Clay stabilizer and zetpass uses for improving sand control performance and resist the sand problem at field X based on laboratory study

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Abstract. This field X well production has indeed occurred in the sand and this well has been carried out with water flooding with injection water that is currently available. In this study of sand problems, it is intended to find out the cause of the problem of sandiness in terms of laboratory analysis of formation rock samples and injection fluid. Laboratory analysis consists of fluid characterization, rock characterization that is specifically assigned to rock minerals (SEM and XRD), and fluid injection compatibility tests with rocks, then a sand retention test is performed. After the addition of clay stabilizer in injection water, Zone A, Zone B and Zone C have increased apparent permeability to reach an interval of 500% -1000% mD. The use of Zetpass cannot be used in zone A because there is a lot of clay and the grain is very fine, but it can be used in zones B and C. Fluid interactions with rock minerals and chemical interactions will reduce the cementation of rocks so that they can trigger the occurrence of sand. Clay stabilizer is important to note in wells that have done water flooding. ZetPass solution is able to become sand control but has limitations. The ZetPas solution is able to become sand control but has limitations, where if it is applied to a reservoir that has a significant composition of clay minerals (smectite, illite and chloride), the performance will decrease.

1. Introduction

The presence of sand problems has caused production loss to continue to increase, which also results in lost costs in the operation of an oil and gas field. This financial loss was caused by the sand problems which resulted in damage to subsurface and surface equipment, well maintenance frequency increased, non-productive time, and decreased oil production. Several references and previous studies have been carried out to obtain an optimal gravel pack size for rock and fluid characteristics of each production well. Then further, the research that will be carried out at this time is trying to increase the performance of the previously designed gravel pack by modifying the injection fluid and testing the performance of the ZetPas chemical solution as an alternative sand control to be used [1].

Appropriate handling of the problems of the sand in the old field by tracing it from the understanding of reservoir rock characterization which includes the type & composition of minerals, distribution, petrophysical properties, and mechanical properties. Then proceed with understanding the reservoir fluid characteristics and injection fluid which includes type, viscosity, salinity, anion / cation, flow rate, pH, and temperature [2]. Furthermore, understanding the conditions of pore pressure and stress around the perforation hole changes as the production process or injection occurs. From these three things,
information about the mechanism of the sand and the current of the wellbore from a well / oil and gas field will then be used as the basis for taking the right solution.

The field X production well has indeed occurred in the sand and the well is no longer able to natural flow, even what is happening now is that this field has been carried out with water flooding with injection water that is currently available.

Mechanical method is the use of sand control (gravel pack). To use this method, particle size testing was done before using the Particle Size Distribution (PSD) tool in dry conditions. In figure II.6 it is indicated by the size of D10 which represents the size where 50% of the particles are larger. D50 represents a size where 50% of the grains are larger and D90 shows a size where 90% of the particles are larger [3].

Schwartz stated that to determine the size of the gravel pack to be used, it must first determine the value of the Gravel to Sand (G-S) ratio. The recommended Gravel to Sand (G-S) ratio is around the value of 6 to 8 times the grain size of the sample at D50, where the gravel pack design will be optimum if it is worth 6 times the D50. Then the sand control (gravel pack) size can be determined to be used according to the results of the item analysis.

2. Methodology
Fluid characterization testing is carried out onsite and, in the laboratory, more thoroughly including temperature, pH, TDS, DO, salinity, resistivity, conductivity. Determination of rock characterization using core samples and field sand in zones A, B, and C includes petrographic analysis, XRD / SEM, and petrophysics to determine the type and composition of minerals microscopically and obtain basic data parameters (porosity, permeability, and rock density grain).

Swelling test to determine the effect of fluid on rock sensitivity using the Grace High Temperature and High Pressure Dynamic Swell Meter devices. Various Clay stabilizers were tested to obtain the right clay stabilizer composition in each sample from all three zones to overcome the effects of clay minerals. The test uses a core sample that has been crushed measuring ≤ 200 Mesh, then made into a pellet and inserted into the chamber containing a clay stabilizer. Test conditions at a temperature of 60 °C and 800 Psi pressure for 16 hours [4].

The dispersion test was carried out to determine the effect of fluid on rock sensitivity using the visual method. Various clay stabilizers are also used in this test. Dispersion testing is carried out by immersing core cutting samples or those which have been crushed in the test fluid. Qualitative observations were carried out and documentation of formation changes from core samples soaked for 4-11 days.

