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Development of Castor Oil as Local Demulsifier to Overcome Water-Oil Emulsion

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Abstract. Crude oil is generally mixed with water at the time of production. The oil and water mixture at the time of production is known as an emulsion. In addressing the problem of emulsions requires the addition of a chemical compound, commonly referred to as demulsifier to be able to separate water and oil. This research aims to make the formulation of demulsifier locally based on castor oil. This castor oil will be processed into a surfactant compound because it has a very high saturated fat content of 33% of the total weight of the seeds. The manufacture of this demulsifier using saponification method is to heat the castor oil and add the KOH dissolved in aquades, as well as the added glycerin to taste. Then, the process of testing demulsification with a sample of the emulsion of crude oil that has been prepared using the bottle test method. From the test results of several temperature conditions, different concentration and time obtained the best test results by demulsifier in the separation of water and oil at a temperature of 80 ^{0}C and concentrations of 5 ml. In sample 1 demulsifier soap and the soap demulsifier added lemon separates the water by as much as 38 ml and 39 ml, meanwhile, the commercial demulsifier separates the water by 32 ml. Thus, it can be concluded that the demulsifier made from castor oil has a better ability than commercial demulsifier.

1. Introduction

In the stage of production and oil processing is often the problem is the water emulsion in the oil is stable. The formation of this emulsion is generally caused by the presence of resins and asphaltenes which act as "natural emulsifiers", as well as wax and solids (Al-Sabagh, Kandile, El-Ghazawy, & Noor El-Din, 2011). In addressing the problem of emulsions requires a requirement to convert the emulsion into a normal return. This requirement is a material that can stabilize the system between surfaces. This ingredient is usually called a stabilizer, or also known as demulsifier (Gavrielatos, Dabirian, Mohan, & Shoham, 2018). Overcoming this emulsion problem is also done to keep the production facility from damage and improve the oil quality itself (Sulaiman et al., 2015).

According to the research of Sulaiman et al., (2015) showed that the demulsifer produced from the local ingredients is very effective in terms of the cheaper price, effective time and solving the crude oil emulsion in a shorter time than on conventional demulsifier. Researchers conducted a test of demulsification using the bottle test method with several parameters, such as temperature, concentration and time. According to Zhou, Dismuke, Lett, & Penny, (2012) to meet the safety standards in the oil and gas world and reduce the impact that occurred on the environment resulting from the use of demulsifier with chemicals, then it takes a new formulation as a demulsifier with develop from local ingredients. Therefore, in this research try to develop a formulation of demulsifier by using local ingredients namely castor oil.

This castor oil will be processed into a surfactant compound because it has a very high saturated fat content of 55% for the core part of the seed or 33% of the total weight of the seed (Sari, Kasih, & Sari, 2010). In the process of making surfactant compounds using the saponification method. Saponification is the process of alkaline hydrolysis to fat from oil by adding KOH (Naomi, Gaol, & Toha, 2013). Furthermore, the local demulsifier that has been made will be conducted by the process of crude oil samples with a demulsification process using the bottle test method. Using this method demulsifier can quickly separate water and oil with the lowest possible moisture content (Manggala, Kasmungin, & Fajarwati, 2017). Then to know the influence of demulsifier with some observed parameters such as temperature, concentration and time in the research, then the analysis is done Regeresi equations using "Minitab Software" (Sungkawa, 2013).

2. Materials And Methods

The method used in this research is the experimental method. In the mention of demulsifier using the saponification method and for testing the effectiveness of demulsifer that has been made using the bottle test method. The materials used in this study are castor oil, local lemon, KOH, glycerin, equadest, commercial finalizing, and X field oil samples.

3. Research Procedures

3.1. Production of Demulsifier

Manufacture of finalizing according to Paramita et al., (2014) using castor oil with saponification method as follows ; heat the oil range 25,79 gr with a temperature of 70 °C for 30 minutes. Then dissolve KOH 8,15 gr with the aquadest as much as 16,3 gr. Gently insert the KOH and Aquades solution into the previously heated range oil. Stir the solution using magnetic stirrer at 800 rpm for ± 100 minutes. Add the glycerin 10 ml into the castor oil solution. Then add 60 ml of the aquadest into the solution.

