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Optimization of Demulsifier formulation for separation of water from crude oil emulsions in deepwater environment.

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Abstract
Emulsions pose a substatial obstacle in oil production operations, complicating the separation process and leading to various performnace issues such as corrosion, viscosity increase, and equipment fouling. When water and oil mix, these emulasions form, making separation challenging and impairing operational efficiency. However, by employing demulsifiers properly, operators can mitigate these adverse effects, ensuring the smooth functioning of oil production systems while preserving their integrity.
The selection of an effective demulsifier depends on the nature of emulsion, which often requires tailored formulations for the scenario evaluated. Demulsifiers, by breaking the stability of emulsions, are important allies in the oil industry and, when formulated with excellence, facilitate the efficient separation of oil and water, mitigating operational challenges. This article delves into the customized selection of a demulsifier for topside application, considering specific operational and production conditions, aiming to present an efficient and cost-effective solution.

Keywords
Oil; emulsion; demulsifier.

Introduction
During production, water from the aquifer (formation water) or water used in the recovery process, which typically originates from steam injection, can become present in the oil [1].

Depending on the chemical and/or physicochemical conditions, this water can form very stable emulsions with the oil. The water that forms the emulsions may contain salts such as sodium, calcium and magnesium chlorides and metal oxides that in addition to increasing the viscosity of the emulsions, affect the pumping and transfer system, and could compromise several operations in refineries [2].

It is important to highlight that much of the oil produced in Brazil is emulsified, as a result of its physicochemical and geological characteristics (deep water oil). [3].

This paper outlines the laboratory development of a customized topside demulsifier, tailored to the specific characteristics of the oil sample received from an operator in Brazil, to be applied in an oil field located in a water depth of 1,700 meters with subsequent evaluation of its performance in field conditions.

Table 1 lists the properties of the crude oil samples.

Table 1. Properties of produced fluids

Properties	Crude Oil
API	28.1
Viscosity at 50°C (cSt)	10.6
Viscosity at 40°C (cSt)	150
Viscosity at 20°C (cSt)	33.2

Methodology
The bottle test began with the evaluation of the samples received from Header A and Header B. The results are provided in Table 2.

Table 2. Emulsion and basic sediment and water (BS&W) test results.

Header A Sample	Header B Sample
BS&W = 55%	BS&W = 50%
Emulsion = 90%	Emulsion = 90%
Water = 1%	Water = 1%

The experimental test used to develop the topside demulsifier was performed considering the variables received from the platform process, such as temperature, residence time and agitation. Tests were also performed comparing the incumbent with EB-82220 [4].

Experimental Procedure

The evaluation was performed using a bottle test, where the oil was added to each bottle, and the bottles were heated in a water bath for 10 minutes at a temperature of 50°C. The selected product was dosed and then the bottles were shaken at a speed of 140 rpm for 10 minutes. Following stirring, they were maintained at temperature of 65°C and the water drop speed was evaluated at time intervals of 5, 10, and 15 minutes.

The bottles were manually shaken 20 times and returned to heating at 65C, which took place over periods of 5, 10, 30 and 45 minutes. Then, aliquots of oil were removed from each bottle and centrifuged in a tube with 50% kerosene to check the BS&W (thief) results. The dosages tested were 20 and 40 ppm.

Results and Discussion

In demulsifier selection tests for topside applications, the water separation speed, residual emulsions, and total BS&W are considered. These variables are critical to choosing the optimal formulation because they provide indications, in a relative form, of the quality of the oil at the end of the treatment.

It is important to consider the residence time of the process, because the phase separation process is kinetic and therefore faster products may be more suitable due to the undersized processing plants and, in this case, the tests were performed over 1 hour. The EB-82220 product provided superior water quality results and the final BS&W values were lower for the Header A and Header B samples than that of the incumbent product.

After approval of the product in the laboratory conditions, through bottle testing, the product was qualified to be field trialed.

Before the product was injected, a compatibility test evaluating EB-82220 and the product that was in use was performed, and no incompatibilities were observed.

