ABSTRAK

ANALISIS KONSENTRASI INHIBITOR BERBASIS *IMIDAZOLE* DAN VARIASI KETEBALAN *API 5L GRADE B* TERHADAP INTEGRITAS STRUKTUR MENGGUNAKAN *FINITE ELEMENT METHOD*

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Permasalahan utama pada baja karbon *API 5L Grade B* adalah ketahanan korosi yang rendah akibat keberadaan gas korosif seperti CO_2 dan H_2S. Penelitian ini bertujuan untuk mengevaluasi kinerja inhibitor berbasis *Imidazole* pada variasi konsentrasi 25 ppm, 50 ppm, dan 75 ppm, serta menganalisis pengaruh degradasi korosi terhadap integritas struktur pipa melalui simulasi *static structural* selama umur operasi 20 tahun dengan variasi ketebalan pipa yaitu *Schedule* 30, 40, dan 60. Pengujian laju korosi dilakukan menggunakan metode *immersion test* dan *potentiodynamic polarization* dengan media *produced water* BLM#21, serta penggunaan inhibitor S-9606 C. Hasil pengujian menunjukkan bahwa konsentrasi 75 ppm memberikan performa terbaik dengan laju korosi terendah sebesar 0,028 mm/*year* pada *immersion test* dan 0,15378 mm/*year* pada *potentiodynamic polarization*. Analisis FTIR mengkonfirmasi keberadaan gugus fungsi aktif C=N, N–H, serta rantai hidrokarbon panjang yang berperan dalam pembentukan lapisan protektif pada permukaan logam. Hasil simulasi *static structural* menunjukkan bahwa pipa *Schedule* 60 dengan inhibitor 75 ppm memiliki nilai *von Mises stress* terendah sebesar 190,89 MPa dan *safety factor* tertinggi sebesar 1,310 dibandingkan variasi lainnya. Hasil penelitian ini memberikan rekomendasi teknis bahwa kombinasi pemilihan ketebalan pipa *Schedule* 60 dan penggunaan inhibitor *Imidazole* konsentrasi 75 ppm secara tepat dapat meningkatkan integritas struktur dan menurunkan laju korosi

Kata Kunci : *API 5L Grade B*, Korosi, Inhibitor *Imidazole*, Adsorpsi

ABSTRACT

ANALYSIS OF THE EFFECT OF IMIDAZOLE-BASED INHIBITOR CONCENTRATION AND API 5L GRADE B THICKNESS VARIATION ON STRUCTURAL INTEGRITY USING FINITE ELEMENT METHOD

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The main issue with API 5L Grade B carbon steel is its low corrosion resistance due to the presence of corrosive gases such as CO_2 and H_2S. This study aims to evaluate the performance of an Imidazole-based inhibitor at concentration variations of 25 ppm, 50 ppm, and 75 ppm, as well as to analyze the effect of corrosion degradation on pipeline structural integrity through static structural simulations over a 20-year service life with pipe thickness variations of Schedule 30, 40, and 60. Corrosion rate testing was conducted using immersion tests and potentiodynamic polarization methods in BLM#21 produced water media, with the application of S-9606 C inhibitor. The results showed that the 75 ppm concentration provided the best performance, with the lowest corrosion rate of 0.028 mm/year in the immersion test and 0.15378 mm/year in the potentiodynamic polarization test. FTIR analysis confirmed the presence of active functional groups such as C=N, N–H, and long hydrocarbon chains, which contributed to the formation of a protective layer on the metal surface. The static structural simulation results indicated that the Schedule 60 pipe with 75 ppm inhibitor exhibited the lowest von Mises stress value of 190.89 MPa and the highest safety factor of 1.310 compared to the other variations. The findings of this study provide a technical recommendation that the proper combination of Schedule 60 pipe thickness selection and the use of a 75 ppm Imidazole inhibitor can improve structural integrity and reduce the corrosion rat

Keywords : API 5L Grade B, Corrosion, Imidazole Inhibitor, Adsorption