ABSTRAK

DESAIN *HIGH PERFORMANCE WATER BASED MUD* UNTUK MENGATASI *PROBLEM* REAKTIF *SHALE* PADA SUMUR "MR-04" LAPANGAN "MA"

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Formasi mundu yang ditembus pada Sumur MR-04 (1670-1690 ft) section 3 Lapangan MA memiliki kompleksitas mineralogi yang tinggi, dengan kehadiran hampir seluruh tipe *clay* mineral. Kandungan *smectite* dan *kaolinite* masing-masing melebihi 20%, sementara *illite* dan *chlorite* melebihi 10%. Selain itu, ditemukan juga keberadaan *mixed-layer clay* baik dalam bentuk *irregular* (13%) maupun *regular* (7%). Kombinasi ini menimbulkan tantangan serius terhadap operasi pemboran akibat potensi reaksi hidrasi yang tinggi serta sifat mekanik batuan yang bervariasi, termasuk *swelling*, dispersi, dan peretakan pada *shale* rapuh.

Penelitian ini dilakukan untuk mengevaluasi tingkat reaktivitas formasi terhadap lumpur berbasis air melalui pendekatan analisis *X-Ray Diffraction (XRD*) dan *Methylene Blue Test* (MBT) guna mengetahui komposisi mineral dan sifat pertukaran kation. Nilai-nilai tersebut kemudian digunakan untuk menentukan karakteristik batuan serta *Brittleness Index* (BI) sebagai indikator kecenderungan dispersi atau runtuhan mekanik.

Tiga formulasi lumpur *High Performance Water Based Mud* (HPWBM) dirancang dan diuji menggunakan Test *Clay Orinted* Lanjutan dan *hot rolled dispersion test* untuk menilai efektivitas masing-masing inhibitor. Hasil pengujian menunjukkan bahwa kombinasi lumpur Sampel 3 (7% KCl, 0,5% PHPA, dan 2% *polyamine*) mampu memberikan perlindungan paling optimal terhadap formasi tersebut, terbukti melalui penurunan signifikan terhadap tingkat pembengkakan dan dispersi *cutting shale*. Formulasi ini direkomendasikan untuk digunakan dalam kondisi formasi dengan masalah reaktif *shale* yang kompleks dan beragam.

.Kata kunci: *Brittle Index, Hot Rolled Dispertion Test*, Methylene Blue Test, Reaktif *Shale, X-Ray Diffraction*

ABSTRACT

DESIGN OF A HIGH PERFORMANCE WATER-BASED MUD TO OVERCOME REACTIVE SHALE PROBLEMS IN WELL "MR-04" FIELD "MA"

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The Mundu formation penetrated at Well MR-04 (1670–1690 ft) section 3, MA Field, exhibits a high degree of mineralogical complexity, characterized by the presence of nearly all types of clay minerals. Both smectite and kaolinite exceed 20%, while illite and chlorite are present in concentrations above 10%. Additionally, mixed-layer clays are identified in both irregular (13%) and regular (7%) structures. This combination presents significant challenges during drilling operations due to high hydration reactivity and varied rock mechanical behavior, including swelling, dispersion, and cracking in brittle shale.

This study aims to evaluate the formation's reactivity toward water-based mud systems using X-Ray Diffraction (XRD) and the Methylene Blue Test (MBT) to determine mineral composition and cation exchange characteristics. These results are further used to characterize the formation and estimate the Brittleness Index (BI), which indicates the potential for dispersion and mechanical failure.

Three High Performance Water-Based Mud (HPWBM) formulations were designed and tested through Clay Orinted Test again and Hot Rolled Dispersion Test to assess the effectiveness of various inhibitors. The test results indicate that Sample 3, containing 7% KCl, 0.5% PHPA, and 2% polyamine, provides the most effective protection against shale instability, significantly reducing both swelling and dispersion of cutting samples. This formulation is recommended for drilling in formations with complex and highly reactive shale conditions.

Keywords: Brittle Index, Hot Rolled Dispertion Test, *Methylene Blue Test, Reactive Shale, X-Ray Diffraction*