# Preliminary Study on the Utilization of Coconut Oil, Lemon, Cassava Starch, Calcium Hydroxide, and Liquid Soap as Demulsifier for Oil in the Field in Riau

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# PRELIMINARY STUDY ON THE UTILIZATION OF COCONUT OIL, LEMON, CASSAVA STARCH, CALCIUM HYDROXIDE, AND LIQUID SOAP AS DEMULSIFIER FOR OIL IN THE FIELD IN RIAU

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**Abstract.** Emulsions in crude oil are very common in the petroleum industry. Compounds that serve as emulsion breakers are commonly called demulsifiers. This test is done by inserting a petroleum emulsion that has been interpreted into a bottle, then placed in a water bath for 3 hours at variations in temperature 50 ˚C, 60 ˚C, and 70 ˚C and demulsifier concentrations of 1 ml, 3 ml, 5 ml to find out the variation in the separation of water and oil in the sample. The results showed that the highest volume of separate water in the demulsifier testing process occurred in DA 1 ml samples at 60 ˚C and 70 ˚C with separate water volumes of 30 ml each. However, based on the separation time DA 1 is still more effective than demulsifier DK 1, where DA 1 takes a faster time to reach the maximum separate water volume of 60 minutes of testing. Meanwhile, DK 1 takes 120 minutes to achieve maximum demulsification results.

**Keyword:** *Emulsion*, *Emulsion Breaker*, *Demulsifier*, *Conventional Demulsifier*, *Bottle Test*

## Introduction

Water that mixed with oil will cause an emulsion, this emulsion is not expected in the petroleum industry because the volume of dispersed water will fill the equipment room at the gathering station thereby increasing the capital cost of an oil and gas company (Ed, 2009). In addition, emulsions can have a negative impact on the quality of the oil produced because dispersed water can cause corrosion in production and processing equipment. Therefore, water dispersed in crude oil needs to be separated.

The selection of a demulsifier formulation must consider the impact of the composition used on the environment. The standards and safety of the use of chemicals in the oil field are increasingly being tightened, thus encouraging the development of environmentally friendly formulations that can be applied in the oil field and carried out as efficiently as possible using existing chemicals.

In order to minimize the impact of using chemicals that have a negative impact on the environment, researchers tried to experiment with making demulsifier formulations using local ingredients such as coconut oil, lemon peel extract, liquid soap, cassava starch, camphor, and whiting. This research was conducted at the Petroleum Engineering Reservoir Laboratory, Islamic University of Riau. To test the effectiveness of this natural demulsifier, a conventional demulsifier is needed which functions as a comparison.

### Methodology

The method used in this research is the R&D (Research and Development) method. Then proceed to the development stage in the form of a lab test on the performance of the demulsifier in the demulsification process. The demulsifier test was carried out using the bottle test method to test the temperature and concentration of the demulsifier made from local ingredients to get optimal results. Meanwhile, the data collection technique is primary data obtained from research results, reference books, journals, papers that are in accordance with the research topic. After obtaining these results, then an evaluation of the data is carried out which leads to conclusions which are the objectives of the study.

Temperature and concentration have a very important influence on the demulsification process of water and oil. The temperature in this research was set on a scale variation of 50 ˚C, 60 ˚C, and 70 ˚C. While the concentrations used were 0.2 ml, 0.4 ml, 0.6 ml, 0.8 ml and 1 ml. The demulsification process was tested using the bottle test method which is a suitable method for conducting tests on a laboratory scale while providing good guidance and in accordance with field conditions (Manggala et al., 2017). Water bath tool is used to perform the test at the desired temperature in the study. The demulsification process was carried out for 180 minutes (3 hours) in order to obtain maximum demulsification results (Erfando, 2018). Each sample tested will observe the results every 30 minutes until the maximum time is 180 minutes. The results of demulsification can be measured by the volume of water separated from the oil.

The crude oil sample used in this research is an oil sample from one of the Riau fields available at the Petroleum Engineering Reservoir Fluid Analysis Laboratory. The oil used is classified as a light oil type.

