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# Purification of Crude Oils by Centrifugation at the Outlet of the Central Processing Facility of the Badila Oil and Gas Field, Chad

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**Abstract:** *Between 2014 and 2024, we evaluated the performance of crude oil purification through centrifugation and the addition of different demulsifiers (DMO7111, DMO7168, Nalco VX9442, BAD106, and VX Champion) to reduce the basic sediment and water (BSW) content in crude oil at the Badila oil and gas field, Chad. The results showed that, despite the addition of single DMO demulsifiers, the BSW percentage remained above the 1% limit recommended for transport and commercialization. The high-water content persisted due to strong interfacial tension and the limited efficiency of single DMO products. However, combinations such as DMO7168/Nalco VX9442 and BAD106/VX Champion were found to be effective (BSW < 1%) at shorter residence times and higher temperatures, while DMO7111/DMO7168 remained ineffective. All demulsifiers exhibited noticeable degradation after 30 minutes of exposure. These findings highlight the importance of selecting suitable demulsifier combinations and operating conditions to enhance the efficiency of crude oil purification at the production site.*

**Keywords:** *crude oil purification; centrifugation; demulsifier; Badila oil field; water–oil separation; BSW reduction*

## 1. Introduction

At the outlet of the Central Processing Facility (CPF), the presence of water and sediments in crude oil remains undesirable for several operational, economic, and safety reasons. First, during crude oil sales, buyers do not pay for the water fraction transported along with the oil, which represents a direct financial loss for producers. Second, water promotes internal corrosion of pipelines, valves, and surface equipment, leading to increased maintenance costs and production downtime (Papavinasam, 2014; Shokri & Fard, 2022). Finally, during refining, the residual water content negatively affects process stability due to the large difference in boiling points between oil and water (Zhang *et al.*, 2025; Nwankwo *et al.*, 2023). In the modern petroleum industry, the commercialization of crude oil is governed by contractual agreements between producers, transporters, and refiners, which establish quality specifications for the oil, particularly with respect to salt and water content (Milessi *et al.*, 2022; Oni *et al.*, 2024). The most common limits are 40 mg/L for salt and around 1% for water in crude oil (Papavinasam, 2014; Pierrat & García-Triñanes, 2024). When these specifications are exceeded, the crude must undergo additional purification stages before it can be transported or refined. The removal of undesirable elements such as brine, suspended solids, and emulsified water is therefore essential at all levels of crude oil processing. This purification requires the use of suitable treatment units and chemical agents that promote phase separation. In practice, the process often involves a combination of physical and chemical treatments, such as centrifugation coupled with demulsifier injection, which enhances the separation kinetics and reduces the basic sediment and water (BSW) content (Abdulkareem *et al.*, 2021; Orodu *et al.*, 2023). However, demulsifiers themselves may undergo degradation under high temperature and shear conditions, which can compromise their long-term performance and environmental compatibility (Suleiman *et al.*, 2022). Understanding the efficiency, degradation mechanisms, and synergistic behavior of demulsifier combinations is thus critical to optimizing crude oil purification systems. This study investigates the effectiveness of several commercial demulsifiers in reducing BSW levels in crude oils from the Badila oil and gas field (Chad), through centrifugation-assisted purification at the CPF outlet.

## 2. Materials and Methods

### 2.1 Site Description

The Badila oil and gas field, located in southwestern Chad, was discovered in 2002 by the American multinational ExxonMobil. Initially operating the DOB and DOI exploration blocks, Petro-Tchad Mangara became the operator of these blocks in 2011 to optimize hydrocarbon production (Qiao et al., 2025). The field is situated primarily in the Nya Pendé Department, between 08°20′25.25″ N latitude and 16°19′40.32″ E longitude, approximately 430 km southwest of N'Djamena and 60 km from Moundou, the economic capital of southern Chad (Figure 1).

