Journal of Earth Energy Science, Engineering, and Technology, Vol. 3, No. 2, 2020
URL: https://trijurnal.lemlit.trisakti.ac.id/jeeset

Laboratory Study of the Effect of Salinity on the Demulsification Process in High Temperature Crude Oil

(Kajian Laboratorium Pengaruh Salinitas pada Proses Demulsifikasi dalam Minyak Mentah Bersuhu Tinggi)

Denny Aditya Rachman[1], Havidh Pramadika[1], Samsol[1*]

[1]Petroleum Engineering Department, Universitas Trisakti, Jakarta, Indonesia

Abstract
In the process of drilling and servicing oil wells, KCl and NaCl used to provide hydrostatic pressure into the bowels of the earth. The brine solution was produced accidentally to the surface facility when the oil lifting process was carried out and induces the thickness of the oil-water emulsion in the separation tank. Emulsions must be broken down into oil and water phases so that they do not interact with the oil treatment process in the refinery unit. Emulsion stability was influenced by pH, salinity, temperature and concentration of asphaltene, resin and wax. The purpose of this study was to determine the effect of salinity on the oil-water demulsification process. This research was conducted by varying the salinity of 5%, 15%, 25%, and 35% in a 100 ml oil-water emulsion sample with a ratio of 1: 1 oil and water. Demulsification of the emulsion sample using the precipitation method for 120 minutes by recording the% of oil volume separate every 20 minutes, at temperatures of 30 ° C and 110 ° C. The higher the temperature given, the more stable the emulsion in crude oil. From the final result after 120 minutes of pricipitation shows that the emulsion separation process which influenced by NaCl salinity is more difficult than the effect of KCl salinity.

Keywords: Salinity, Emulsion, Crude Oil, brine solution, NaCl, KCl

Sari
Injeksi uap panas adalah salah satu bentuk peningkatan produksi minyak menggunakan energi termal paling sukses yang sudah digunakan di seluruh dunia, serta telah menghasilkan porsi minyak paling banyak dari semua metode peningkatan produksi minyak (EOR). Karena untuk memproduksi minyak dibutuhkan intensitas energi dan biaya yang tidak sedikit, maka pengoptimalan injeksi uap panas di tingkat manapun dapat memberikan dampak yang luar biasa. Optimasi operasi injeksi uap panas dapat dicapai dengan mengoptimalkan injeksi uap panas (laju, waktu), terutama pada lapangan/bidang matang (mature) atau sudah dekat dengan akhir masa penutupan lapangan. Hal itu dapat dicapai dengan melalui pemanfaatan panas yang tertahan dalam reservoir, serta tekanan overburden/ underburden yang tidak terproduksikan seketika dengan fluida reservoir. Dengan menggunakan simulasi reservoir, dapat ditunjukkan bahwa injeksi tidak perlu diteruskan sampai masa penutupan lapangan, namun dapat dihentikan di waktu yang lebih awal sehingga operasi injeksi uap panas yang lebih menguntungkan dapat dicapai.

Kata-kata kunci: WASP, Injeksi Air Panas, Injeksi Uap Panas Terus-Menerus

*Corresponding author
E-mail: samsol@trisakti.ac.id
Tel: +(62) 81318216234

I. INTRODUCTION

In the process of drilling for oil wells and gas wells, a salt solution is used in a drilling mud mixture to withstand the pressure from the bowels of the earth hydrostatically. Generally speaking, the process that is passed until the well is ready for production includes drilling new wells, run logging testing, casing, cementing and testing wells. Before testing the well, rocks that have oil content are first shot with an explosive so that the oil flows in the pores of the rock to the wellbore which has a lower pressure [1].

In order to control this movement, the well is filled with a certain liquid to maintain under balance (the well can still be controlled and not blow out), for example liquid: brine, diesel, or water. Because the well is filled with a certain liquid, it is very possible that a strong emulsion is formed. The formation of a strong emulsion causes many problems such as plan instability, increased consumption of demulsification, losses using high pressure, corrosion and decreased productivity [2].