Table 1. Physical properties of X oil field

| No | Parameter | Value | Description |
|---|---|---|---|
| 1 | Oil Mass (mminyak) | 42.74 | Gram |
| 2 | Oil Density (ρminyak) | 0.854 | gr/ml |
| 3 | Specific Gravity (SG) | 0.854 | - |
| 4 | ˚API | 34.19 | - |

# Results and Discussion

On a scale of 50 ˚C, the DA sample with a concentration of 0.2 ml had the least volume of separated water compared to the other samples with a value of only reaching 5 ml or 16.67% for 180 minutes (3 hours). The DA sample with a concentration of 0.4 already showed better results with the separated water volume of 10 ml or 33.33% at 180 minutes. Furthermore, the separation results showed an increase in the 0.6 ml and 0.8 ml DA samples where the separation results were 12 ml (40%) and 15 ml (50%) within 180 minutes (3 hours). The results of the separation at a temperature of 50 ˚C the most optimum was obtained from the DA sample at a concentration of 1 ml with a separate water volume of 20 ml (66.67%) within the last 30 minutes of the test (150 minutes), it can be seen from the volume of separated water which was larger than other samples under these conditions.

The result of the separated water volume using DK 1 at a temperature of 50 ˚C during the last 3 hours of testing was only 12 ml (40%) This indicates that DK 1 is not very functional at low temperatures. According to Manggala et al., (2017) temperature is the main factor affecting emulsion stability. The higher the temperature, the more unstable the emulsion and vice versa if the temperature is lower, the emulsion will be more stable. While the effect of time in the separation also increases with increasing time. Where significant water separation was obtained when the time reached 30 minutes, after that the increase was slightly (Hamadi & Mahmood, 2016).

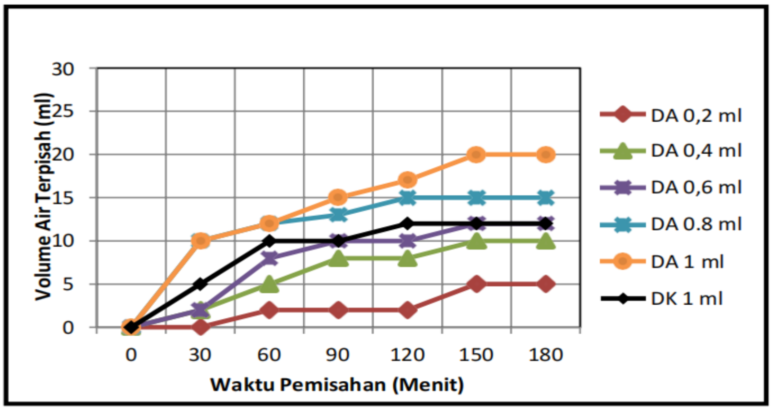


**Figure 2 Results of demulsification versus time at a temperature of 50 ˚C**

At a temperature of 60 ˚C, the water separated from the crude oil emulsion has begun to stabilize and what is certain is that there has been an increase in demulsification efficiency compared to a temperature of 50 ˚C. According to Abdulkadir, (2010) the heat added to the demulsification test can increase the effectiveness in mixing the demulsifier with the emulsion so that it can perform the separation quickly. Based on the results of the demulsification test using the bottle test method at a temperature of 60oC, there was a fairly high increase in water separation due to the increase in temperature in this demulsification test. The DA sample with a concentration of 0.2 ml had the least volume of separated water compared to the other samples with a value of only reaching 10 ml (33.33%) for 180 minutes (3 hours). The DA sample with a concentration of 0.4 already showed better results with the separated water volume of 18 ml (60%) at 180 minutes. Furthermore, the separation results showed an increase in the 0.6 ml DA sample where the separation result was 22 ml (73.33%) within 180 minutes (3 hours).