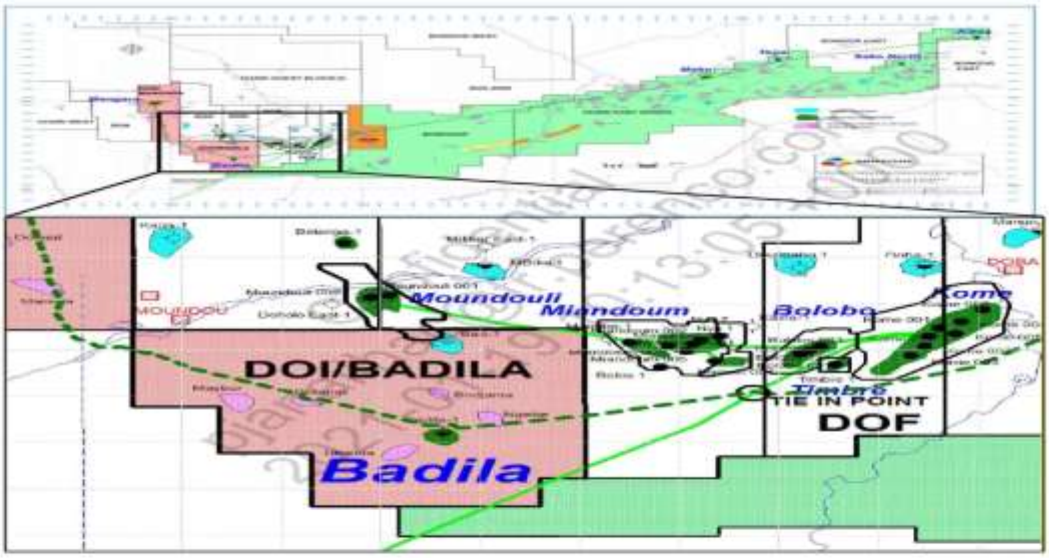


**Figure 1.** *Location of the Badila oil field (adapted from Glencore, 2012).*

The field is characterized by medium to light crude oil (API gravity ~35°), with water and sediment contents that frequently exceed commercial transport specifications (>1% BSW), making effective purification essential before sale and refining.

### 2.2 Sample Collection And Data Acquisition

Crude oil samples were collected directly from the CPF outlet over a ten-year period (2014–2024). The sampling protocol followed standard oilfield procedures to ensure representative measurements of basic sediment and water (BSW) content, using **clean, airtight containers** to avoid evaporation and contamination.

BSW measurements were performed using a **laboratory-scale centrifugation method**. Two identical pear-shaped tubes were filled: one with the crude oil sample and the other with water, each having equal volumes. The tubes were placed in the centrifuge rotor, ensuring uniform distribution and balance. Centrifugation was carried out at a fixed rotational speed and duration to separate water and sediment from the oil phase.

The **BSW content (%)** was calculated using the following equation:

$$\text{BSW}\ (\%) = \frac{V_{\text{water}}}{V_{\text{sample}}} \times 0.8773 \times 100$$

where $V_{\text{water}}$is the volume of separated water (mL) and $V_{\text{sample}}$is the total volume of the crude oil sample (mL). The factor 0.8773 accounts for the density correction between water and oil phases.

The **reduction efficiency of BSW** after treatment with demulsifiers was evaluated as:

$$\%\text{RBSW} = [1 - \frac{\text{BSW}_o}{\text{BSW}_i}] \times 100$$

where $BSW_i$ and $BSW_o$ represent the initial BSW content at the CPF inlet and the measured BSW at the outlet after centrifugation, respectively.

### 2.3 Demulsifiers And Treatment Procedure

Five commercial demulsifiers were tested: **DMO7111, DMO7168, Nalco VX9442, BAD106, and VX Champion**. Each demulsifier was applied either **individually or in binary combinations** to evaluate potential synergistic effects on water separation efficiency.

Demulsifier dosages were determined based on manufacturer recommendations and preliminary optimization trials. Crude oil samples were treated with demulsifiers and maintained at controlled **residence times (5, 15, 30 min)** and **temperatures (25–70 °C)**, representative of CPF operational conditions. The treated samples were subsequently centrifuged, and BSW content was measured as described above.

