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Laboratory Study Of A Suitable Demulsifier For Implementation In Ramba Field

Rahmat Ernowo [1*], KRT. Nur Suhascaryo [1]
[1] Petroleum Engineering, Universitas Pembangunan Nasional Veteran Yogyakarta
* corresponding email: ernowo.rahmat@gmail.com

ABSTRACT

This study was conducted to identify the optimal demulsifier composition capable of breaking water-in-oil (W/O) emulsion found in the production fluid at the Ramba Gathering Station (with a water-to-oil ratio of 60:40). Initial effectiveness was evaluated on seven single active agents across three types (water drop, interface, and clear water) to select the best agent from each category. The selected active agents were then blended to produce eight new demulsifier compositions (RE-1 to RE-4), by varying the component percentages, including a variation with the addition of 5% acid to assess its synergistic effect on emulsion separation performance.

The tests were performed using the standard bottle test method with a demulsifier injection dosage of 200 ppm and heated at 40°. The main focus of the test was to compare the degree of emulsion destabilization, the quality of the oil-water interface formed, and the clarity of the separated water phase. The performance of the demulsifier compositions (RE-1 to RE-4) was directly compared against the same versions formulated with 5% acid, as well as against a control sample (Blank) without chemical treatment.

Observation results consistently showed that the addition of 5% acid significantly enhanced the emulsion breaking performance across all composition samples. The acid-enhanced demulsifiers (RE-1 to RE-4) produced an oil-water interface that was far more stable, distinct, and easier to observe, and resulted in a clearer water phase compared to formulations without the 5% acid addition. The improved water clarity indicates a much more effective coalescence and settling process. Overall, this study concludes that the addition of 5% acid proved to be a crucial factor in improving demulsifier effectiveness and optimizing production fluid processing at the Ramba field.

Keywords: emulsion; demulsifier; bottle test; acid; Ramba Field

I. INTRODUCTION

Oil production from mature oil fields is commonly accompanied by an increase in water cut and various production challenges, one of the most significant being the formation of crude oil emulsions. Water-in-oil (W/O) emulsions are frequently encountered in petroleum production systems and can adversely affect production operations by increasing fluid viscosity, reducing separation efficiency, and lowering crude oil quality. These emulsions are typically stabilized by naturally occurring surface-active components in crude oil, such as asphaltenes, resins, waxes, and fine solids, which form a strong interfacial film around dispersed water droplets.

The Ramba Field produces heavy crude oil with an API gravity of approximately 21°, indicating a high content of polar compounds that promote the formation of stable W/O emulsions. In field operations, such emulsions cannot be effectively separated using gravity settling alone, especially under conditions of limited or unavailable heating facilities. As a result, chemical treatment using demulsifiers becomes a critical method for breaking emulsions and ensuring efficient oil–water separation in surface production facilities.

Selecting an appropriate demulsifier requires a thorough understanding of the interaction between chemical formulations and the specific characteristics of the production fluid. Laboratory-scale evaluation, particularly through the bottle test method, is widely used to screen and optimize demulsifier performance prior to field application. Therefore, this study focuses on identifying and evaluating suitable demulsifier formulations for the Ramba Field, with particular emphasis on the effect of acid addition on emulsion-breaking performance.

II. METHODS

This study was conducted at the laboratory scale using production fluid samples from the Ramba Gathering Station, with a water-to-oil ratio of 60:40. The main experimental method employed was the bottle test. The research stages included:

1. Initial screening of seven single active demulsifier agents from three main categories.
2. Selection of the best-performing active agents from each category based on water drop, interface quality, and water clarity.
3. Preparation of blended demulsifier formulations (RE-1 to RE-4).
4. Performance comparison between formulations without and with 5% acid addition.

All experiments were performed at 40°C with a demulsifier dosage of 200 ppm and a fixed observation period. The evaluation parameters included separated water volume, interface stability, and separated water quality.

