CITIZEN: Jurnal Ilmiah Multidisiplin Indonesia
Vol 2, No. 4, 2022
ISSN: 2807-5994
https://journal.das-institute.com/index.php/citizen-journal

DETERMINATION OF ACID FORMULA TO OVERCOME SCALE PROBLEMS IN "MAXI" WELLS USING SOLUBILITY TEST

Angela Ayu Catherine, Mirza, Abdul Gafar Karim, Baiq Maulinda Ulfah, Aprilliano Alfa Kurmasela, Nabila Callista Valensi
Sekolah Tinggi Teknologi Minyak Gas Bumi Balikpapan, Indonesia
E-mail: AngelaAC0310@gmail.com

DOI: 10.53866/jimi.v2i4.120

Abstract

Scale is one of the main problems in oil and gas production, which can cause blockages in production pipes and reduce the efficiency of hydrocarbon extraction. This deposit is formed due to the precipitation of minerals in formation fluids, especially those containing ions such as calcium, magnesium, and iron. This study aims to identify the components of the scale formed in the MAXI well and determine the most effective acidification method to overcome this problem. The scale samples taken were analyzed using spectroscopy methods to determine their composition. Furthermore, solubility tests were carried out at room temperature and high temperature with various concentrations of hydrochloric acid (HCl) to evaluate their effectiveness in dissolving scale. The results showed that the main component of the scale is iron sulfide (FeS), which has a lower solubility in water. The solubility test showed that a 15% HCl solution at 60°C gave the best results with a solubility level of 87%, compared to lower HCl concentrations. Therefore, the acidification method using 15% HCl is recommended to be applied in MAXI wells to increase oil and gas production and reduce the risk of blockage due to scale.

Keywords: Kutai Basin, Kampung Baru Formation, Pulaubalang Formation, Depositional Environment, Kerogen Type.

1. Introduction

Oil and gas consumption is increasing day by day, both for industrial needs and for domestic fuel (Adha, 2021). Therefore, the oil and gas extraction process must run well so that the results obtained are optimal and in accordance with the objectives to be achieved (Abdurrahman, 2018). However, the production of oil and gas fields is decreasing from year to year, because the resources in the interior of the earth are depleting.

In addition to experiencing a decline from year to year, oil and gas production also often experiences problems where scale is one of the problems of the well (Taufik, 2017). Scale is the process of crystallization or deposits that occur due to water formation(Widodo, 2020). If the scale problem is not resolved immediately, it can reduce the permeability of the rock, thus reducing oil and gas production (Restya, 2019).

There are two efforts to handle scale, namely preventive efforts, namely prevention of scale formation by using chemical scale inhibitors and curative, namely efforts to remove scale that has been formed. Generallyusing chemical acids or acidizing stimulatio (Sari, 2017).

Scale is also formed due to chemical interactions between formation fluids and production fluids, which cause precipitation of minerals such as carbonates, sulfates, and metal sulfides(Megawati, 2022). Under certain conditions, ions in the formation water become supersaturated and form deposits that greatly inhibit fluid flow. Various methods have been developed to overcome this problem, one of which is the acidification method which uses an acid solution to dissolve the scale formed in the production system(Suprayitno, 2020). Oil and gas production often faces operational challenges, one of which is the formation of scale or mineral crust on production equipment and well formations. Scale can inhibit fluid flow, reduce production efficiency, and increase the cost of well maintenance and intervention. Therefore, an effective method of handling this problem is needed(Sima, 2022).

This study also focuses on analyzing the characteristics of the scale formed in the MAXI well and determining the acidification method with high effectiveness to overcome this problem. This study also tested the solubility of scale in various concentrations of HCl solution with varying temperatures to evaluate the effectiveness of the method to be used. It is expected that the results of this study can provide better recommendations in selecting the optimal acidization method to increase the efficiency of oil and gas well production and reduce operational costs associated with well maintenance.

2. Methods

2.1. Research Methods

This study was also conducted by conducting an experimental approach involving sampling on the scale from the MAXI well, analyzing the mineral composition, and solubility testing with various concentrations of acid solutions. Scale samples taken from the MAXI well tubing were analyzed using spectroscopy to identify the mineral content of the components. In addition, morphological analysis was also carried out using an electron microscope to observe the structure and distribution of minerals in the scale.