All experiments were conducted in **triplicate**, and the average values are reported. The **stability and degradation of demulsifiers** during treatment were monitored by observing changes in separation efficiency over time.

### 2.4 Statistical Analysis

Data were analyzed using **descriptive statistics** and **one-way ANOVA** to evaluate the significance of demulsifier type, combination, and residence time on BSW reduction efficiency. Differences were considered statistically significant at **$p < 0.05$**.

## 3. Results and Discussion

### 3.1 Characterization of Crude Oil and BSW Content

Crude oil samples from the Badila field contain water both dissolved in the oil phase and as stable emulsions. This emulsion stability is attributed to the presence of natural surfactants such as asphaltenes, mercaptans, and naphthenic acids (Azmoon et al., 2025). Water and sediments present in crude oil, collectively termed **Basic Sediment and Water (BSW)**, must be reduced below 0.2% to comply with transport and sale specifications.

Sediments include fine particles of sand, drilling mud, rock debris (feldspar, gypsum), and metallic impurities such as Fe, Cu, Pb, Ni, and V. These solids originate from pipeline erosion, storage tanks, valves, and surface equipment. Their presence can block pipelines and compromise crude quality. During storage, sediments settle with water, paraffins, and asphaltenes to form viscous deposits in storage tanks (Garcia-Nunez *et al.*, 2016). Accurate knowledge of separation efficiency between the water–sediment phase and crude oil is essential to prevent operational disturbances during refining (Chaos-Hernández *et al.*, 2023).**BSW Reduction Using Single Demulsifiers**

**Table 1.** *BSW(%) reduction using single demulsifiers on crude oil from Badila field*

| Year | Average sediment and water content in crude oil (BSW), before and after treatment" | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DMO 7111 | | | DMO 7168 | | | NALCO VX9442 | | | BAD 106 | | | VX CHAMPION | | |
| | BSWi | BSWo | %RWC | BSWi | BSWo | %RWC | BSWi | BSWo | %RWC | BSWi | BSWo | %RWC | BSWi | BSWo | %RWC |
| 2014 | 72 | 62 | 14 | 72 | 52 | 28 | 72 | 41 | 44 | 72 | 39 | 46 | 72 | 35 | 52 |
| 2015 | 73 | 61 | 17 | 73 | 49 | 33 | 73 | 42 | 43 | 73 | 41 | 44 | 73 | 38 | 48 |
| 2016 | 75 | 63 | 16 | 75 | 48 | 36 | 75 | 40 | 47 | 75 | 40 | 47 | 75 | 37 | 51 |
| 2017 | 75 | 61 | 19 | 75 | 49 | 35 | 75 | 41 | 46 | 75 | 38 | 50 | 75 | 35 | 54 |
| 2018 | 43 | 37 | 14 | 43 | 28 | 35 | 43 | 25 | 42 | 43 | 24 | 45 | 43 | 24 | 45 |
| 2019 | 75 | 61 | 19 | 75 | 44 | 42 | 75 | 36 | 52 | 75 | 35 | 54 | 75 | 31 | 59 |
| 2020 | 55 | 43 | 25 | 55 | 37 | 33 | 55 | 34 | 39 | 55 | 34 | 39 | 55 | 32 | 42 |
| 2020 | 73 | 62 | 16 | 73 | 43 | 42 | 73 | 39 | 47 | 73 | 33 | 55 | 73 | 30 | 59 |
| 2021 | 65 | 52 | 20 | 65 | 41 | 37 | 65 | 35 | 47 | 65 | 32 | 51 | 65 | 30 | 54 |
| 2022 | 70 | 58 | 26 | 70 | 42 | 40 | 70 | 35 | 50 | 70 | 31 | 56 | 70 | 28 | 60 |
| 2023 | 45 | 34 | 25 | 45 | 27 | 40 | 45 | 24 | 47 | 45 | 24 | 47 | 45 | 22 | 52 |
| 2024 | 50 | 38 | 24 | 50 | 32 | 36 | 50 | 27 | 46 | 50 | 25 | 50 | 50 | 23 | 54 |

Laboratory tests were conducted using five commercial demulsifiers: **DMO7111, DMO7168, Nalco VX9442, BAD106, and VX Champion**. These demulsifiers are surfactant blends in hydrocarbon-based solvents, recommended for dehydrating crude oil emulsions.