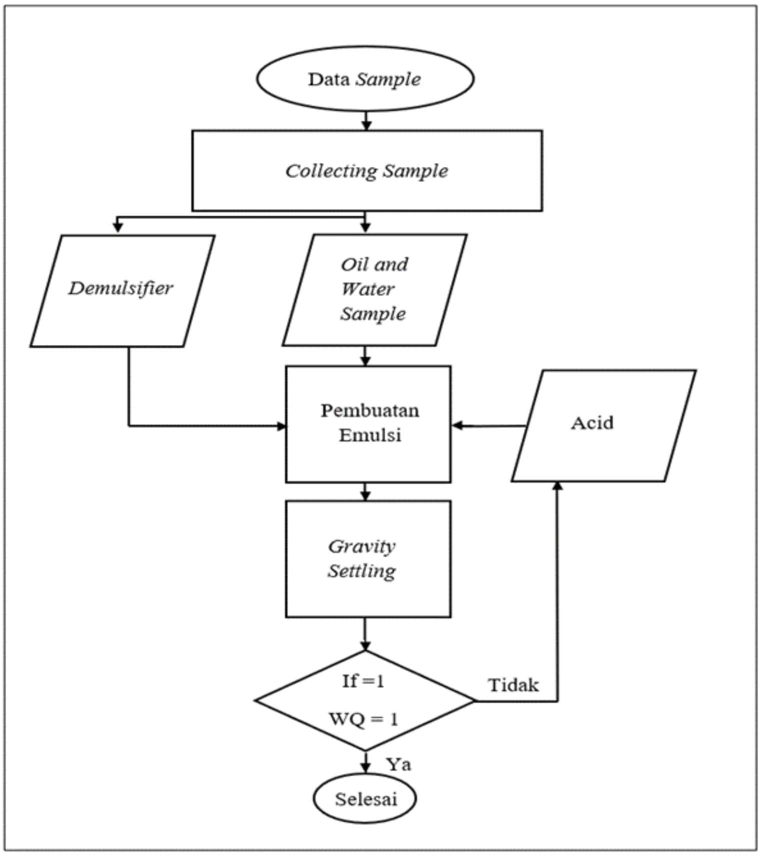

Figure 1. Flowchart

III. RESULTS AND DISCUSSION

3.1. Experimental workflow of demulsifier screening and formulation

Illustrates the overall experimental workflow applied in this study, starting from crude oil and produced water sampling, single demulsifier screening, formulation blending, acid addition, and final performance evaluation using the bottle test method.

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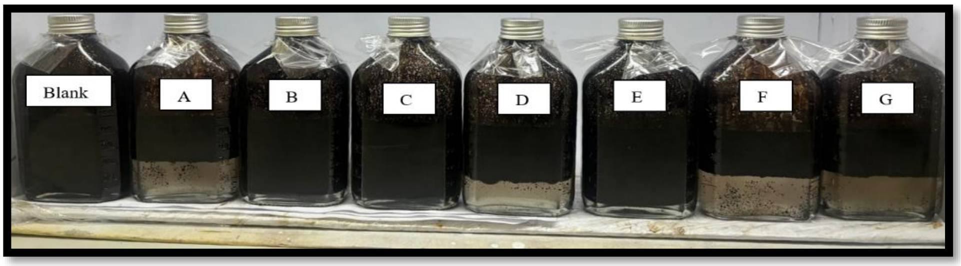

Figure 2. Screening Active Ingredient

3.2. Bottle test results of single active demulsifiers

The bottle test observations for seven single active demulsifiers at 40°C and 200 ppm dosage. Differences in water separation rate, interface sharpness, and water clarity are clearly observed, indicating varying demulsification performance among the tested chemicals.

Tabel 1. The Results of Active Ingredient

No	*Chemical*	*Dosage*	*Minutes*				WQ	IF
			5	10	15	60		
1	Blank	200	0	0	0	0	3	3
2	Zat Aktif A	200	10	20	45	58	2	2
3	Zat Aktif B	200	0	0	0	8	3	3
4	Zat Aktif C	200	0	0	0	10	3	3
5	Zat Aktif D	200	5	18	28	45	2	3
6	Zat Aktif E	200	0	0	0	10	3	3
7	Zat Aktif F	200	5	20	32	55	3	2
8	Zat Aktif G	200	0	20	32	60	3	2

3.3. Demulsifier formulation

The results of the active substance screening were taken, with the best results for each type being selected. The hope is that the active substances can cover each other's weaknesses.

Tabel 2. Demulsifier Formulation Without Acid

No	Demulsifier	Demulsifier Component		
1	RE-1	Zat Aktif A ; Water drop 40%	Zat Aktif D ; Interface 40%	Zat Aktif G ; Clear water 20%
2	RE-2	Zat Aktif A ; Water drop 40%	Zat Aktif D ; Interface 20%	Zat Aktif G ; Clear water 40%
3	RE-3	Zat Aktif A ; Water drop 20%	Zat Aktif D ; Interface 40%	Zat Aktif G ; Clear water 40%
4	RE-4	Zat Aktif A ; Water drop 40%	Zat Aktif D ; Interface 30%	Zat Aktif G ; Clear water 30%