Solubility testing was carried out by mixing the scale in HCl solution with concentration variations of 7.5%, 10%, and 15%. This experiment was also carried out at room temperature at 60°C to evaluate the effect of temperature on the effectiveness of dissolving the scale. The results of this test were also analyzed by measuring the weight of the residue remaining after the dissolution process took place. The results of the solubility analysis were used as a basis for determining the most effective HCl concentration in dissolving the scale. The acidizing method with optimal concentration was then recommended as a solution to overcome the scale problem in the MAXI well.

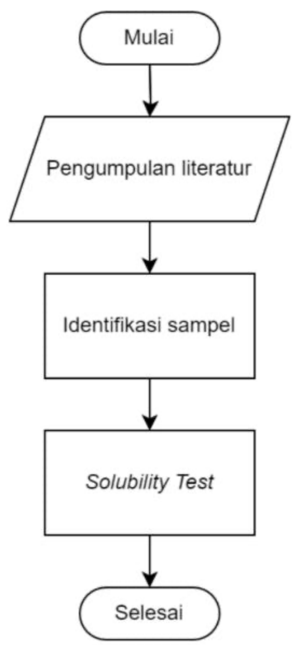


Figure 1. Research flow diagram

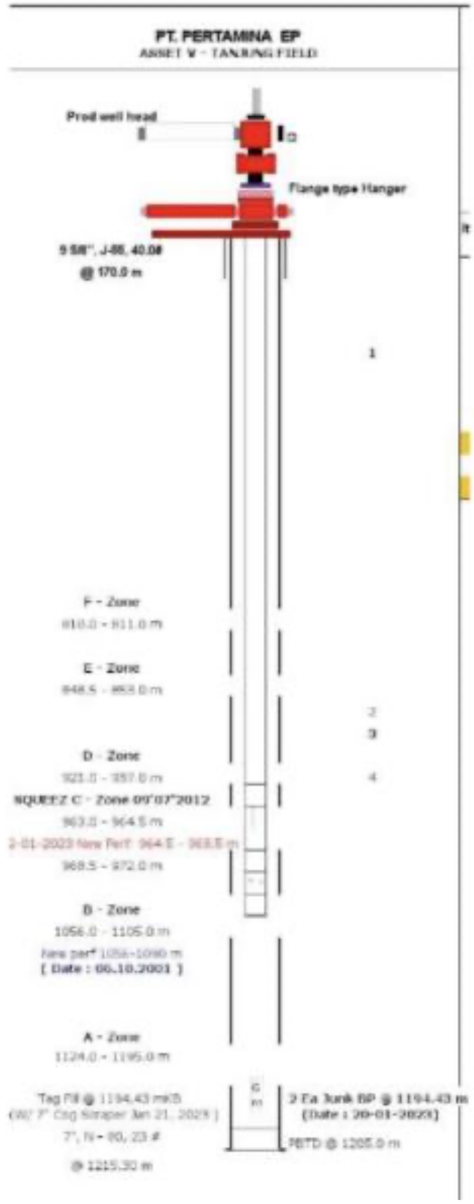


Figure 2. Well Profile

Source: Pertamina Hulu Indonesia Region 3 Zona 9 Tanjung Field then continued with the optimisation of the treatment. Below is a sample identification flowchart