This sand retention test uses core samples that have been crushed. In this test it was conducted to simulate the gravelpack sand design that had been obtained through mathematical calculations added with KCl solution and also the core added with Zetpas solution by being expected to be able to overcome the sand produced as well. The choice of a method for overcoming this problem is an understanding of current borehole geometry conditions, mechanisms, and economics. The method used in this study is chemical / chemical handling. Chemical handlers in this study are divided into two, namely: 1). Use chemical consolidation (ZetPas), and 2). Use clay stabilizer to increase the performance of sand control (gravel pack) [4].
3. Result and discussion

3.1. SEM (Scanning Electron Microscope) test
One of the results of a photo Scanning Electron Microscope (SEM) in zone A shows a condition where almost the entire surface of the rock is covered by clay minerals. In the figure it can also be observed that the cementation process that takes place in this rock is dominated by chlorite and Illite.

![SEM result](image)

**Figure 2.** Example of SEM results on the grains of rocks [5].

In contrast to zone A, the results of the Scanning Electron Microscope (SEM) photo in zone B show the conditions in which the grains of rock can be clearly observed in angular-rounded shape. The results of the photo Scanning Electron Microscope (SEM) in zone C also indicate conditions where the rock grains can be clearly observed. Unlike zone B, the grain shape in this zone is angular-sub rounded which consists of quartz minerals, rock fragments and a little feldspar.

3.2. XRD (X-ray Diffraction)
Based on this test shows that Illite and quartz minerals dominate in zone A. XRD results in zone B and zone C show varying amounts of clay minerals.
3.3. Swelling Test
In testing using WIP it was seen that swelling in zone A almost reached a stable point valued at 42%, then in zone B it showed almost stable conditions rated at 50% and in zone C it was almost stable at 25%.
Based on the three tests above, it shows that the injection water used is incompatible with the mineralogy found in rocks (clay minerals). This can be seen from the swelling test which is valued at a range of zone A values (42%), zone B (50%) and zone C (25%). This mismatch has the potential to cause the occurrence of sandiness in these three zones by weakening rock strength. Other tests use 7% KCl in zone A, zone B and zone C. In this test it can be seen that swelling has decreased which can be said to be significant when compared to injection water as in zone A almost reaches a stable point rated 24%, then in zone B shows almost stable conditions valued at 23% and in zone C it is almost stable at 15%. So the swelling phenomenon that occurs can be controlled using certain types of salt, in this case NaCl will be more effective than KCl. By controlling this swelling phenomenon with a salt solution on injection water it can reduce the occurrence of sandiness [7].
**Figure 7.** Sand retention in zone A with 60/80 sand and WIP solution plus clay stabilizer.

Result of sand retention test for zone A using gravel pack 60/80 and water injection plus clay stabilizer, the permeability value increase around 465 - 623 mD with solid produced 0.00533 – 0.0202 grams.

**Figure 8.** Sand retention in zone A with 60/80 sand and Chemical EON (ZetPass).

Result of sand retention test for zone A using zetpas (chemical EON), the permeability value around 19 - 29 mD with solid produced 0.00485 - 0.15712 grams.

For comparison in zone B and zone C can be seen in the table below.

**Table 1.** Comparison of all the results of sand retention tests in zones A, B, and C.

| No | Method | Sand Control | Fluids used | Zona A | Zona B | Zona C |
|----|--------|--------------|-------------|--------|--------|--------|
|    |        |              |             | GPS size | App. | Solid (g) | App. | Solid (g) | App. | Solid (g) |
| 1  | GPS    | WIP          | 60/80       | 19-58    | 0.01  | 16/20 | 43-110 | 0.0001-0.015 | 30/50 | 9-38 | 0.001-0.004 |
| 2  | GPS    | KCl 7%       | 60/80       | 465-623  | 0.00533-0.0202 | 16/20 | 1813-6649 | 0.00784-0.04497 | 30/50 | 287-438 | 0.00477-0.01293 |
| 3  | Zetpas | WIP          | -           | 19-29    | 0.00485-0.15712 | - | 39-129 | 0.0068-0.0382 | - | 65-113 | 0.00086-0.02789 |

From table 1 above it can be seen that the addition of KCl in the fluid used can increase permeability with the same sand control method, namely Gravel Pack Sand Control (GPS). In zone A, the Zetpass
method does not increase permeability. Different conditions occur in zone B and Zone C, the use of Zetpass can increase permeability. Two different trends can be observed, in which $K$ increases with an increase in the percent of clay and silt, while an inverse trend is observed between $K$ and the percent of sand-sized particles [8].

4. Conclusion

- Swelling and dispersion phenomena that interfere with cementation of rocks cause the release of sand grain so that it can trigger the occurrence of sandiness.
- Swelling will also greatly affect the effectiveness of the flow in the production well when the gravel pack is installed.
- The use of KCl and NaCl has the potential to be a clay stabilizer capable of increasing the permeability values in these three zones (A, B, and C) to reach 500% - 1000% mD of permeability values before adding clay stabilizers.
- The ZetPas solution is able to become sand control but has limitations, where if it is applied to a reservoir that has a significant composition of clay minerals (smectite, illite and chloride), the performance will decrease.

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