**Table 1** summarizes the BSW content before and after treatment over the period 2014–2024 and the corresponding reduction efficiency (%RBSW).

From 2014 to 2024, **DMO7111** and **DMO7168** showed degradation of their physicochemical properties during residence in crude oil, resulting in low efficiency for reducing surface tension. DMO7111 was generally less effective than DMO7168. At high concentrations, DMO7111 sometimes induced inverse emulsions. Neither DMO was able to reduce BSW below 0.2%. At lower surface tensions, these demulsifiers could reduce BSW to ~1.2% (Ramos de Souza et al., 2022).

In contrast, **Nalco VX9442, BAD106, and VX Champion** consistently achieved better BSW reduction. Their effectiveness suggests potential for **combination treatments** irrespective of residence time.

### 3.2 Optimization via Demulsifier Combinations

#### 3.2.1 DMO7111/DMO7168 Combinations

Combinatorial tests with DMO7111 and DMO7168 (Table 2) indicated that high concentrations achieve significant BSW reduction even at short residence times (5 min). However, degradation over longer residence times and elevated temperatures reduced their efficiency. For crude oils with API < 30, longer residence times and higher temperatures enhanced BSW removal, reaching over 50% (Muvel et al., 2025).

**Table 2.** *BSW reduction using DMO7111/DMO7168 combinations.*

| DMO7111 (ppm) | DMO7168 (ppm) | Sample Vol (mL) | Temperatures (°C) | Crude Oil Purification Rate in BSW (%) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 5 min | 10 min | 15 min | 30 min |
| 122 | 58 | | 35 | 43 | 34 | 20 | 27 |
| 115 | 50 | | 45 | 44 | 31 | 25 | 21 |
| 105 | 45 | 100 | 55 | 41 | 29 | 22 | 20 |
| 80 | 25 | 35API | 65 | 43 | 29 | 28 | 24 |
| 65 | 15 | | 70 | 43 | 25 | 27 | 22 |

Observations: Higher DMO7168 concentrations on low DMO7111 levels increased BSW removal at short residence times and high temperatures (Zulfiqar et al., 2024).

#### 3.2.2 DMO7168/Nalco VX9442 Combinations

Combining DMO7168 with Nalco VX9442 (Table 3) demonstrated that high concentrations (122 ppm DMO7168 + 58 ppm VX9442) at 35°C achieved ~45% BSW reduction after 5 min. Longer residence times increased efficiency, whereas low concentrations at high temperatures led to reduced BSW removal, likely due to dilution and evaporation effects (Qiao et al., 2025; Lakzian et al., 2024).

**Table 3.** *BSW reduction using DMO7168/Nalco VX9442 combinations.*

| DMO7168 (ppm) | NALCOvx9442 (ppm) | Sample Vol (mL) | Températures (°C) | Crude Oil Purification Rate in BSW (%) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 5 min | 10 min | 15 min | 30 min |
| 122 | 58 | | 35 | 45 | 50 | 60 | 57 |
| 115 | 50 | | 45 | 46 | 51 | 56 | 59 |
| 105 | 45 | 100 | 55 | 43 | 54 | 52 | 53 |
| 80 | 25 | 35°API | 65 | 4 | 24 | 48 | 45 |
| 65 | 15 | | 70 | 23 | 25 | 47 | 43 |

#### 3.2.3 Nalco VX9442/BAD106 Combinations

The combination of BAD106 and Nalco VX9442 showed high synergistic efficiency. At 55°C, concentrations of 115 ppm (BAD106) and 50 ppm (VX9442) achieved high BSW reduction across all residence times. Low concentrations at the same temperature resulted in less effective separation. At 75°C, even low concentrations of this combination yielded significantly improved BSW reduction, demonstrating thermostability and strong surface tension reduction (Yap et al., 2021; Lakzian et al., 2024).