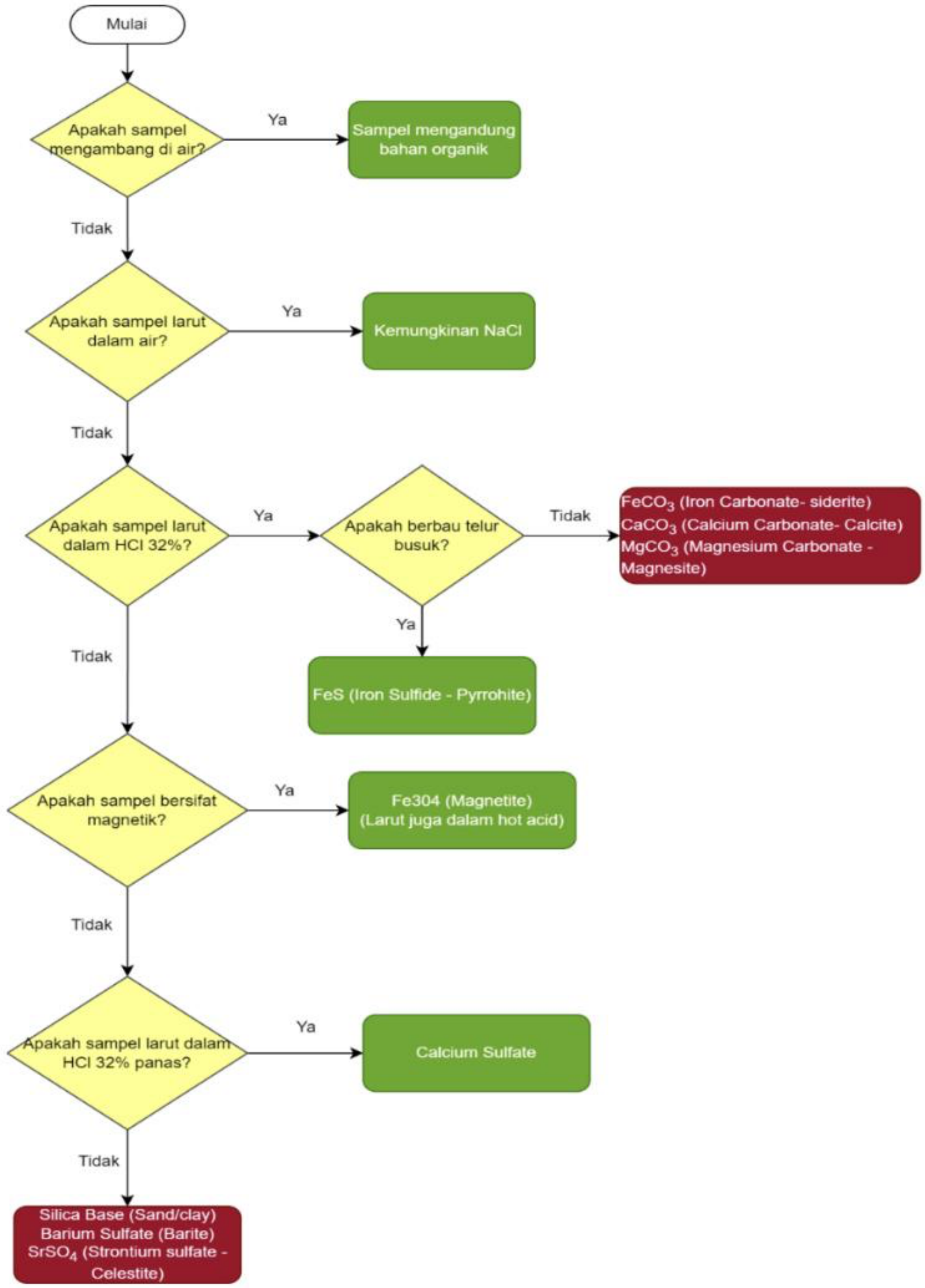


Figure 3. Sample Identification Diagram
Source: PT Pertamina Hulu Indonesia Region 3 Zona 9 Tanjung Field

The MAXI well has a total depth of 1124.0 metres and has 5 perforation zones, namely zones A, B, D, E, F. Each perforation zone has its own depth difference. The process of implementing chemical injection at the MAXI well is carried out in zone A at a depth of 1124.0-1195.0 metres. The MAXI well hole measures 7 inches and uses a casing with a size 7 inches and tubing with a size of 3 1/2 inches.

