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Performance and Emission Analysis of Mixed Plastic-Derived Pyrolysis Oil-Blended Diesel Fuel
Marcello Adhiguna, Prof. Ir. Harwin Saptoadi, MSE., Dr. Ing., IPM.; Dr. Ir. Akmal Irfan Majid, S.T., M.Eng.
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ABSTRACT

Increasing vehicular emissions have become a major environmental concern due to the growing number of vehicles and their extensive use across various industries. While the complete elimination of vehicle emissions is not currently feasible, various researches have been done to find ways to minimize the number of emissions produced by existing engines. The development of alternative fuels offers a potential approach in reducing the environmental impact of internal combustion engines by affecting the combustion process which in turn will affect the emission's behavior.

This study investigates the performance and emission characteristics of diesel fuel blended with mixed plastic pyrolysis oil at blending ratios of 75:25, 50:50, and 25:75, with B0 diesel fuel serving as the reference fuel. The performance of the engine was evaluated in terms of brake power (BP), brake thermal efficiency (BTE), and brake specific fuel consumption (BSFC), while exhaust emissions were assessed through measurements of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), and opacity.

The experimental results showed that the blended fuels produced BP values comparable to those of conventional diesel fuel. The BSFC showed slight improvements by consuming less fuel than reference fuel. Therefore, the BTE of the blends was found to be higher than that of conventional diesel fuel. In terms of emissions, the blends generally produced lower CO, HC, and opacity values than conventional diesel fuel, whereas NO_x emissions were higher. Among the tested fuel mixtures, the 50:50 diesel blended plastic pyrolysis oil blend demonstrated the most favorable balance between engine performance and emission characteristics.

The findings indicate that mixed plastic pyrolysis oil has the potential to be utilized as a partial substitute for diesel fuel, offering comparable engine performance while reducing several harmful exhaust emissions.

Keywords: Mixed plastic pyrolysis oil, diesel fuel blend, diesel engine performance, brake thermal efficiency, exhaust emissions.

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INTISARI

Seiring dengan meningkatnya jumlah kendaraan bermotor dan penggunaannya di berbagai sektor industri, emisi gas buang kendaraan menjadi salah satu permasalahan lingkungan yang semakin sulit ditangani. Berbagai penelitian telah dilakukan untuk mengurangi emisi yang dihasilkan oleh kendaraan yang masih menggunakan bahan bakar fosil. Salah satu pendekatan yang banyak dikembangkan adalah penggunaan bahan bakar alternatif yang mampu mengurangi dampak lingkungan melalui perubahan karakteristik pembakaran, sehingga memengaruhi performa mesin dan emisi gas buang yang dihasilkan.

Penelitian ini bertujuan untuk mengevaluasi performa dan karakteristik emisi bahan bakar diesel yang dicampur dengan minyak pirolisis plastik campuran pada rasio 75:25, 50:50, dan 25:75, dengan bahan bakar diesel B0 sebagai bahan bakar acuan. Performa mesin dievaluasi berdasarkan *brake power* (BP), *brake thermal efficiency* (BTE), dan *brake specific fuel consumption* (BSFC). Karakteristik emisi dianalisis melalui pengukuran kadar *carbon monoxide* (CO), *hydrocarbons* (HC), dan *nitrogen oxides* (NO_x), serta opasitas gas buang.

Hasil penelitian menunjukkan bahwa BP yang dihasilkan oleh seluruh bahan bakar campuran sebanding dengan bahan bakar diesel B0. Nilai BSFC bahan bakar campuran cenderung lebih tinggi dibandingkan bahan bakar diesel konvensional, sedangkan nilai BTE menunjukkan peningkatan dibandingkan bahan bakar acuan. Dari sisi emisi, bahan bakar campuran menghasilkan emisi CO, HC, dan opasitas gas buang yang lebih rendah dibandingkan bahan bakar diesel konvensional. Namun demikian, emisi NOx yang dihasilkan lebih tinggi dibandingkan bahan bakar acuan. Di antara seluruh variasi campuran yang diuji, campuran dengan rasio 50:50 menunjukkan keseimbangan terbaik antara performa mesin dan karakteristik emisi.

Berdasarkan hasil penelitian ini, campuran minyak pirolisis plastik dengan bahan bakar diesel memiliki potensi sebagai bahan bakar alternatif yang mampu mempertahankan performa mesin sekaligus mengurangi beberapa emisi berbahaya yang dihasilkan oleh mesin diesel.

Kata kunci: minyak pirolisis plastik campuran, campuran bahan bakar diesel, performa mesin diesel, *brake thermal efficiency*, emisi gas buang.