This emulsion is stabilized by natural chemicals contained in the crude oil itself, such as: asphaltene, resin, and wax is known as interfacial active components or natural surfactants. Crude oil is a complex mixture, starting from hydrocarbons as the main component, crude oil also contains other components, namely sulfur, nitrogen, oxygen, metal, asphaltene, resin, wax, basic sediment and water (BS&W), and solids (suspended solid). The loss caused by the increase in density and viscosity is that crude oil is difficult to flow so that transportation costs increase. Therefore, water dispersed in crude oil must be separated. Separation of water from crude oil emulsions is generally carried out by mechanical, thermal, electrical and chemical processes [3, 4].

In this study an experiment will be conducted to determine the potential for salinity as a demulsifier to determine the parameters of temperature, and time. The study was conducted in order to test the salinity of the stability of the crude oil emulsion.

It is known that the characteristics of crude oil greatly affect the stability of the emulsions. In addition, crude oil originating from different regions has different characteristics [5]. According to the results of the study, the factors that influence the stability of the emulsion include internal factors that affect the characteristics (physical and chemical properties) of crude oil where these factors are not easily changed or controlled. Other factors are external factors that can be controlled, namely operating conditions such as temperature, pH, the salinity of water forming emulsion, type of solvent demulsifier, solid particles, age of the emulsion, and so on [6, 7]. With the study of solving the stability of the emulsion it is hoped that it can help solve the emulsion problem in the processing of Indonesian crude oil.

II. METHOD

The procedure of this research is depicted in Figure 1. Works performed for testing oil demulsification in the laboratory consisted of:

1. Making emulsion samples from stirring crude oil and water.
2. Characterization of oil samples.
3. Testing the demulsification of the oil sample that has been emulsified.
4. Analyzing the separated oil volume.

The equipment used in this study included:

a. Measuring cups (200 ml, 100 ml) were used to collect the emulsified oil.
b. The reaction tube was used for the emulsion sample test.
c. The mixer was used to stir the emulsion sample so that a homogeneous oil-water emulsion was obtained.
d. Stopwatch / hour
e. The oven was used for the demulsification testing of the emulsion sample.

The materials used in this study were crude oil, NaCl (Sodium Chloride), KCl (Potassium Chloride), and distilled-water. The constant variable in this study is the ratio of oil to aquadest is 1: 1 with a volume of 100 ml, the mixing time is 2 minutes with a 9000 rpm homogenizer speed.

The independent variables were used with 2 types of salt (KCl and NaCl) and the concentrations given were 5%, 15%, 25%, and 35%. The temperature given in this test is a comparison of room temperature and temperature of 110 °C, with a test time of 120 minutes.

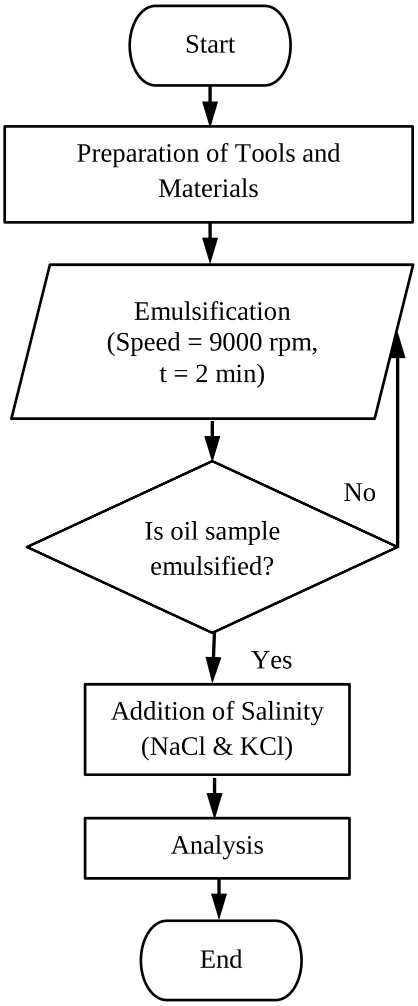

Figure 1. Research Procedure

III. RESULTS AND DISCUSSION

In this research, the results of oil separation in oil and water emulsion samples were observed. The results of demulsification of oil and water at room temperature can be seen in Table 1.