2.2. Sample Identification

The first step to determine the treatment that cooks with the sample you have is to first identify the sample visually. The purpose of this is to be able to know the components contained in the scale. Later, an effective treatment is carried out to destroy the scale and

3. Results and discussion

The scale problem on the MAXI well is influenced by the type of scale that has not been identified and has been analysed, so the solution composition optimisation process is carried out which consists of several stages as follows:

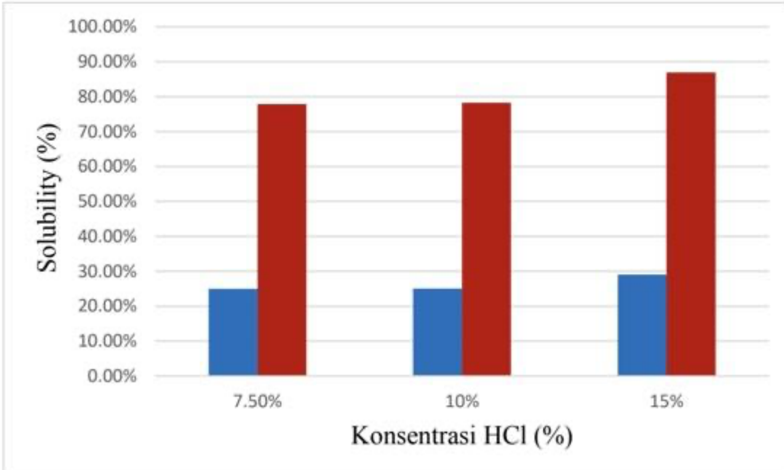
3.1. The initial stage to do optimisation is by identifying the scale, by immersing the sample with aquadest. As for soaking with aquadest serves to know the type of component in general. The test method is to soak the sample in aquadest water, if the sample can be dissolved using water then the constituent component of the sample is only NaCI. So, the treatment that is done to overcome the scale problem in this case is enough to soak using tapa water with the addition of other acids. This is due to the nature of NaCI itself which can dissolve in water.

3.2. When the sample does not dissolve with water, the treatment is done by soaking using 32% HCI. The analysis carried out on the sample soaking process with this HCI is by looking at the reaction of the soaking process. If the sample is unflavoured then the scale tested may contain FeCOs, CaCO, or MCOs. Meanwhile, if during the sample soaking process it emits an unpleasant odour, then it can be concluded that the content in the scale in this case is FeS. And when the experiment was carried out, it was concluded that the constituent component for scale in was FeS (Iron Sulphide) because the sample experiment was not soluble in water but soluble in 32% HCI and smelled of rotten eggs.

For the second method, namely the Solubility Test in the research calculation of the amount of residues is represented by W where the concentration of 7.5% at a temperature produces 3.8312 grams of residue and at a temperature of 60°C produces 1.1880 grams of residue. At a concentration of 10% at a temperature it produces a residue of 3.8285 grams and at a temperature of 60°C it produces a residue of 1.1682 grams. At a concentration of 15% at room temperature produces a residue of 3.6269 grams and at a temperature of 60°C produces a residue of 0.7302 Gram. Solubility is very important to know, this is because it is related to the residue that will be formed when the soaking process is carried out where in the calculation that has been done the soaking process takes place quickly at a temperature of 60°C

Where the least residue is produced and it is obtained that 15% HCI is the most optimal solution leaving a little residue. If the residue formed is more, then it will hinder the performance of the pump for a long time. Solubility is also related to the length of soaking time needed in the downhole later. The longer the time it takes for the soaking process, the greater the possibility that this process will cause damage to the pump in the reservoir.

Based on the results of the calculation analysis, data was obtained in the form of the influence between the concentration of HCI on the solubility of the sample in Figure 4 as follows:



Graph 4. Effect of HCI on Solubility

Based on Graph 4. above, it can be seen that in each concentration of HCI that was tested, a variable solubility value was obtained, namely in the range of 26- 87%, the difference for the state of room temperature and the state of the temperature of 60°C

So with the results of the data for the soaking process that will be done simply by using 15% HCI where 15% HCI at room temperature and 60°C

4. Conclusions

This study also shows that the scale formed in the MAXI well consists of iron sulfide (FeS) components with minor calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$) content. These components cause blockages in the production system, requiring an effective mitigation method. The solubility test showed that HCl solution with a concentration of 15% at a temperature of 60°C was the most effective method in dissolving scale, with a solubility level reaching 87%. This shows that increasing the temperature can increase the efficiency of dissolution, which can be applied in acidizing operations in the field. The acidizing method with 15% HCl is recommended to be applied to the MAXI well to increase oil and gas production and reduce the frequency of maintenance due to blockages. However, further studies are needed on the long-term impact of using HCl on tubing materials and rock formations.