3.2. Demulsification With Bottle Test Method

Bottle test procedure according to Erfando et al., (2019) and Impian & Praputri, (2014) including the following ; Prepare a demulsifer formulation that will be injected into the crude oil emulsion. Insert the crude oil emulsion samples into the test bottle as much as 50 ml. Inject the demulsifier formula into the test bottles that have been filled with the crude oil emulsion with each concentration of 1 ml, 3 ml, 5 ml. Place the test bottle into the Waterbath using the temperature to be tested that is 40 °C, 60 °C, 80°C. Bottle test time is for 3 hours and observed every 30 minutes.

4. Results And Discussion

This research aims to determine the ability to demulsifier locally sourced castor oil which is reviewed from several variables, such as temperature, concentration, and timing. This research also aims to determine the effectiveness of the ratio of the demulsifier formula to local oil with a commercial demulsifier to the separation process of the water-in-oil emulsion (W/O). Temperature is an important factor that affects the emulsion stability. The higher the temperature, the more unstable and vice versa, the lower the temperature and the more stable the emulsion (Manggala et al., 2017). This study made a formula for demulsifier as many as 3 formulae, which is a surfactant demulsifier (DS) made of local material namely castor oil, demulsifier a lemon surfactant (DSL) that is a mixture of formulation of Surfactant demulsifier From the available lemon and commercial demulsifier.

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4.1. Temperature Conditions 40 ℃

The results of this study at a temperature of 40 ^{0}C in Sample 1 can be seen in **Figure 1**. demulsifier surfactant (DS) is high in breaking down the emulsion at 5 ml concentrations of 12,5 ml. In the commercial demulsifier (DK) only able to break down the emulsion at a concentration of 1 ml by 5 ml. This is because the commercial demulsifier is more effective in high temperature, where the combination of heat and the application of chemicals designed can decide the interfacial film (Sulaiman et al., 2015). Meanwhile, lemon surfactant demulsifier can solve the emulsion by 13 ml with 5 ml concentration. According to Kokal, Al-juraid, & Aramco, (1999) several factors affect the performance of demulsifier namely because of the stability properties of the emulsion, the factors influencing it is low temperature and heavy oil type. According to Wylde, Coscio, & Barbu (2008) in this temperature is seen as the result of high water separation influenced by temperature. Known the lower the temperature then the emulsion will stabilize.