**Table 4.** *BSW reduction using BAD106/Nalco VX9442 combinations.*

| BAD106 (ppm) | NALCOvx9442 (ppm) | Sample Vol (mL) | Temperatures (°C) | Crude Oil Purification Rate in BSW (%) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 5 min | 10 min | 15 min | 30 min |
| 122 | 58 | | 35 | 46 | 53 | 66 | 67 |
| 115 | 50 | | 45 | 41 | 48 | 56 | 69 |
| 105 | 45 | 100 | 55 | 43 | 54 | 52 | 53 |
| 80 | 25 | 35°API | 65 | 42 | 44 | 48 | 45 |
| 65 | 15 | | 70 | 23 | 25 | 47 | 43 |

### 3.2.4 BAD106/VX Champion Combinations

Combining BAD106 with VX Champion yielded the highest stability and efficiency across temperatures and residence times. The mixture resisted chemical degradation and effectively reduced low surface tension in crude oil. At temperatures >70°C, efficacy declined slightly for light crude, whereas heavier crude (API < 30) maintained effective BSW reduction after longer residence times (Chaos-Hernández et al., 2023; Zulfiqar et al., 2024).

**Table 5.** *BSW reduction using BAD106/VX Champion combinations.*

| Bad 106 (ppm) | Vxchampion (ppm) | SampleVol (mL) | Températures (°C) | Crude Oil Purification Rate in BSW (%) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 5 min | 10 min | 15 min | 30 min |
| 122 | 58 | | 35 | 60 | 70 | 72 | 77 |
| 115 | 50 | | 45 | 63 | 71 | 76 | 79 |
| 105 | 45 | 100 | 55 | 64 | 72 | 72 | 73 |
| 80 | 25 | 35°API | 65 | 62 | 74 | 78 | 75 |
| 65 | 15 | | 70 | 59 | 65 | 67 | 72 |

The efficiency of demulsifiers in crude oil purification is strongly influenced by their chemical stability, concentration, and operating conditions such as temperature and residence time. Experimental analyses indicate that single demulsifiers such as DMO7111 and DMO7168 progressively lose their effectiveness due to physicochemical degradation when exposed to heat and extended contact with crude oil. This degradation reduces their ability to minimize interfacial tension, leading to limited reductions in Basic Sediment and Water (BSW) content. Furthermore, at high concentrations, these demulsifiers tend to promote the formation of inverse emulsions, further complicating the separation process and potentially increasing water retention within the crude matrix. To overcome these limitations, combination treatments have been developed to enhance separation performance. The blending of DMO compounds with other agents such as Nalco VX9442 or BAD106 has shown remarkable improvement in BSW reduction, achieving efficient demulsification even under short residence times. These synergistic effects arise from complementary chemical mechanisms—while DMO agents act primarily as surfactant-based dispersants, Nalco VX9442 and BAD106 provide enhanced interfacial activity and water coalescence capabilities. Among the various combinations tested, the pairing of BAD106 with VX Champion demonstrated the highest overall performance. This combination exhibited superior thermostability and a strong ability to reduce surface and interfacial tension, maintaining efficiency across a wide temperature range and prolonged residence times. Its robustness under thermal stress and consistent BSW reduction make it the most suitable option for long-term crude oil treatment and field-scale application. From an operational standpoint, the findings highlight the critical importance of selecting appropriate demulsifier combinations and carefully optimizing process parameters. Adjusting concentration ratios, controlling temperature exposure, and managing residence time can significantly influence the demulsification kinetics and final product quality. Inadequate optimization not only limits purification efficiency but also increases the risk of equipment fouling, pipeline corrosion, and non-compliance with transport and export specifications. Therefore, a data-driven approach to chemical selection and process control is essential to ensure consistent oil dehydration, reduced operational costs, and prolonged equipment life in crude oil production systems.

## 3.3 Evaluation of Demulsifier Quality After Crude Oil Reproduction Tests

The physicochemical stability of the demulsifiers was evaluated before and after six consecutive crude oil reproduction tests to determine their resistance to degradation under operational conditions.