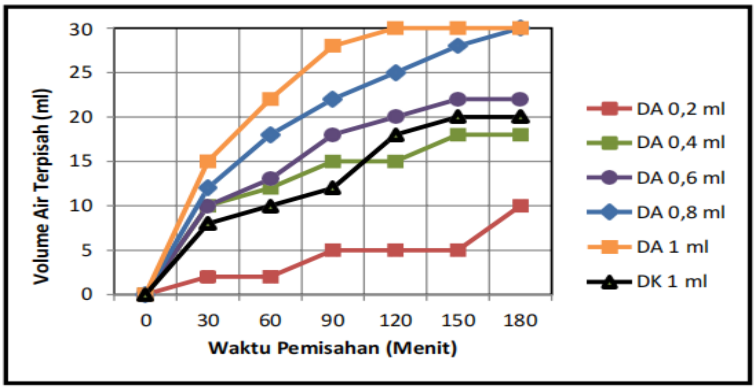


***Figure 1 Results of demulsification versus time at a temperature of 60 ˚C***

This 60 ˚C temperature is a suitable temperature for demulsification testing on a laboratory scale, according to Bin Mat, Samsuri, Aizan, & Ilyani Rani, (2006) that the appropriate temperature considered for the demulsification process on a laboratory scale is between 50 ˚C to 70 ˚C. The results of demulsification of all samples at temperature conditions of 50 showed a fairly dominant concentration effect, this was supported by Hajivand & Vaziri (2015) which stated that the higher the concentration of the demulsifier given, the higher the rate of coalescence in droplets.

At a temperature of 70 ˚C, the highest demulsification yield and the shortest separation time were obtained compared to other temperatures. According to Sulaiman et al., (2015) high temperatures can be more effective in breaking emulsions because they reduce the interfacial tension between oil and water. The most effective separation results at temperature 70 ˚C were obtained from DA samples at concentrations of 0.8 ml and 1 ml with the same volume of separated water, which was 30 ml (100%) at the end of the test. However, the 1 ml DA sample was more effective than the 0.8 ml DA sample in terms of separation time. The 1 ml DA sample was able to completely separate the water at the 60th minute while the 0,8 DA reached the maximum separation at the 90th minute. This 70 ˚C temperature is one of the optimal temperatures for demulsification testing (Erfando et al., 2018).

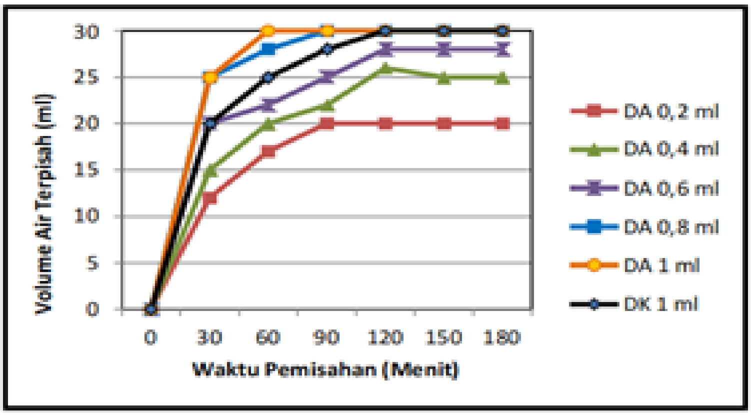


**Figure 3 Results of demulsification versus time at a temperature of 70 ˚C**

## Conclusion

Based on the test of a demulsifier made from coconut oil, lemon, cassava starch, calcium hydroxide and liquid soap using the bottle test method under conditions of variation of test temperature 50 ˚C, 60 ˚C, 70 ˚C, concentration 0.2 ml, 0.4 ml, 0.6 ml, 0.8 ml, 1 ml and time testing for 180 minutes (3 hours), the results obtained the highest volume of separated water in the demulsifier testing process, namely the 1 ml DA sample at a temperature of 60oC of 30 ml and 1 ml of DA at a temperature of 70 ˚C of 30 ml. The results of demulsification between DA 1 and DK 1 had the same value, namely 30 ml. However, based on the separation time, DA 1 is still more effective than commercial demulsifier DK 1, where DA 1 requires a faster time to reach its maximum separated water volume, which is 60 minutes of testing. Meanwhile, DK 1 takes 120 minutes to achieve maximum demulsification results.

