NOISE AND VIBRATION ANALYSIS IN THE DIESEL ENGINE BASED ON BIODIESEL USAGE

MUHAMMAD ZIKRI BIN JAPRI

MASTER OF SCIENCE

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

(Supervisor's Signature)

Full Name : DR. HJ. MOHD SHAHRIR BIN MOHD SANI

Position : ASSOCIATE PROFESSOR

Date : 5/2/2022

(Co-supervisor's Signature)

Full Name : DR. ABDUL ADAM BIN ABDULLAH

Position : ASSOCIATE PROFESSOR

Date : 5/2/2022

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

(Student's Signature)

Full Name : MUHAMMAD ZIKRI BIN JAPRI

ID Number : MMV18002

Date : 5/2/2022

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MUHAMMAD ZIKRI BIN JAPRI

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ABSTRAK

Penggunaan biodiesel telah menjadi salah satu tarikan utama untuk menggantikan bahan bakar fosil yang selari dengan pelaksanaan teknologi hijau yang menekankan produk agar lebih mesra alam. Walaupun begitu, kewujudan pelbagai jenis biodiesel tidak semestinya sesuai meskipun pengubahsuaian utama tidak diperlukan pada enjin. Oleh itu, kajian ini telah dilakukan dengan analisis eksperimen untuk mengkaji hubungkait antara kadar kebisingan dan getaran dengan biodiesel sebagai bahan bakar pengganti di dalam enjin diesel satu silinder dengan pancitan terus yang dihasilkan dari pelbagai campuran biodiesel, kelajuan dan beban enjin . Punca kuasa dua (RMS) halaju, pemetaan keamatan bunyi (SIM) bersama dengan analisis tahap tekanan bunyi (SPL) digunakan untuk menunjukkan keberkesanan biodiesel dalam pengurangan tahap kebisingan dan getaran yang dihasilkan oleh enjin diesel. D100, B5, B10 dan B20 dari metil ester kelapa sawit (POME) telah digunakan untuk mengoperasikan enjin dengan 1200 hingga 2160 putaran per minit (RPM) dengan penerapan beban bervariasi dari 0 hingga 28 Nm. Pengambilan data getaran telah dilakukan dengan menggunakan satu paksi meter pecut sementara untuk data pencemaran bunyi, sepasang mikrofon ½ inci digunakan. Dalam aspek getaran, penggunaan campuran B20 didapati berada di tahap terendah dalam hampir semua keadaan yang diuji kerana nombor cetana dan kandungan oksigen yang lebih tinggi sementara penggunaan B5 dan B10 cenderung untuk meningkatkan tahap getaran berbanding D100. Juga dapat diperhatikan bahawa kenaikan beban enjin telah ketara meningkatkan tahap getaran manakala peningkatan kelajuan enjin tidak mempengaruhi getaran menjadi lebih tinggi kerana pembakaran tidak lengkap terjadi yang menyebabkan penurunan kadar kenaikan tekanan sehingga berkurang tahap getaran dalam kelajuan enjin yang lebih tinggi. Dalam analisis pencemaran bunyi, persaingan antara B20 dan D100 dapat dilihat apabila dalam kelajuan enjin yang rendah, tahap kebisingan terendah diperoleh oleh B20 sementara dalam kelajuan enjin yang tinggi, yang terendah diperoleh oleh D100. Di samping itu, lokasi tertinggi sumber kebisingan dicatatkan di kepala silinder, komponen pautan engkol, penyinar, roda tenaga dan dinamometer. Dapat disimpulkan, penggunaan POME sebagai biodiesel dapat menghasilkan getaran yang lebih rendah dan telah mengurangkan sebahagian kebisingan yang dihasilkan oleh enjin. Juga, parameter yang paling ketara yang dapat menyumbang kepada penurunan kadar kebisingan adalah nisbah campuran diikuti oleh beban dan kelajuan enjin.

ABSTRACT

Utilization of biodiesel has become one of the major interests in substituting fossil fuel parallel to the implementation of green technology which emphasizes the products to be more environmental-friendly. Nevertheless, despite having various kinds of biodiesel, this does not ensure suitability since the usage could improve or aggravate the engine due to higher combustion effects that further influence the higher level of engine noise and vibration, albeit major modification on the engine is not required. Therefore, this study had been conducted by experimental analysis to investigate the relation of noise and vibration level with biodiesel as a substitution fuel in the single cylinder, direct-injection diesel engine produced from various biodiesel blends, engine speed and engine load. The Root Mean Square (RMS) velocity, Sound Intensity Mapping (SIM) together with Sound Power Level (SPL) analyses were used to indicate the effectiveness of biodiesel in the attenuation of the noise and vibration level generated by the diesel engine. D100, B5, B10 and B20 of Palm Oil Methyl Ester (POME) had been utilized to operate the engine by 1200 to 2160 RPM with the application of engine load varied from 0 to 28 Nm. The measurement of the vibration data was done using the uniaxial accelerometer, while for the noise emission data, a pair of ½ inch of microphones were used. In the vibration aspect, the usage of the B20 blend was found to be the lowest level in almost all conditions tested due to the higher cetane number and oxygen content while the B5 and B10 usage tend to increase the vibration level compared to D100. It also can be noticed that the increment of engine load significantly increases the vibration level while increasing the engine speed does not influence the vibration to be higher since an incomplete combustion occurred which led to a reduction in the rate of pressure rise, thus reducing the vibration level in higher engine speed. In the noise emission analysis, the competitiveness between B20 and D100 could be seen in the low engine speed, where the lowest noise level was obtained by B20 while in the high engine speed, the lowest was obtained by D100. On top of that, the highest location of noise source was recorded at the cylinder head, crank-link components, radiator, flywheel and dynamometer. As can be concluded, the usage of POME as a biodiesel could be owed to the lower vibration and partially reducing the noise generated by the engine. Also, the most significant parameter that could contribute to the decrement of the level was the blend ratio followed by the engine load and engine speed.

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