The summary of results is presented in Table 6. All tested demulsifiers maintained their liquid phase throughout the experiments, indicating that no phase separation or solidification occurred during exposure to crude oil and thermal stress. However, noticeable color changes were observed: the initial pink coloration progressively turned to yellow after the completion of the tests. This chromatic shift suggests possible molecular degradation or oxidation of active compounds, likely induced by the elevated temperatures and chemical interactions with the crude matrix.

For **DMO7111** and **DMO7168**, the physical parameters exhibited significant variations. Density measurements at 15.6 °C revealed decreases of **31.1%** and **31.7%**, respectively, indicating a reduction in molecular packing or possible volatilization of lighter components. The pH values measured at 21 °C demonstrated a clear tendency toward alkalinity, increasing by **17.04%** for DMO7111 and **10.40%** for DMO7168. This shift toward basicity could be attributed to the breakdown of acidic species or the release of amine-based stabilizers during the demulsification process. The viscosity values recorded at 40 °C decreased substantially—**25.5%** for DMO7111 and **46.3%** for DMO7168—implying partial molecular degradation and diminished intermolecular interactions responsible for viscosity control.

The commercial demulsifiers **VX Champion** and **BAD106** also displayed notable physicochemical changes following repeated use. VX Champion exhibited a density reduction of **31.4%**, an increase in pH of **11.26%**, and a viscosity decrease of **33.34%**. These results indicate that VX Champion retained moderate structural stability but experienced chemical alterations affecting its rheological properties. BAD106, in contrast, underwent a **30.99%** decrease in density, a **25.72%** increase in pH, and a **38.78%** decrease in viscosity. This suggests that while BAD106 remained chemically active, its viscosity reduction may limit its emulsifying persistence during long-term operations.

Finally, Nalco **VX9442** demonstrated a comparable trend, with a density decrease of **31.04%**, a pH increase of **23.30%**, and a viscosity reduction of **32.7%**. These findings confirm that prolonged exposure to crude oil and heat conditions leads to gradual degradation of the demulsifiers' structural integrity and modifies their physicochemical equilibrium.

Overall, these results highlight that although all demulsifiers preserve their physical state after successive reproduction tests, they undergo measurable chemical and rheological transformations. Such modifications, particularly the observed decreases in density and viscosity and the shift toward alkaline pH, indicate thermochemical aging. This aging process may influence demulsifier efficiency in field operations, underscoring the necessity of monitoring their physicochemical profiles to ensure consistent performance in crude oil treatment and water separation processes.

**Table 6.** *Physicochemical properties of demulsifiers before and after six reproduction tests.*

| No. of Tests | Product Type | Product Name | Physical State | | Color | | Density at 15,6°C | | pH at 21°C | | Viscosity (cp) at 40°C | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Before | After | Before | After | Before | After | Before | After | Before | After |
| 6 | Demulsifier | DMO 7111 | Liquid | Liquid | Pink | Yellow | 0.9372 | 0.6475 | 8.45 | 9.89 | 51 | 38 |
| | Demulsifier | DMO 7168 | Liquid | Liquid | Pink | Yellow | 0.9396 | 0.6422 | 8.65 | 9.55 | 54 | 29 |
| 6 | Demulsifier | VX champion | Liquid | Liquid | Pink | Yellow | 0.9389 | 0.6448 | 8.79 | 9.78 | 48 | 32 |
| 6 | Demulsifier | BAD106 | Liquid | Liquid | Pink | Yellow | 0.9327 | 0.6437 | 8.32 | 10.46 | 49 | 30 |
| 6 | Demulsifier | NALCOVX 9442 | Liquid | Liquid | Pink | Yellow | 0.9375 | 0.6465 | 8.24 | 10.16 | 52 | 35 |

Observation: Demulsifiers lost a significant fraction of their physicochemical properties after multiple tests. Both density and viscosity decreased with increasing temperature, while pH increased due to chemical dilution effects.