Several parameters that affect the results of the demulsifier test include temperature, concentration and time. All of these parameters have a directly proportional effect on the volume of separated water in a demulsification process.

## Reference


1. Abdel-raouf, E. M. E. (2012). Crude Oil Emulsions– Composition Stability. In Theodora Smiljanic (Ed.), *Egyptian Petroleum Research Institute* (pp. 184– 185). InTech.

2. Abdulkadir, M. (2010). Comparative analysis of the effect of *demulsifier*s in the treatment of crude oil emulsion. *ARPN Journal of Engineering and Applied Science*, *5*(6), 67–73.
3. Adewunmi, A. A., Kamal, M. S., & Fahd, K. (2019). Performance Evaluation of Fly Ash as a Potential *Demulsifier* for Water-in-Crude-Oil Emulsion Stabilized by Asphaltenes. *SPE Annual Technical Symposium and Exhibition, Dammam, Saudi Arabia*, (April 2018), 1–3.
4. Al-Sabagh, A. M., Kandile, N. G., El-Ghazawy, R. A., & Noor El-Din, M. R. (2011). Synthesis and evaluation of some new *demulsifier*s based on bisphenols for treating water-in-crude oil emulsions. *Egyptian Journal of Petroleum*, *20*(2), 67–77.
5. Alomair, O., Alqabandi, S., Malallah, M., & Alajmi, A. (2015). Experimental Investigation of Crude Oil Emulsion Physicochemical Properties and *Demulsifier* Dosage Prediction. *SPE/IATMI Asia Pacific Oil & Gas Conference and Exhibition, Nusa Dua, Bali, Indonesia*, (SPE-176464-MS), 1–24.
6. Augustina, O., & Sylvester, O. (2015). Emulsion Treatment in the Oil Industry : A Case Study of Oredo Field. *SPE Annual International Conference and Exhibition, Lagos, Nigeria*, 1–4.
7. Bin Mat, H., Samsuri, A., Aizan, W., & Ilyani Rani, S. (2006). *Study on Demulsifier Formulation for Treating Malaysian Crude Oil Emulsion.Universiti Teknologi Malaysia* (Vol. 74).
8. Borges, O. C., Cristante, V. M., Nokai, R. A., & Furtado, R. G. (2015). Improving Flow Stability and Increase of Oil Production in Electrical Submersible Pump Systems Through *Demulsifier* Application in Jubarte. *SPE Artificial Lift Conference, Latin America and Caribbean, Salvador, Bahia, Brazil*.
9. Dosunmu, Otikiri, & Fekete. (2012). Evaluation of Emulsion Treatment UsingDifferent De-emulsifiers. *SPE Annual International Conference and Exhibition, Abuja, Nigeria*, (SPE 1629).
10. Draper, N. R., & Smith, H. (1998). *Applied regression analysis* (Vol. 326). John Wiley & Sons.
11. Ed, T. F. T. (2009). Emulsion Science and Technology (pp. 3–38). Weinheim: The Deutsche Nationalbibliothek. Retrieved from http://dnb.d-nb.de.