From the experimental results it can be seen that emulsion samples with more salt concentration content tend to be difficult to separate compared to samples that have less salt content. In Figures 2 and 3 we can see the difference in the amount of separate oil for each sample with varying concentrations of salt content.

In this experiment the test was carried out at a temperature of 110 °C using an oven as a heater for testing the emulsion sample. The results of demulsification of oil and water at 110 °C can be seen in Table 2.

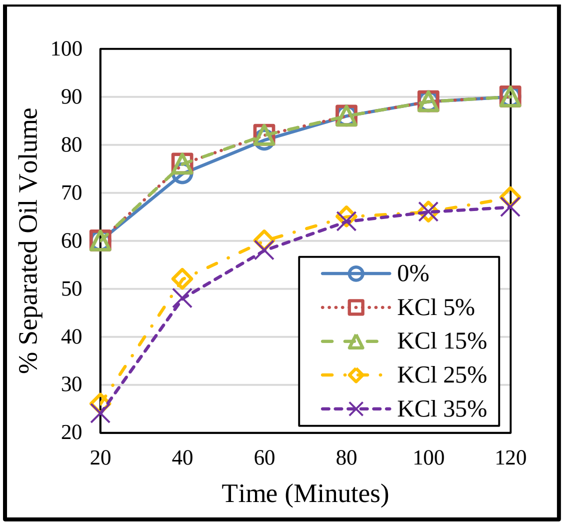

Figure 2. Demulsification Results at Room Temperature with Addition of KCl Salt

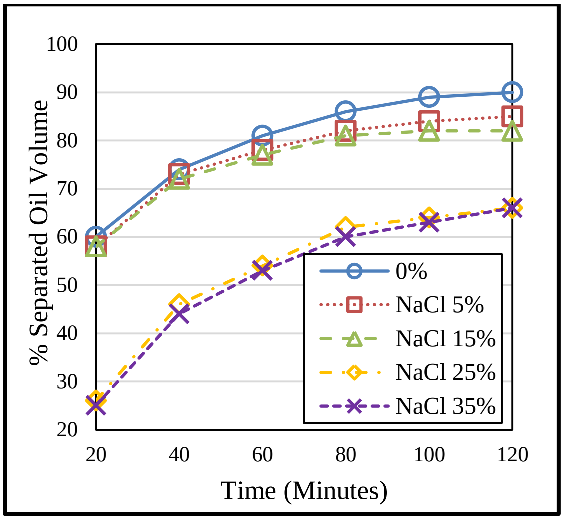

Figure 3. Demulsification Results at Room Temperature with Addition of NaCl Salt

From the experimental results it can be seen that the longer the separation speed will be slower it can be seen in Figures 4 and 5, this is because the amount of oil is getting smaller and is scattered in the emulsion. At the 100th minute, the speed of separation almost touched the 0 points, which meant that there was no separation between oil and water. In Figures 6 and 7 we can see the difference in the amount of oil separated during 120 minutes of testing from 2 types of salt with room temperature and temperature of 110 °C.

From the results of this experiment that the type of salt also affects the process of demulsification. In samples with NaCl salt content, the amount of oil separated for 120 minutes was less than in samples with KCl salt content. This can be caused by differences in electronegativity. Between K and Cl are higher than Na and Cl. Besides, the molar mass of KCl is higher than NaCl. This needs further research to prove the effectiveness of these two types of salt.