Tabel 3. Demulsifier Formulation With Acid

No	Demulsifier	Demulsifier Component		
1	RE-1 + Acid 5%	Zat Aktif A ; Water drop 40%	Zat Aktif D ; Interface 40%	Zat Aktif G ; Clear water 20%
2	RE-2 + Acid 5%	Zat Aktif A ; Water drop 40%	Zat Aktif D ; Interface 20%	Zat Aktif G ; Clear water 40%
3	RE-3 + Acid 5%	Zat Aktif A ; Water drop 20%	Zat Aktif D ; Interface 40%	Zat Aktif G ; Clear water 40%
4	RE-4 + Acid 5%	Zat Aktif A ; Water drop 40%	Zat Aktif D ; Interface 30%	Zat Aktif G ; Clear water 30%

3.4. Performance comparison of blended demulsifier formulations (RE-1 to RE-4)

Compares the emulsion-breaking performance of blended demulsifier formulations RE-1 to RE-4 without acid addition. The blended formulations show improved separation behavior compared to single demulsifiers, particularly in terms of interface stability.

3.5. Effect of 5% acid addition on demulsifier performance

The bottle test results of blended demulsifier formulations with the addition of 5% acid. A faster separation time, clearer oil–water interface, and higher water clarity are observed, demonstrating the positive effect of acid addition on demulsification efficiency.

The bottle test results indicate that individual active agents exhibit varying emulsion-breaking capabilities. Blended demulsifier formulations showed better performance than single-component demulsifiers. The addition of 5% acid to all RE-1 to RE-4 formulations consistently improved demulsification performance. A faster and clearer oil–water interface formation and improved water clarity were observed. These results suggest that acid plays a significant role in accelerating interfacial film destabilization, particularly those stabilized by polar components such as asphaltenes and resins.

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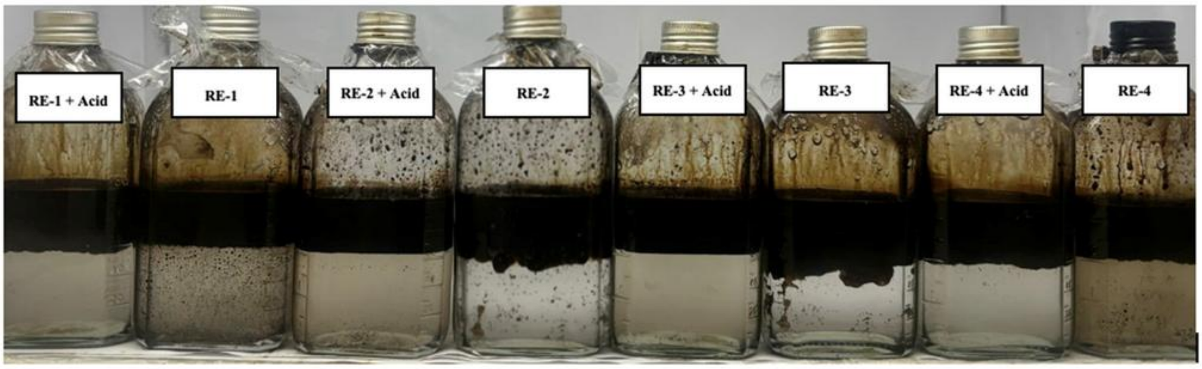

Figure 2. Bottle Test Observation Results

This Research also examines water quality and interface. The results can be seen in the table below.

Tabel 4. Demulsifier Research Results

No	Formula	*Dosage*	*Minutes*				WQ	IF
			5	10	15	60		
1	RE-1 + (Acid 5%)	200	8	20	32	58	1	1
2	RE-1	200	8	20	32	58	2	1
3	RE-2 + (Acid 5%)	200	15	25	40	58	1	1
4	RE-2	200	12	22	36	56	2	3
5	RE-3 + (Acid 5%)	200	16	40	50	58	1	1
6	RE-3	200	15	28	42	50	2	3
7	RE-4 + (Acid 5%)	200	20	35	45	57	1	1
8	RE-4	200	15	25	37	57	2	1

IV. CONCLUSION

Based on the laboratory study, the following conclusions can be drawn:

1. Demulsifiers are effective in breaking W/O emulsions in Ramba Field production fluids.
2. Blended demulsifier formulations outperform single active agents.
3. The addition of 5% acid significantly enhances emulsion separation performance.

The findings of this study can serve as a preliminary reference for demulsifier selection and optimization prior to field implementation in the Ramba Field.

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