SPE Brazil Flow Assurance Technology Congress
Rio de Janeiro, Brazil, November 06 – 08 2024

Development and Qualification of a High-Performance Subsea Demulsifier for Efficient Oil Production in Deepwater Fields.

Roberta S. Oliveira[1], Andre S. Meliande [2], Guilherme S. Barreto[3], Felipe B. Silva [4], Jose A. Ladeira [5], Carina A. Dal'Col [6], Pedro. P. Mendonça [7], Lais R. Gomes[8].
[1,2,3,4,5,6,7,8] SLB, Brazil, [1]roliveira28@slb.com, [2]ameliande@slb.com, [3]gbarreto3@slb.com, [4]fsilva40@slb.com, [5]jladeira@slb.com, [6]cdalcol@slb.com, [7]pmendonca2@slb.com, [8]lgomes14@slb.com.

Abstract
The formation of a water-in-oil emulsion during production significantly impacts flow dynamics, resulting in increased viscosity and pressure loss. The fluid flowing in the form of a stable emulsion may present conditions for the deposition of organic and inorganic fractions different from those observed naturally in the produced fluid. The emulsion produced also compromises the processing capacity of surface equipment, especially those located in offshore environments [1].
This study addresses a Brazilian offshore operator's need for a highly effective subsea demulsifier for their 4,600 ft deepwater oilfield. Meeting stringent safety criteria, including flash point >60◦C, and being methanol-free formulation and fully compatibility with monoethylene glycol (MEG), posed significant challenges. The rigorous product qualification protocol for subsea applications coupled with the necessity of maintaining cost efficiency added to the project complexity. Subsea demulsifier DS-83066 was developed, and demonstrated exceptional performance in deep water, leading to enhanced production stability, improved well integrity, and optimized topside operation.

Keywords
Deepwater field; subsea demulsifier; flow improver

Introduction
Once formed, petroleum emulsions are typically stable, making the separation process relevant. During production, it is essential to remove water and organic salts from the crude oil, to mitigate corrosion risks in pipelines and meet specifications for sale. While much of the water is promptly separated by means of simple decantation in separators.
The remaining emulsified often contains a water percentage exceeding refinery requirement, prompting the need for emulsion breaking.

Stable emulsions can be broken by increasing the sedimentation time, through the use of heating, demulsifying agents, electrostatic treatment, centrifugation and filtration [2].

A demulsifying product developed was developed using an oil sample from an operator, to optimize chemical oil treatment programs for use in an oil field situated at a water depth of 1,400 meters.
Products could not be flammable (the flash point had to be greater than 60°C) and had to be free of methanol, organohalogens, acrolein and chromate in its formulation.

The folloowing criteria for product development were a separation of 80% of water in the chosen well sample at a temperature of 45◦C, 50% separation at 20◦C, and also good water quality and a good interface. The product was also required to perform at the maximum global dosage of 140 ppmv.

Table 1 lists the properties of the crude oil samples.

Table 1. Properties of produced fluids

Properties	Crude Oil	Emulsion
API	16.2	-
Viscosity at 60°C (cp)	50	1200
Viscosity at 40°C (cp)	150	2700
Viscosity at 20°C (cp)	650	8200

Methodology
The bottle test began with the evaluation of the sample received from the selected well, which had a basic sediment and water (BS&W) value of 22%. To enable the application of the demulsifier in umbilical, the operator requested that the BS&W of the well sample be adjusted to a value of 68% v/v, achieved by utilizing water extracted from the

sample that was collected in the production header. The results are presented in Tab 2 [3].

Table 2. Emulsion and BS&W test result

Chosen well	Chosen well/synthetic emulsion
BSW 22%	BSW 68%
Emulsion 50%	Emulsion 90%
Water 0%	Water 0%

Experimental Procedure

The evaluation was performed using a bottle test. The oil was added to each bottle, and the bottle s were heated in a water bath for 10 minutes at temperatures of 20°C and 45°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 the respective test temperatures and the water drop speed was evaluated at a time interval of 5, 10, 15, 20 and 30 minutes.

Results and Discussion

Bottle tests were performed to investigate products that help in the phase separation of fluids produced in wells chosen to receive underwater injection of demulsifier via umbilical.

Because the objective of injection at the wellhead is to weaken the emulsion, the only criterion for evaluating the product was the water separation speed. Therefore, neither the thief nor the compound steps were permed.

In the tests, the use of the selected demulsifier products resulted in water separations greater than 50% and 80% at 20°C and 45°C respectively, as shown in Figs. 1 and 2.

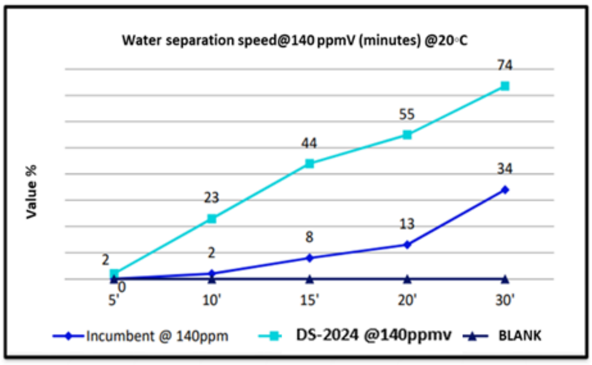

Figure 1. Water separation speed at 20◦C

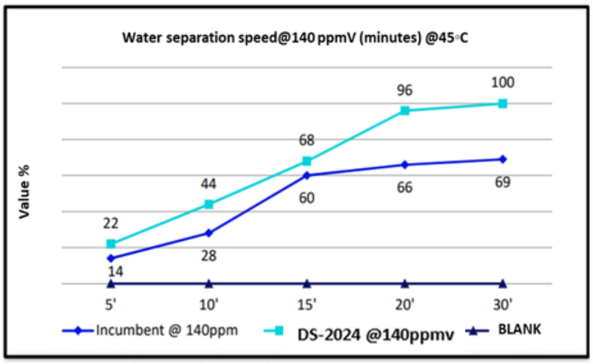

Figure 2. Water separation speed at 45◦C

The fit-for-purpose solution DS-83066 successfully navigated the stringent umbilical qualification protocol, paving the way for further testing and validation. As a result of the laboratory results and cost considerations, field trial was performed.

The field test was overseen by the operator's field engineers and a representative of the technical team, to evaluate the efficiency of the demulsifying product for subsea application in the selected well.

During the field trial if we had observed an increase in pressure in the process, it would indicate that the oil would have difficulty breaking the emulsion and, consequently, the flow of the fluid would be worsening and impacting the loss of production.

However, it was observed that the injection of DS-83066 kept the process stable.
The criteria for well production pressure, oil flow, water/oil separation, free water content, well temperature, BS&W, and TOG analysis were meticulously observed, and the product meeting all evaluated criteria.

Conclusions

In response to operator requirements, a subsea demulsifier DS-83066 was developed, and demonstrated exceptional performance in deep water, leading to enhanced production stability, improved well integrity, and optimized topside operation, as well as a very competitive product cost.

Responsibility Notice

The authors are the only responsible for the paper content.

References

[1] Oliveira, M.C.K; Gonçalves, M.A.L; Marques, L.C.C; *Flow Assurance Fundamentals*. Ed. Interciência, Brazil, 143 p, 2018.

[2] Brito, S; *Evaluation of the efficiency of demulsifiers used in separation of phases of water and oil mixtures*., Brazil, 16 p, 2013.

[3] Meliande, A.S, B Barreto, G. S, Silva, F.B; *Demulsifier Rrecomendation for Subsea purposes, Technical Report,* 2023