The field test began with the injection of the product into Header B first, at the same dosages as the product that was in use, and the test continued with optimization according to the BS&W and the oil and grease content (TOG) results (Fig.1).

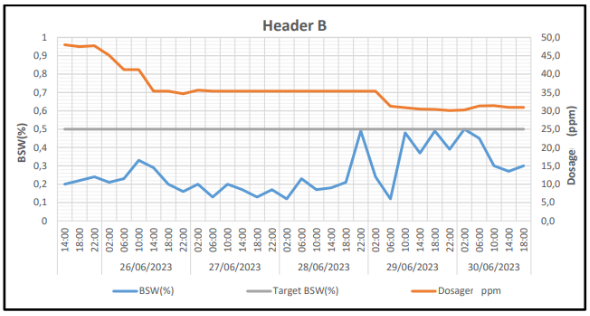

Figure 1. Demulsifier dosage and Header B BS&W result.

It can be seen in Fig. 2 that the TOG remained below 10 ppm (a requirement of this platform) throughout the test.

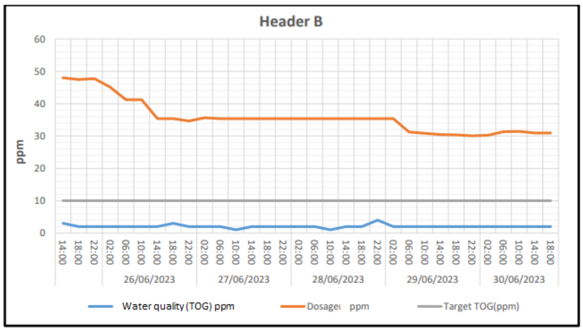

Figure 2. Demulsifier dosage and Header B TOG result.

The same procedure was performed at Header A. Some instabilities in the process impacted the BS&W results from Header A at the beginning of the field test.

However, during the test, these results fell within the specifications established by the operator, as shown in Figs 3 and 4.

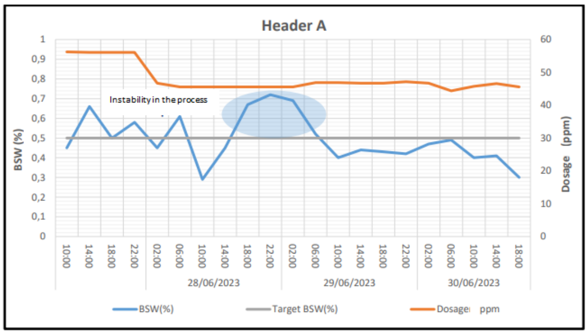

Figure 3. Demulsifier dosage and Header A BS&W result.

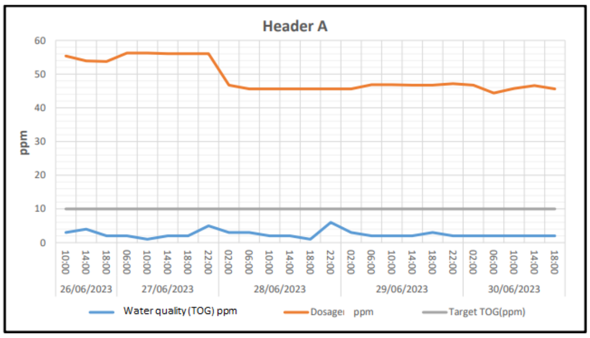

Figure 4. Demulsifier dosage and Header A TOG result.

Conclusion

During laboratory testing, the fit-for-purpose solution EB-82220 improved water quality and lowered the BS&W value for the oil samples from Header A and Header B compared to those of incumbent product.

During the field trial, the test took place in compliance with the conditions pre-established by the operator regarding production pressure, oil flow and well temperature, in addition to BS&W analysis and TOG analysis within a dosage of 10 ppm, as required by the operator.

Responsibility Notice

The authors are the only ones responsible for the paper content.

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