

INTISARI

ANALISIS GEOMEKANIKA UNTUK MENENTUKAN BATAS MAKSIMUM INJEKSI AIR PADA FORMASI KEUTAPANG, LAPANGAN "ZA", CEKUNGAN SUMATRA UTARA

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Geomekanika memiliki peran penting dalam siklus minyak dan gas, seperti eksplorasi, *development*, dan produksi. Geomekanika biasanya digunakan untuk analisis potensi *fault seal*, prediksi tekanan pori, kestabilan lubang sumur, dan lain-lain. Analisis geomekanika juga dilakukan sebelum dioperasikannya pemboran ataupun injeksi guna meminimalisir potensi bencana yang dapat terjadi. Pada penelitian ini dilakukan analisis geomekanika untuk mengetahui batas tekanan injeksi maksimum di Lapangan "ZA", Formasi Keutapang, Cekungan Sumatra Utara. Analisis geomekanika satu dimensi akan menghasilkan nilai tekanan *overburden*, tekanan pori, sifat elastik, kekuatan batuan, dan tegangan horizontal minimum.

Tekanan pori dikalkulasi menggunakan metode Eaton. Sifat elastik batuan diwakilkan dengan nilai modulus Young dan rasio Poisson. Kekuatan batuan diwakilkan oleh nilai UCS, *tensile strength*, dan *friction angle*. Tegangan horizontal minimum dikalibrasi dengan *fracture gradient*. Dari analisis tersebut diketahui bahwa Lapangan "ZA" memiliki sumur dengan permasalahan *Underpressure*, *overpressure*, dan *Underpressure-overpressure*. *Underpressure* disebabkan oleh fluida yang sudah diproduksi sebelumnya, sedangkan *overpressure* disebabkan oleh laju sedimentasi yang lebih cepat dibandingkan laju fluida yang keluar dari pori-pori batuan. Selain itu, berdasarkan sifat elastiknya, batuan di Lapangan "ZA" mudah terdeformasi.

Lapangan "ZA" juga memiliki jenis batuan yang kuat dengan litologi *shally sand* dan *friction angle* yang kecil berdasarkan nilai kekuatan batumannya. Hal ini disebabkan batuan belum terlalu kompak yang didukung oleh kurva tegangan horizontal minimum lebih mendekati tekanan hidrostatik dibandingkan tekanan *overburden*, sehingga *window* injeksi pada lapangan ini cukup sempit dari tekanan hidrostatiknya. Pada penelitian ini juga diketahui nilai batas maksimum injeksinya sebesar 7,63 MPa yang diperoleh dari *step rate test*. Namun, nilai ini hanya berada di satu sumur sehingga diperlukan *minifrac test* lebih lanjut untuk mengetahui jumlah batas maksimum injeksinya guna pengoperasian lebih lanjut.

Kata kunci: 1D MEM, tekanan pori, kekuatan batuan, sifat elastik, tegangan horizontal minimum

ABSTRACT

GEOMECHANICAL ANALYSIS TO DETERMINE THE MAXIMUM LIMIT OF WATER INJECTION IN KEUTAPANG FORMATION, "ZA" FIELD, NORTH SUMATRA BASIN

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Geomechanics has an important role in the oil and gas cycle, such as exploration, development, and production. Geomechanics is commonly used for fault seal potential analysis, pore pressure prediction, wellbore stability, etc. Geomechanical analysis is also conducted prior to drilling or injection operations to minimize potential disasters that could occur. In this study, a geomechanical analysis is conducted to determine the maximum injection pressure limit in the "ZA" Field, Keutapang Formation, North Sumatra Basin. The one-dimensional geomechanical analysis will produce values of overburden stress, pore pressure, elastic properties, rock strength, and minimum horizontal stress.

Pore pressure was calculated using Eaton's method. The elastic properties of the rock are represented by Young's modulus and Poisson's ratio values. Rock strength are represented by UCS, tensile strength, and friction angle values. The minimum horizontal stress is calibrated with fracture gradient. From the analysis, it is known that the "ZA" field has wells with Underpressure, overpressure, and Underpressure-overpressure problems. Underpressure is caused by previously produced fluid. Meanwhile, overpressure is caused by a sedimentation rate that is faster than the rate of fluid coming out of the rock pores. In addition, based on their elastic properties, the rocks in the "ZA" Field are easily deformed.

The "ZA" field also has a strong rock type with shally sand lithology and a low friction angle based on its rock strength value. This is because the rock is not yet too compact which is supported by the minimum horizontal stress curve which is closer to hydrostatic pressure than overburden stress, so the injection window in this field is quite narrow from the hydrostatic pressure. In this study, the maximum injection limit value is also known to be 7.63 MPa obtained from the step rate test. However, this value is only in one well so further minifrac tests are required to determine the maximum injection limit amount for further operations.

Keyword: 1D MEM, pore pressure, rock strengths, elastic properties, minimum horizontal stress