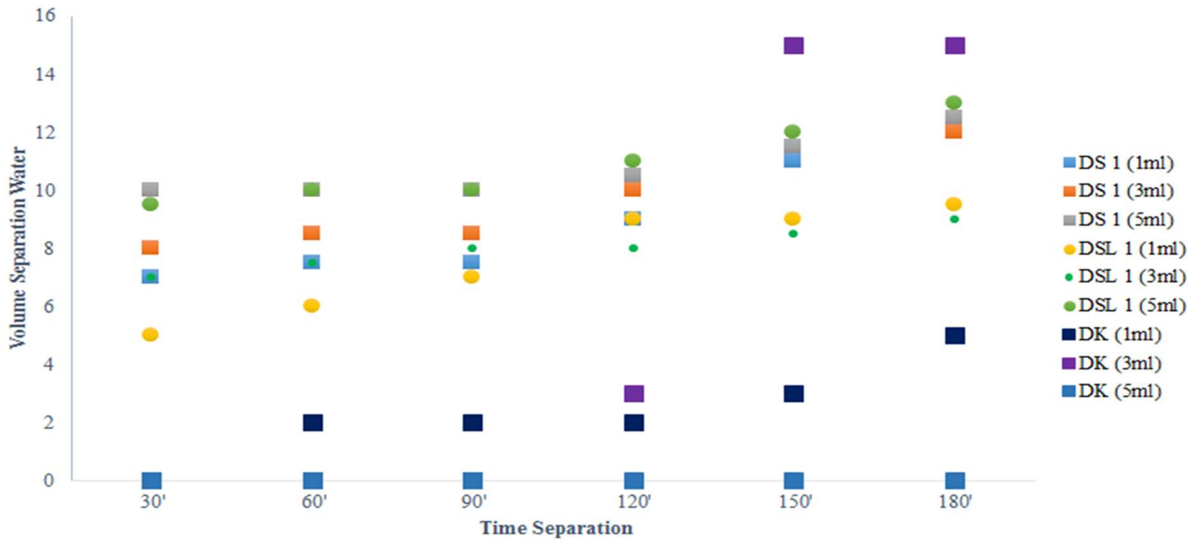

Figure 1. Water separation result of testing time at 40 ^{0}C

4.2. Temperature Conditions 60 ℃

At 60 ^{0}C temperature, the result of water separation from the emulsion has increased compared with the previous temperature, where it is seen that all types of demulsifier have been able to break down the emulsion in all concentrations. From the result in **Figure 2**. It is seen that the surfactant demulsifier (DS) is also able to work as a commercial demulsifier (DK). The result of emulsion breakdown using commercial demulsifier (DK) is 28 ml with 5 ml concentration. Solving the highest emulsions use surfactant demulsifier (DS) of 31,5 ml with a concentration of 5 ml (Sulaiman et al., 2015). Whereas a lemon surfactant demulsifier (DSL) can solve a very high emulsion of 32.5 ml with a concentration of 5 ml since the lemon it self contains citric acid which amounts to 90% of the total organic acids (Sadka, Dahan, Cohen, & Marsh, 2000). Inorganic acids, especially citric acid, has excellent demulsification efficiency in crude oil emulsions because citric acid has more carboxyl groups that can participate in the reaction, resulting in more demulsification efficiency High than other acids (Liu et al., 2018).