12. Emuchay. (2013). *Breaking of Emulsions Using Locally Formulated Demusifiers* (SPE-167528). *SPE Annual International Conference and Exhibition. Lagos, Nigeria*. River State.
13. Emuchay, D., Onyekonwu, M. O., Ogolo, N. A., & Ubani, C. (2013). Breaking of Emulsions Using Locally Formulated Demusifiers. *SPE 167528*.
14. Erfando.T, Irma Elfradina, N. R. (2019). Effects Of Adding Local Materials On *Demulsifier* Performance For Oil-Water Emulsions. *International Journal Of Geomate*, *17*(62), 107–112.
15. Erfando, T. (2018). Identifikasi Potensi Jeruk Purut Sebagai *Demulsifier* Untuk Memisahkan Air Dari Emulsi Minyak di Lapangan Minyak Riau. *Jurnal Kimia Mulawarman*, *15*(2), 117–121.
16. Erfando, T., Rita, N., & Cahyani, S. R. (2018). Identifikasi Potensi Jeruk Purut Sebagai *Demulsifier* Untuk Memisahkan Air dari Emulsi Minyak Di Lapangan Minyak Riau. *Jurnal Kimia Mulawarman*, *15*, 117–121.
17. Estiasih, T., Harijono, Waziiroh, E., & Fibrianto, K. (2016). *Kimia dan Fisik Pangan*. (S. B. Hastuti, Ed.) (1st ed.). Jakarta: Sinar Grafika Offset.
18. Fernando, Y. (2012). *Proses Demulsifikasi Heavy Crude Oil Jatibarang*. Universitas Indonesia.
19. Foy, C. L., & Pritchard, D. W. (1996). *Pesticide formulation and adjuvant technology*. CRC press.
20. Hajivand, P., & Vaziri, A. (2015). Optimization of *demulsifier* formulation for separation of water from crude oil emulsions. *Braziilian Journal of Chemical Engineering*, *32*(1), 107–118.
21. Hamadi, A. S., & Mahmood, L. H. (2010). *Demulsifier*s for Simulated Basrah Crude Oil. *Engineer & Technologi Journal*, *28*(1), 54–64.
22. Hamadi, A. S., & Mahmood, L. H. (2016). *Demulsifier*s for Simulated Basrah Crude Oil. *Eng & Tech Journal*, *28(1), 54*–(January 2010).
23. Impian, D., & Praputri, E. (2014). Optimasi Injeksi *Demulsifier* Sebagai Respon Terhadap Proses Acidizing. *Jurnal Teknik Kimia , FTI, Universitas Bung Hatta*, (19).
24. Kokal. (2005). Crude-Oil Emulsions : A State-Of-The-Art Review. *SPE Annual Technical Conference and Exhibition. San Antonio, Brazil*, (December 2004). Leal-Calderon, F., Schimitt, V., & Bibette, J. (2007). *Emulsion Science Basic Principles* (2nd ed.). New York, USA: Springer Science & Business Media.
25. Liu, D., Suo, Y., Zhao, J., Zhu, P., Tan, J., Wang, B., & Lu, H. (2009). Effect of Demulsification for Crude Oil-in-Water Emulsion: Comparing CO and Organic Acids, *22*(3), 567–570.

