Electrical dehydration of petroleum emulsion: application to extra-heavy oil

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Most crude oil in the world is produced as water-in-oil emulsions that generate process problems related to their extreme stability especially in the case of heavy oils. Within the objective to obtain dehydrated oil, processes based on electrical field effect are classically used. However, chemical product addition is required to enhance the efficiency of electro-coalescence .

Significant improvements in the capacity and performance of existing crude oil dehydrators and desalters have been achieved through a continuous research on the mechanisms of action , the development of new electric field technologies , and the emergence of compact pre-coalescers.

The first part of this paper presents the current understanding about the mechanism of electro-coalescence in water in crude oil emulsions up to now. Some typical technologies of electrostatic dehydration or desalting as well as online electrostatic pre-coalescers will be reviewed.

The second part of this paper will be focused on the electrical destabilisation of difficult crude oils. In the case of asphaltenic heavy oils, the presence of a rigid film at the water/oil interface limits the coalescence phenomena and reinforce the emulsion stability. Experiments on various extra-heavy crudes from Canada and Venezuela were performed and results are discussed.

The effect of an electrical stress on water-in-oil emulsion stability was studied through two types of experiments based on a methodology of selection of the emulsion breaker additive and the electrical field parameters for optimal electrical dehydration of extra-heavy oils.

Electrical Stability Tester API device (EST) was used to select demulsifiers and to optimise their concentration. The test consists in a simple electrode dropped in the fluid and in a recording of the electrical field characteristics. The critical voltage corresponding to the short-circuiting conditions of the apparatus is determined. The lower the critical voltage value, the lower the stability of the emulsion and the higher the additive efficiency.

The other type of experiment was performed on an electrocoalescer rig (ER) using a tubular electrocoalescer device with one central electrode and with the fluids flowing into the annular space. A sinusoidal electrical field at several voltages and frequencies was applied in the annular space between tubes. Water droplet coalescence was measured and quantified by Differential Scanning Calorimetry (DSC). Experiments were performed at different flow rates or residence times in presence of the previous selected demulsifiers additives.

For extra-heavy crude oils, high voltage (kVolt) and high frequency (kHz) are required to destabilise the droplets but are not sufficient to induce coalescence. The combined effects of optimised electrical field parameters and chemical demulsifiers are necessary to enhance coalescence phenomena and allow a complete dehydration of crude oil

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