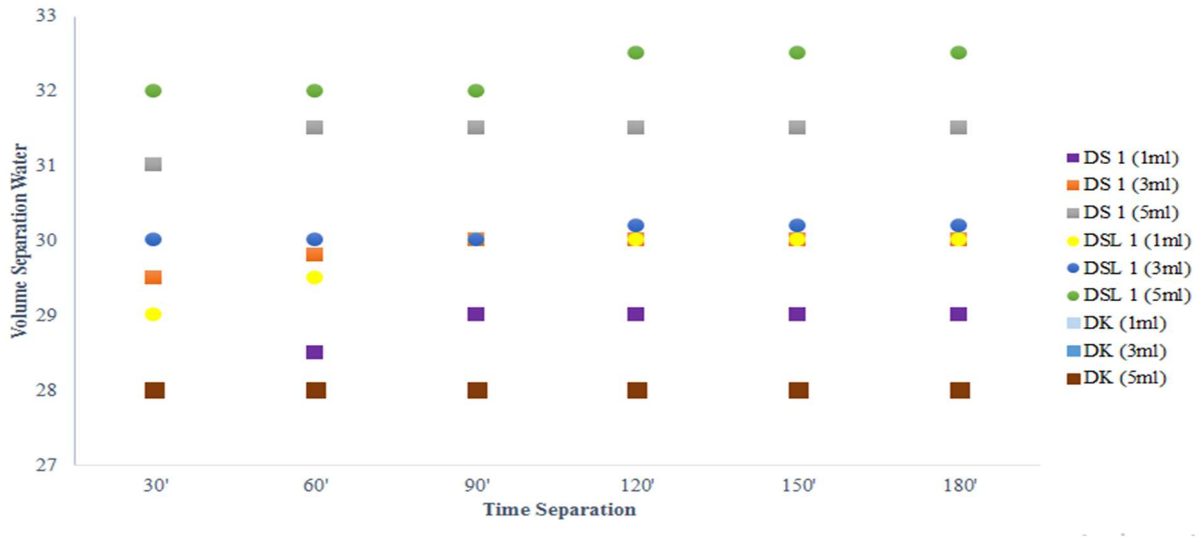

Figure 2. Water separation result to test time in temperature 60 ^{0}C

4.3. *Temperature Conditions 80 ℃*

At 80 ^{0}C The result of water separation from emulsions in all types of demulsifier both locally and commercially experienced a drastic increase from the previous can be seen in **Figure 3**. It appears that the result of water separation from the emulsion in a commercial demulsifier sample (DK) at a concentration of 5 ml is 39 ml. Where good characteristics of demulsifier one of them are the faster separation (Rita & Hadi, 2017). In other results use surfactant demulsifier (DS) with a concentration of 5 ml can separate water by 38 ml. While a lemon surfactant demulsifier (DSL) with a concentration of 5 ml can separate water by 39 ml. The higher the test temperature then The separation that looks faster and a lot of water is separated. This indicates the high temperature and high concentration of the demulsifier injection greatly affects the demulsification process. The high concentration of demulsifier greatly affects the voltage between fluid loading (Kang, Jing, Zhang, Li, & Wu, 2006).

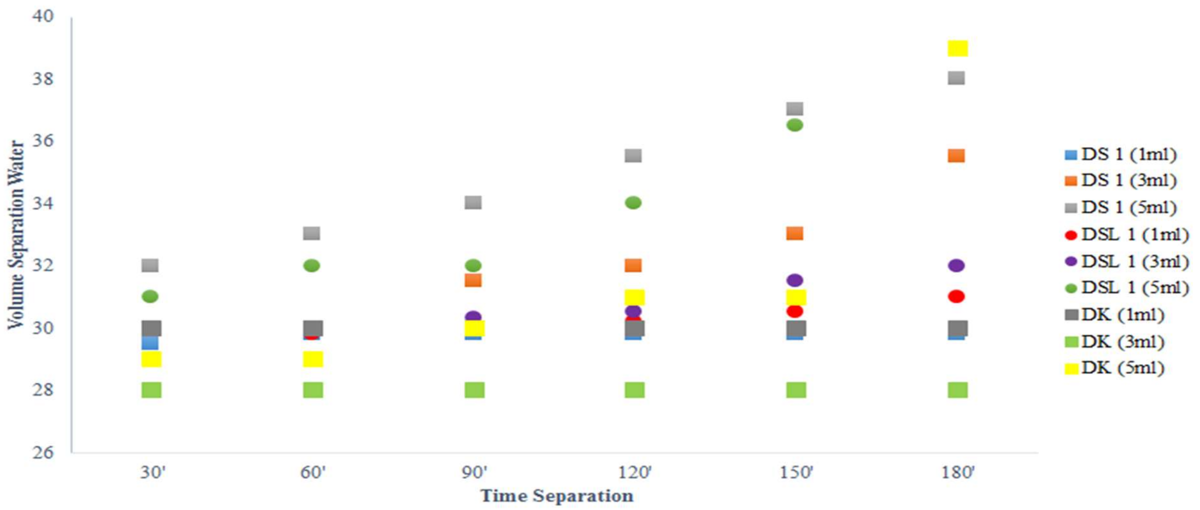

Figure 3. Water separation result to test time in temperature 80^{0}C

4.4. *Statistical Analysis Of Regression And Correlation Using Minitab Software*

In this study also saw how much influence of temperature and concentration on water separation from oil emulsion with statistical calculations using MINITAB application. Minitab provides various programs for the complete processing of statistical data, such as regression analysis, statistical quality control, forecasting with time series analysis and other (Wahyuni, Agoestanto, & Pujiastuti, 2018). Here's the result of statistical calculations with Minitab application.

Table 1. Results of regression and correlation of Software Minitab

Parameters	*P*-Value	R-Sq	R-Sq (adj)
Temperature	0	71.0	70.9
Concentration	0.014	1.6	1.3

