

ABSTRAK

STUDI PENGARUH SUHU PEMANASAN PADA PROSES PIROLISIS ASAP CAIR DARI TEMPURUNG KELAPA SEBAGAI INHIBITOR KERAK KALSIMUM KARBONAT (CaCO_3) MENGGUNAKAN METODE *UNSEEDED EXPERIMENT*

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Kerak kalsium karbonat (CaCO_3) merupakan permasalahan yang sering dijumpai pada sistem perpipaan industri karena dapat menurunkan efisiensi operasional secara signifikan. Penelitian ini bertujuan untuk mengkaji pengaruh suhu pirolisis terhadap komposisi senyawa kimia, kestabilan, dan efektivitas asap cair tempurung kelapa sebagai inhibitor kerak CaCO_3 .

Penelitian ini menggunakan metode *unseeded experiment* dengan variasi suhu pirolisis 300, 400, dan 500 °C. Konsentrasi inhibitor yang digunakan yaitu 5, 10, 15, dan 20 ppm, sedangkan konsentrasi larutan pertumbuhan CaCO_3 divariasikan pada 0,0005 M; 0,0010 M; 0,0020 M; dan 0,0030 M.

Hasil penelitian menunjukkan bahwa suhu pirolisis berpengaruh nyata terhadap kestabilan dan efektivitas inhibitor. Asap cair hasil pirolisis pada suhu 400 °C menunjukkan kestabilan tertinggi karena tidak mengalami pertumbuhan jamur selama periode pengamatan, sementara asap cair pada suhu 300 °C dan 500 °C mengalami kerusakan masing-masing pada hari ke-27 dan ke-10. Nilai efektivitas tertinggi diperoleh pada asap cair suhu pirolisis 400 °C dengan konsentrasi inhibitor 20 ppm pada larutan pertumbuhan 0,0005 M, yaitu sebesar 95,03%. Efektivitas inhibitor berbanding lurus dengan konsentrasi inhibitor dan berbanding terbalik dengan konsentrasi larutan pertumbuhan. Analisis menggunakan *Scanning Electron Microscope* (SEM) dan *X-Ray Diffraction* (XRD) menunjukkan adanya perubahan morfologi dan struktur kristal CaCO_3 setelah penambahan inhibitor, di mana kristal yang terbentuk lebih tersebar, berukuran lebih kecil, dan tidak seragam. Analisis *Particle Size Analyzer* (PSA) memperlihatkan penurunan ukuran partikel rata-rata kerak CaCO_3 dari 7.470 nm menjadi 4.413 nm, disertai penurunan nilai *polydispersity index* dari 0,496 menjadi 0,1428 setelah penambahan inhibitor.

Kata kunci: asap cair tempurung kelapa, pirolisis, inhibitor, kalsium karbonat, *unseeded experiment*

ABSTRACT

STUDY OF THE EFFECT OF HEATING TEMPERATURE IN THE PYROLYSIS PROCESS OF LIQUID SMOKE FROM COCONUT SHELL AS AN INHIBITOR OF CALCIUM CARBONATE (CaCO_3) SCALE USING THE *UNSEEDED EXPERIMENT* METHOD

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Calcium carbonate (CaCO_3) scale is a common problem encountered in industrial piping systems as it can significantly reduce operational efficiency. This study aimed to investigate the effect of pyrolysis temperature on the chemical composition, stability, and effectiveness of coconut shell liquid smoke as a CaCO_3 scale inhibitor. This study employed the *unseeded experiment* method with pyrolysis temperature variations of 300, 400, and 500 °C. The inhibitor concentrations used were 5, 10, 15, and 20 ppm, while the CaCO_3 growth solution concentrations were varied at 0.0005 M, 0.0010 M, 0.0020 M, and 0.0030 M. The results showed that pyrolysis temperature significantly affected the stability and effectiveness of the inhibitor. Liquid smoke produced at a pyrolysis temperature of 400 °C exhibited the highest stability, as no fungal growth was observed throughout the observation period, whereas liquid smoke at 300 °C and 500 °C deteriorated on day 27 and day 10, respectively. The highest inhibition efficiency was achieved by liquid smoke pyrolyzed at 400 °C with an inhibitor concentration of 20 ppm in a 0.0005 M growth solution, reaching 95.03%. Inhibitor effectiveness was directly proportional to inhibitor concentration and inversely proportional to the growth solution concentration. Analysis using *Scanning Electron Microscopy* (SEM) and *X-Ray Diffraction* (XRD) revealed changes in the morphology and crystal structure of CaCO_3 upon inhibitor addition, where the resulting crystals were more dispersed, smaller in size, and less uniform. *Particle Size Analyzer* (PSA) analysis showed a reduction in the average CaCO_3 particle size from 7.470 nm to 4.413 nm, accompanied by a decrease in the *polydispersity index* from 0.496 to 0.1428 following inhibitor addition.

Keywords: coconut shell liquid smoke, pyrolysis, inhibitor, calcium carbonate, *unseeded experiment*