### 3.4 Effect of Centrifugation Acceleration on Water Droplet Size

Centrifugal acceleration affects water droplet size during separation. **Figure 2** illustrates this effect. At high speeds (>3000 rpm), turbulence fragments water droplets, creating microdroplets that are difficult to separate regardless of demulsifier type. Conversely, low speeds (<500 rpm) favor sedimentation and droplet coalescence. Extremely high speeds (5000 rpm) can suspend droplets and hinder separation (Subramanian, 2021). Droplets smaller than 10 µm are particularly challenging to recover, even under low-speed demulsification (Segueni, 2024).

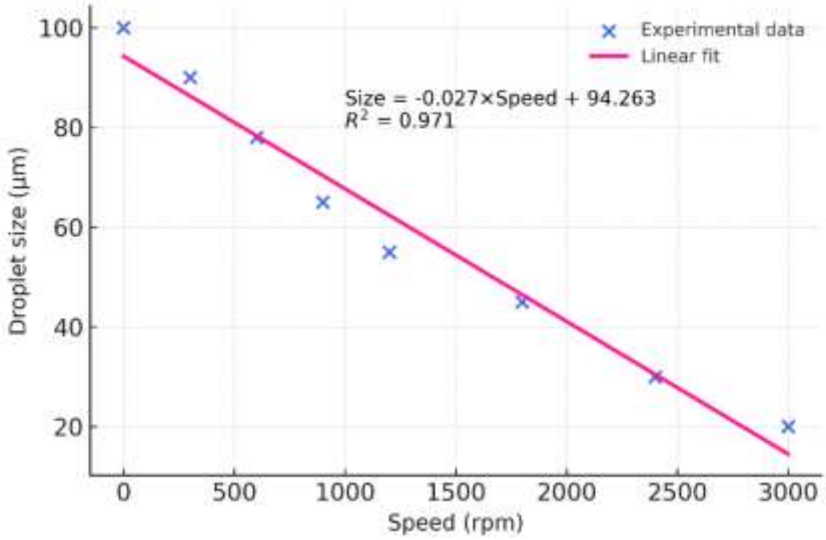


**Figure 2.** *Effect of centrifugation acceleration on water droplet size in crude oil.*

## 3.5 Effect of Interfacial and Surface Tension on Water Droplet Size

Surface and interfacial tension influence droplet morphology during separation. **Figure 3** shows that higher interfacial tension (>70 mN/m) minimizes the water–oil contact area, producing smaller, more spherical droplets (Ibrahim et al., 2017; Mohshim et al., 2026). High surface tension resists droplet deformation, resulting in larger and more stable droplets (Kouchi & Debbah, 2024; Ramzan et al., 2019).

