

INTISARI

Pengenceran bahan bakar (*fuel dilution*) menurunkan viskositas oli mesin dan mempercepat kerusakan komponen. Penelitian ini bertujuan untuk menganalisis penyebab *fuel dilution* pada mesin Caterpillar C9 di PT Trakindo Utama BSD serta merumuskan tindakan perbaikan menggunakan kombinasi uji diagnostik, *Root Cause Analysis* (RCA), dan *Failure Mode and Effect Analysis* (FMEA). Data laboratorium *Scheduled Oil Sampling* (S.O.S) pada awalnya mengonfirmasi adanya kontaminasi solar yang signifikan dalam pelumas. Pengujian diagnostik melalui *Automated Cylinder Cutout Test* pada software *Caterpillar Electronic Technician* (CAT ET) menunjukkan bahwa Silinder No. 5 memiliki rata-rata *fuel delivery* terendah sebesar 32,95 mm³/stroke, dibandingkan silinder lainnya (33,06–34,05 mm³/stroke). Kendati demikian, fungsi solenoid elektronik dan atomisasi nozel pada Silinder No. 5 masih berada dalam batas toleransi operasi ECM. Pengujian fisik lanjutan melalui *Pressurize Test* dan *UV Dye Leak Test* mengonfirmasi adanya kebocoran statis pada *housing* Injektor No. 5, yang menyebabkan solar merembes langsung ke karter oli tanpa melalui proses pembakaran. Analisis RCA (Fishbone dan 5 Whys) mengidentifikasi kelelahan material (*material fatigue failure*) pada bodi injektor akibat akumulasi tekanan hidrolik HEUI secara berulang (*cyclic stress*) sebagai akar masalah utama. Berdasarkan matriks FMEA dan analisis Pareto 80/20, rekomendasi tindakan perbaikan meliputi penggantian Injektor No. 5, pembilasan (*flushing*) oli mesin, serta penerapan pemantauan tren S.O.S secara berkala untuk mencegah berulangnya kegagalan serupa.

Kata Kunci: *Fuel Dilution*, HEUI Injektor, Caterpillar C9, *Root Cause Analysis* (RCA), *Failure Mode and Effect Analysis* (FMEA), S.O.S.

ABSTRACT

Fuel dilution degrades engine oil viscosity and accelerates component failure. This study analyzes the cause of fuel dilution in a Caterpillar C9 engine at PT Trakindo Utama BSD and formulates corrective actions using diagnostic testing, Root Cause Analysis (RCA), and Failure Mode and Effect Analysis (FMEA). Scheduled Oil Sampling (S.O.S) laboratory data initially confirmed significant fuel contamination in the lubricant. Diagnostic testing via Caterpillar Electronic Technician (CAT ET) Automated Cylinder Cutout Test showed that Cylinder No. 5 had the lowest fuel delivery rate at 32.95 mm³/stroke, compared to other cylinders (33.06–34.05 mm³/stroke). However, the electronic solenoid and nozzle atomization on Cylinder No. 5 remained within normal ECM operating limits. Subsequent pressurize and UV dye leak tests confirmed a static housing leak on Injector No. 5, allowing unburned fuel to seep directly into the engine oil crankcase. RCA (Fishbone and 5 Whys) identified material fatigue failure in the injector body, caused by cyclic HEUI hydraulic pressure stress, as the primary root cause. Based on the FMEA matrix and Pareto 80/20 analysis, recommended actions include replacing Injector No. 5, flushing the engine oil, and implementing periodic S.O.S trend monitoring to prevent future failures.

Keywords: Fuel Dilution, HEU Injector, Caterpillar C9, Root Cause Analysis (RCA), Failure Mode and Effect Analysis (FMEA), S.O.S.