26. Liu, D., Suo, Y., Zhao, J., Zhu, P., Tan, J., Wang, B., & Lu, H. (2018). Effect of Demulsification for Crude Oil-in-Water Emulsion: Comparing CO2and Organic Acids. *Energy and Fuels*, *32*(1), 757–764.
27. Lou, Y., Zhang, Y., Zhang, Y., & Liu, Q. (2012). Research and application of combinational *demulsifier*. *Advanced Materials Research*, *475*(27–2), 2674– 2677.
28. Manggala, M. R., Kasmungin, S., & Fajarwati, K. (2017). Studi Pengembangan *Demulsifier* Pada Skala Laboratorium Untuk Mengatasi Masalah Emulsi Minyak Di Lapangan “ Z ”, Sumatera Selatan. *Seminar Nasional Cendikiawan*, *1*, 145–151.
29. Martínez-palou, R., & Aburto, J. (2015). Ionic Liquids as Surfactants – Applications as *Demulsifier*s of Petroleum Emulsions. *In INTECH*, (pp. 306- 326).
30. Nofrizal, A., & Ady Prashetya, Y. (2011). Pengaruh Suhu dan Salinity Terhadap Kestabilan Emulsi Minyak Mentah Indonesia. *Jurnal Teknik Kimia Universitas Diponegoro*, 1–9.
31. Nuri, W. (2013). Pengaruh Daya Listrik Oven Gelombang Mikro terhadap Pemecahan Emulsi Minyak Mentah Cepu. *Jurnal Teknik Kimia, FTI, UPN "Veteran" Yogyakarta*, *11*, 50–56.
32. Oliveira, M. C. (2017). OTC-28132-MS Subsea *Demulsifier* Injection to Reduce Emulsion Viscosity and Enhance Crude Oil Production. *Offshore Technology Conference. Rio de Janeiro, Brazil*.
33. Pratomo, D. S., & Astuti, E. Z. (2014). Analisis Regresi Dan Korelasi Antara Pengunjung Dan Pembeli Terhadap Nominal Pembelian Di Indomaret Kedungmundu Semarang Dengan Metode Kuadrat Terkecil. *Ilmu Komputer*, (1).
34. Saad, M. A., Kamil, M., Abdurahman, N. H., Yunus, R. M., & Awad, O. I. (2019). An Overview of Recent Advances in State-of-the-Art Techniques in the Demulsification of Crude. *MDPI, Basel, Switzerland*, *7*, 3–26.
35. Santos, R. G., Loh, W., Bannwart, A. C., & Trevisan, O. V. (2014). An Overview of Heavy Oil Properties and Its Recovery and Transportation Method. *Brazilian Journal*, *31*(3), 571–590.
36. Schramm, L. L. (2000). Surfactants : Fundamentals and Applications in the Petroleum Industry. *Cambridge University Press*, (ISBN 0521640679), 79– 150.
37. Subekti, P. (2015). Perbandingan Perhitungan Matematis Dan SPSS Analisis Regresi Linear Studi Kasus (Pengaruh IQ Mahasiswa Terhadap IPK). *Prosiding SNATIKA*, *3*, 70–75.
38. Sulaiman, A. D. I., Abdulsalam, S., & Francis, A. O. (2015). Formulation of *Demulsifier*s from Locally Sourced Raw Materials for Treatment of a Typical Nigerian Crude Oil Emulsion. In *SPE Nigeria Annual International Conference and Exhibition* (p. SPE-178377). Society of Petroleum Engineers.
39. Sulaiman, A. D. I., Abdulsalam, S., Technology, E., Tafawa, A., Francis, A. O., & Polytechnic, A. (2015). *Formulation of Demulsifiers from Locally Sourced Raw Materials for Treatment of Typical Nigerian Crude Oil Emulsion* (SPE- 178377-MS). Auchi.
40. Wahyu, A., Widharyanto, R., Setijono, H., & Nirmala, S. (2013). Rancang Bangun Sensor Specific Gravity pada Crude Oil Menggunakan Serat Optik Plastik. *Jurnal Teknik Pomits*, *2*(2), 2337–3539.
41. Wahyuni, T., Agoestanto, A., & Pujiastuti, E. (2018). Analisis Regresi Logistik terhadap Keputusan Penerimaan Beasiswa PPA di FMIPA Unnes Menggunakan Software Minitab. *Prosiding Seminar Nasional Pendidikan Matematika*, *1*, 755–764.
42. Wen, Y., Cheng, H., Lu, L., Liu, J., Feng, Y., Guan, W., … Huang, X. (2010). Bioresource Technology Analysis of biological demulsification process of water-in-oil emulsion by Alcaligenes sp . S-XJ-1. *Bioresource Technology*, *101*(21),
43. Wylde, J. J., Coscio, S., & Barbu, V. (2008). *A Case History of Heavy Oil Separation in Northern Alberta : A Singular Challenge of Demulsifier Optimization and Application*. *SPE International Thermal Operations and Heavy Oil Symposium*. Alberta, Canada.
44. Yaakob, abu B., & Sulaimon, A. A. (2017). Performance Assessment of Plant Extracts as Green *Demulsifier*s. *Japan Petroleum Institute*, *60*(4), 186–193.