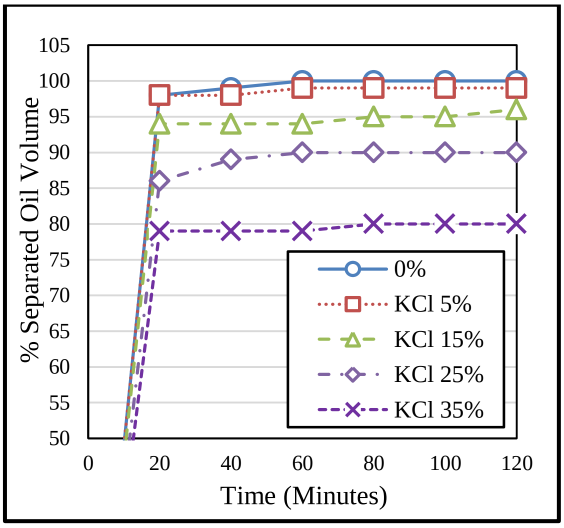

Figure 4. Demulsification Results at 110°C with the Addition of KCl Salt

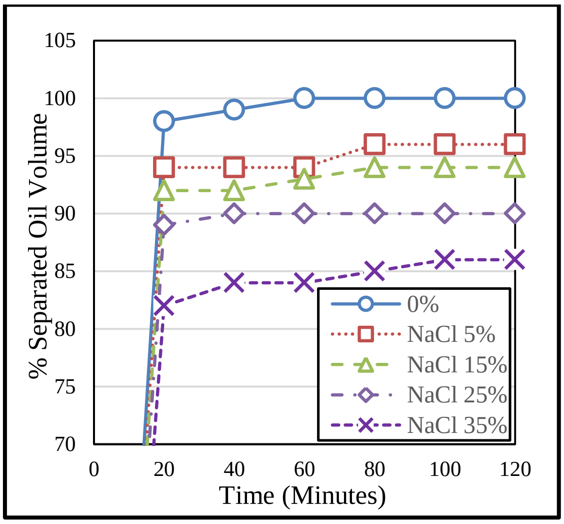

Figure 5. Demulsification Results at 110°C with the Addition of NaCl Salt

IV. CONCLUSIONS

From the results of the analysis from 4 wells to improve performance by strategy from KPI target as the objective to achieve performance.

1. Separate volume % value of oil decreases with increasing salinity.
2. Emulsion samples without salinity at 30°C for 40 minutes, where 70% of oil has been separated.
3. In the process with the addition of 25% and 35% salinity at a temperature of 30°C for 120 minutes where the volume of % oil apart does not reach 70%.

4. In the process of demulsification of the type of salt affects the stability of the emulsion that samples containing NaCl salinity are more difficult to separate than samples containing KCl salinity, and
5. Emulsion stability depends on the pH level. Low pH will increase oil solids and tighten water emulsions in oil. Conversely, high pH increases water solids and tightens emulsions oil in water.

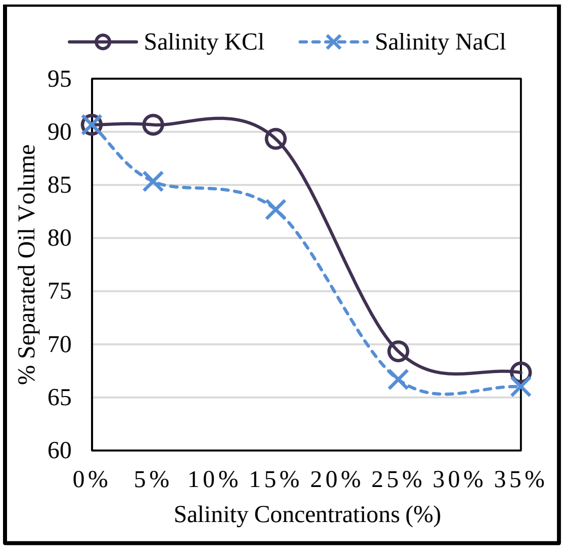

Figure 6. Percentage of Separated Oil Volume for 120 Minutes at Temperature 30°C

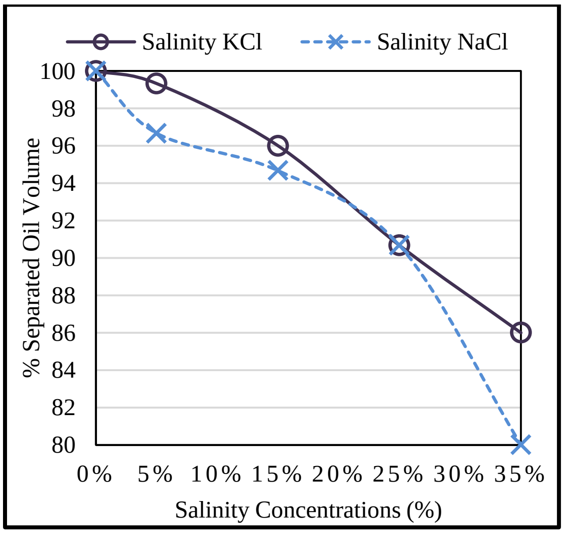

Figure 7. Percentage of Separated Oil Volume for 120 Minutes at Temperature 110°C