References

Abdurrahman, M. (2018). Analisis potensi hidrokarbon dan perhitungan cadangan oil current lapisan M1 dan M2 pada Formasi W Sumur AP#1 Lapangan Lirik. *Jurnal Mineral, Energi dan Lingkungan*, *2*(1), 38. https://doi.org/10.31315/jmel.v2i1.2215

Abrian, Y., Prasetya, D., & Wibowo, R. (2015). Analisis kinerja acidizing pada PT Pertamina EP Asset 2 Pendopo Field. *Jurnal Teknik Perminyakan*, *7*(2), 45–52.

Adha, I. (2021). Reservoir di Lapangan Cipluk Kendal. *PETROGAS: Journal of Energy and Technology*, *3*(2), 39–50.

Akhdan, W., Supriyadi, & Dewayanti, D. S. (2010). Studi penyebab scale di lapangan-lapangan minyak Sumatra. *Lembaran Publikasi Minyak dan Gas Bumi (Lemigas Journal)*, *44*(3), 99–108.

Ariandinata, F., & Nirmala, G. S. (2024). Penentuan kecenderungan pembentukan scale PMB-X pada Lapangan Prabumulih PT. Pertamina Hulu Rokan. *Scientica: Jurnal Ilmiah Sains dan Teknologi*, *2*(3), 1–15.

Friadi, R., Prabu, U. A., & Iskandar, H. (2014). Evaluasi penanggulangan scale dengan metode inject scale inhibitor pada Sumur 'X' di PT Pertamina EP Asset 2 Field Limau [Skripsi, Universitas Sriwijaya].

Kusrini, D., & Setiawan, M. R. (2022). Evaluasi keberhasilan penanggulangan problem scale dalam upaya optimasi produksi pada sumur "X" Lapangan "Y". *Jurnal Offshore: Oil, Production Facilities and Renewable Energy*, *6*(2), 61–67.

Megawati, E., Pradipta, Y. H., Warsa, I. K., & Yuniarti. (2022). Optimasi flow feed gas terhadap flow amine pada kolom CO_2 removal. *PETROGAS: Journal of Energy and Technology*, *4*(1), 19–25.

Musmuliadi. (2020). Pencegahan terbentuknya produk scale pada pipa produksi area Minas dengan injeksi chemical scale inhibitor. *Jurnal Surya Teknika*, *7*(1), 69–76.

Restya, D. (2019). Studi pengaruh scale terhadap penurunan permeabilitas batuan reservoir. *Jurnal Energi dan Sumber Daya Mineral*, *12*(1), 33–40.

Sari, A. P. (2017). Analisis tingkat keberhasilan penanggulangan scale $CaCO_3$ dalam upaya optimasi produksi pada sumur X dengan menggunakan kurva IPR [Skripsi, Universitas Sriwijaya].

Sima, N., Sinaga, J. F., & Perminyakan, T. (2022). Optimasi hydraulic pumping unit pada sumur "Wn-98" Lapangan "X". *PETROGAS: Journal of Energy and Technology*, *4*(1), 47–56.

Suprayitno, A., Amiruddin, A., Talaiftha, A., & Maulidya, R. N. (2020). Penyelidikan tingkat pengaruh patahan geologi dengan arah retakan di Jalan Raya: Studi kasus jalan besar di Balikpapan. *PETROGAS: Journal of Energy and Technology*, *2*(2), 52–61. https://doi.org/10.58267/petrogas.v3i2.74

Taufik, M. (2017). Menggunakan metode geolistrik resistivitas konfigurasi Wenner-Schlumberger. *Jurnal Energi dan Geoteknologi*, *6*(2), 42–52.

Verawati. (2024). Pengaruh penggunaan asam terhadap penanggulangan scale pada pipa produksi lapangan minyak [Skripsi, UIN Syarif Hidayatullah Jakarta].

Widodo, D. F. E. E. (2020). Analisa performa reservoir tight gas menggunakan analisa decline curve metode Duong pada sumur vertikal dan horizontal multifrakturing menggunakan simulasi reservoir. *PETROGAS: Journal of Energy and Technology*, *2*(1), 1–15. https://doi.org/10.58267/petrogas.v2i1.28