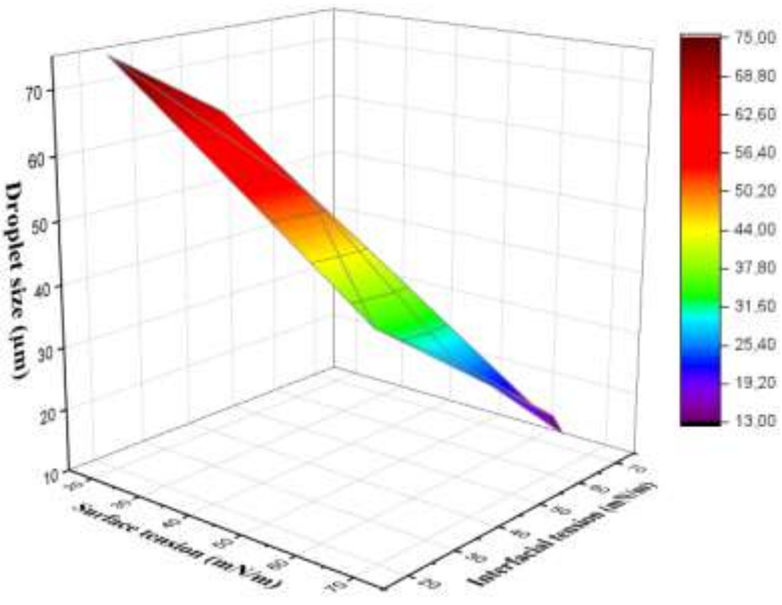


**Figure 3.** *Effect of surface and interfacial tension on water droplet size during crude oil separation*

## 3.6 Effect of Crude Oil Viscosity on Water Droplet Size

Oil viscosity plays a critical role in determining the size and behavior of dispersed water droplets during crude oil separation. An inverse relationship exists between viscosity and droplet size: as viscosity increases, the size of the water droplets tends to decrease. In highly viscous crude oils, the internal resistance to flow reduces the kinetic energy available for droplet movement and coalescence, thereby restricting the formation of larger droplets. This results in a stable emulsion with finely dispersed water particles that are more difficult to separate. In contrast, when the viscosity of the crude oil is lower, the fluid offers less resistance to droplet movement, enabling water droplets to merge and form larger agglomerates. These larger droplets are less stable within the oil phase and tend to settle or coalesce more rapidly under gravitational or centrifugal forces, facilitating phase separation. Therefore, viscosity not only governs the droplet size but also significantly influences the overall efficiency of the demulsification and purification processes in crude oil treatment. Optimizing viscosity through temperature control or chemical additives can thus enhance water removal efficiency and improve compliance with commercial transport and refining specifications (Muvel *et al.,* 2025).

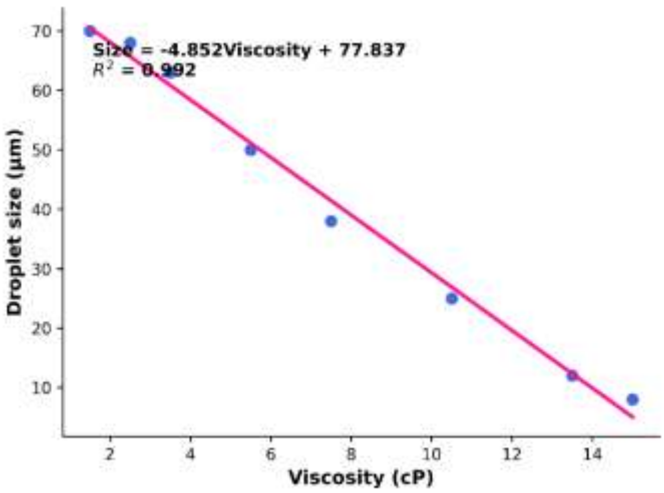


**Figure 4.** *Effect of crude oil viscosity on water droplet size during separation*

## 4. Conclusions

In the case of the Badila oil wells, the water content in produced fluids tends to increase with the well's lifetime, irrespective of whether water injection is applied. This increase is more pronounced in crude oil, reflected in the water-to-oil ratio (WOR), and less significant in associated gas, reflected in the water-to-gas ratio (WGR). Water in crude oil is typically associated with suspended solids such as salts, clays, and sand, collectively referred to as basics, sediments, and water (BSW).

Effective treatment of crude oil is required to reduce BSW content to below 1%, in compliance with commercial and transport specifications. Laboratory reproduction tests using individual demulsifiers—DMO7111, DMO7168, Nalco VX9442, BAD106, and VX Champion—showed varied efficiency, with BAD106 and VX Champion demonstrating the highest performance. Furthermore, combinatorial applications of demulsifiers significantly enhanced BSW reduction, with the BAD106/VX Champion combination achieving reductions exceeding 50% over residence times ranging from 5 to 30 minutes.

Although the demulsifiers largely retained their liquid state after repeated tests, noticeable color changes from pink to yellow were observed, indicating chemical degradation. Physicochemical properties, including density, pH, and viscosity, also experienced significant alterations: density and viscosity decreased, whereas pH exhibited a shift towards a more basic nature. These findings underscore the importance of selecting appropriate demulsifier types and concentrations, as well as considering operational parameters such as temperature and residence time, to optimize crude oil purification at the Badila field and similar oil-producing sites.

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