REFERENCES

1. Hayuningwang, D., Fadli, A., and Akbar, F. (2015). Pengaruh Salinitas KCl & NaCl Terhadap Kestabilan Emulsi Minyak Mentah-Air di Lapangan Bekasap, PT. Chevron Pacific Indonesia, Jurnal Online Mahasiswa FTEKNIK UNRI, 2(1), 1-5.
2. Kokal, S., 2005, Crude Oil Emulsion: A State-Of-The-Art Review. SPE Production and Facilities, SPE 77497PA, 20(1), pp. 5-13.
3. Aske, N. (2002). Characterization of crude oil components, Asphaltene Aggregation & Emulsion Stability by Means of Near Infrared Spectroscopy & Multivariate Analysis. Thesis. Department of Chemical Engineering, Norwegian University of Science & Technology, Trondheim. Pp 2- 10.
4. Grace, R. (1992). Commercial Emulsion Breaking. In.: Schramm, L.L. Emulsions Fundamentals and Applications in the Petroleum Industry. American Chemical Society, Washington DC. 313-338.
5. Elsharkawy, A.M., Al-Sahaf, T.A., Fahim, M.A. 2000. Effect of inorganic solids, wax to asphaltene ratio, and water cut on the stability of water-in-crude oil emulsions. College of Engineering and Petroleum. Kuwait University. Kuwait.
6. Ese, M. H. dan Kilpatrick, P. K. (2004). Stabilization of Water-in-Oil Emulsions by Naphthenic Acids and Their Salts: Model Compounds, Role of pH, and Soap:Acid Ratio. Journal of Dispersion Science and Technology, 25(3), 253-261.
7. Pramudono, B., 2009, Destabilisasi Sistem Emulsi: Detol-Asphaltene-Rsin Menggunakan Agen Pendemulsi Methyl Trioctyl Ammonium Chloride. Prosiding Seminar Nasional Teknik Kimia Indonesia – SNTKI 2009. Bandung.

Table 1. Demulsification Results at 30°C

Consentration Salinities		Time Analysis (minutes) 20	40	60	80	100	120
		Separate Oil Volume (%)					
0%		60.00	74.67	81.33	86.67	89.33	90.67
5%	**KCL**	60.00	76.00	82.67	86.67	89.33	90.67
	NaCL	56.67	73.33	78.67	82.67	84.00	85.33
15%	**KCL**	54.67	70.67	81.33	85.33	88.00	89.33
	NaCL	58.67	72.00	77.33	81.33	82.00	82.67
25%	**KCL**	26.67	52.00	60.00	65.33	66.67	69.33
	NaCL	26.67	46.67	54.67	62.00	64.00	66.67
35%	**KCL**	24.00	48.67	58.67	64.00	66.67	67.33
	NaCL	25.33	44.00	53.33	60.00	63.33	66.00

Table 2. Demulsification Results at 110°C

Consentration Salinities		Time Analysis (minutes) 20	40	60	80	100	120
		Separate Oil Volume (%)					
0%		98.67	99.33	100.00	100.00	100.00	100.00
5%	**KCL**	98.00	98.67	99.33	99.33	99.33	99.33
	NaCL	94.67	94.67	94.67	96.00	96.00	96.67
15%	**KCL**	94.67	94.67	94.67	95.33	95.33	96.00
	NaCL	92.00	92.00	99.33	94.00	94.67	94.67
25%	**KCL**	89.33	90.00	90.67	90.67	90.67	90.67
	NaCL	86.67	89.33	90.67	90.67	90.67	90.67
35%	**KCL**	82.67	84.00	84.00	85.33	86.00	86.00
	NaCL	79.33	79.33	79.33	80.00	80.00	80.00