A comparison of linear regression models determines the influence of X variables on Y (P. Subekti, 2015). If a positive result is obtained, the value of X variables will be equal to the value of the variable Y. From **Table 1**. In regression analysis, the value of P or P-value was obtained at 0.000 which means that the value of P is smaller than the significant criteria of 0.05 so that the free variable has a significant effect on the associated variables. At the output P-value obtained from the temperature is only less than the value of significance ($\alpha = 0.05$) means that the linear regression model meets the criteria of linearity and the changes occurring are very significant (Draper & Smith, 1998). Besides, the value of R-esq (adj) of 70,9% can be seen in **Figure 4**. This means the effect of temperature on water separation in the demulsification process of 70,9% and the remaining 29,1% is the influence of other free variables in addition to temperature (Wahyuni et al., 2018). In this case, it means the correlation of temperature to the separation of the demulsification result is very high because its value is almost close to 1 or 100% and with its positive value indicates that both variables or tested parameters are increased together (Pratomo & Astuti, 2014)

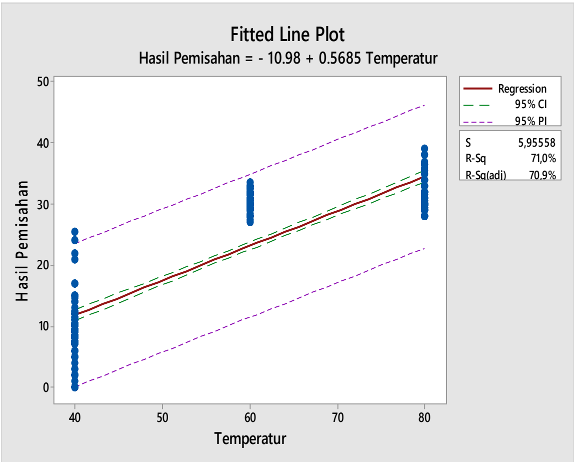

Figure 4. *Fitted Line Plot* temperature vs water separation

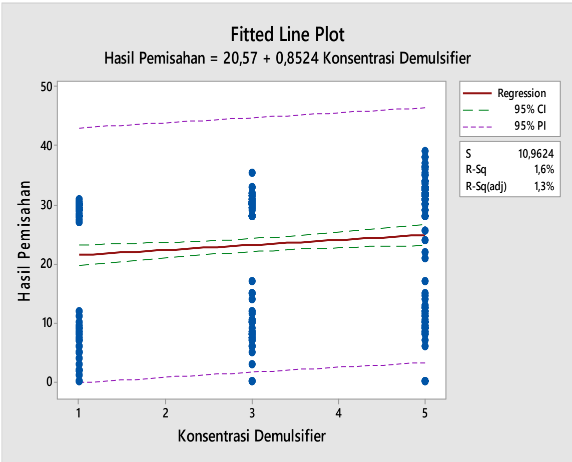

Figure 5. *Fitted Line Plot* concentration vs water separation

In **Figure 5**. The value of the coefficient of determination or R-esq (adj). The value of this coefficient of determination is used to know how large the associated variables are influenced by free variables. From the results of the regression analysis obtained the value of R-esq (adj) by 1,3%, this indicates that the variable on the separation of water is influenced by the free variable (concentration) of 1,3% and the residual amount is 98,7% influenced by variables other than concentration (Wahyuni et al., 2018). In this regard, the higher the centralization of the water separation result from the demulsification process is increasingly higher (Puji Subekti, 2015). Also, the correlation value gained a positive value of 1,3. The result of this value means that the correlation of the concentration on the water separation of demulsification result is low because its value is far from 1 and with positive value indicates that both variables or parameters are tested with (Pratomo & Astuti, 2014). The difference in the efficiency rate of the demulsification of each of the formulas can be due to unequal homogenization of each sample and the durability and quality differences of each formula acting at a certain temperature (Erfando.T, Irma Elfradina, 2019).

5. Conclusion

The retractable conclusion in this study is that local demulsifier samples were able to break down the emulsion throughout the test temperature, the highest separation occurred at 80 ^{0}C with an optimal concentration of 5 ml, namely the surfactant demulsifier (DS) amounted to 38 ml and a lemon surfactant demulsifier (DSL) of 39 ml, while the commercial demulsifier (DK) at a concentration of 5 ml at 40 ^{0}C was not able to break down the emulsion. The effect of temperature and concentration on water separation in the order of 70,9% and 1,3%. In this case that has the greatest influence among some parameters of the regression analysis data is the temperature of 70,9%.

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