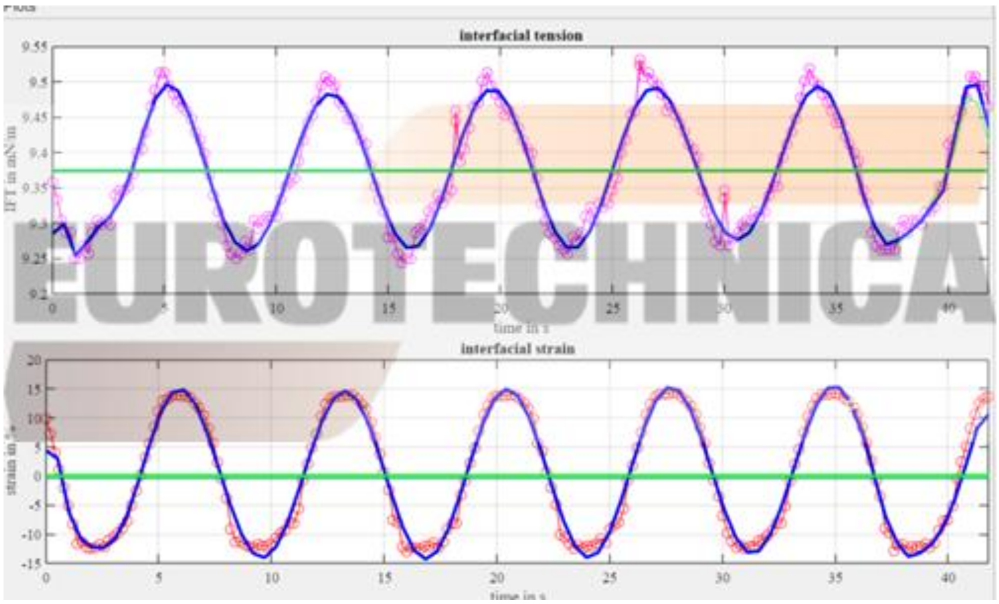
The Oscillating Drop Module – Description for the ET-website

Interfacial rheology plays an important role in several processes relating to pharmaceutical, food and petroleum industries. For example, in the oil and gas industry, the stability of water-in- crude oil emulsions or the lack thereof can result in severe operational and economic challenges pertaining to flow assurance and separation processes. Asphaltenes, for example, are high molecular weight aromatic hydrocarbons that are known to be natural stabilizing agents for water-in- crude oil emulsions. They adsorb at the water-oil interface, reduce interfacial tension and form rigid films that hinder coalescence of dispersed water droplets; an undesirable phenomenon in separation processes as it increases the transportation and refining costs. The stability of water-in-crude oil emulsions is largely controlled by the mechanical strength and viscoelasticity – or the so-called interfacial rheological properties - of the interface. Therefore, a deep understanding of the mechanisms by which this interface can be destabilized is essential for surface facility operators for the design and optimization of successful separation processes.

The rheological properties of the interface are determined using the oscillating drop method, where the interfacial area of a pendant or a standing drop is dilated and contracted at different oscillation frequencies. The interfacial area is simultaneously measured along with the interfacial tension to determine the elastic modulus (E’) which describes the degree with which the interface resists being elastically deformed (energy-storing response), the viscous modulus (E’’) which signifies the energy dissipation response of the interface, in addition to the phase shift (δ) between the oscillating surface area and the resultant oscillating interfacial tension.

Our oscillating drop module provides a fast, accurate, and straightforward way to determine interfacial viscoelastic properties under real process conditions. With automated data analysis built directly into the software, results are fully processed and ready to interpret—eliminating the need for complex mathematical treatment or additional post-processing. This saves engineers valuable time and effort, enabling them to make faster, more confident decisions when designing and optimizing processes.

Dr. H. Samara 22.8.2026



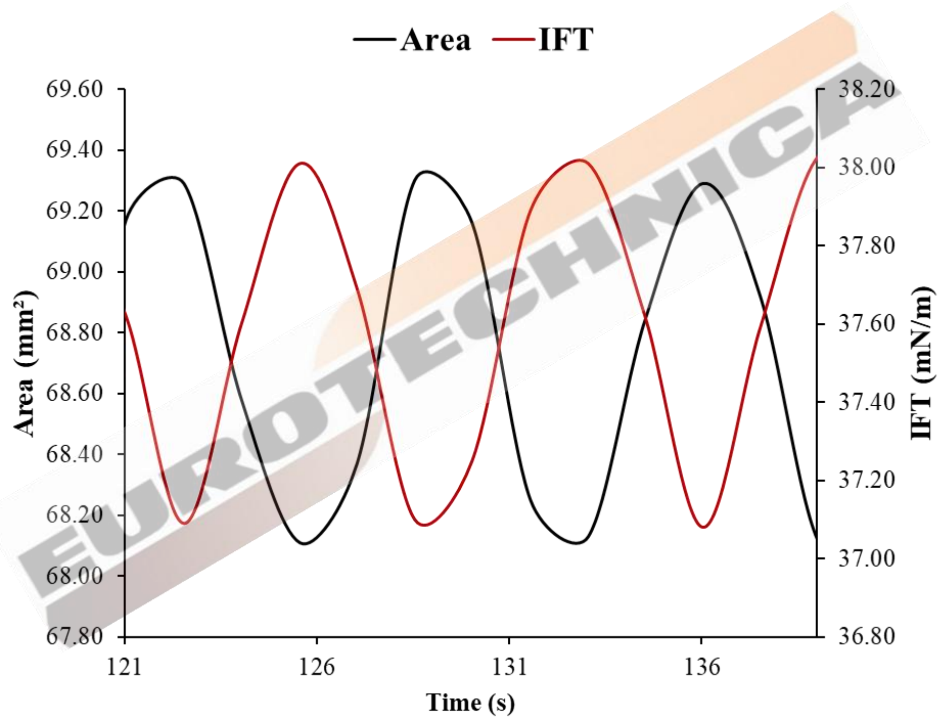


Figure: 3 wt% asphaltene in toluene in contact with carbonated water at 2 MPa and 297 K.