CHARACTERIZATION OF LUBRICATING GREASE FORMULATED FROM WASTE ENGINE OIL

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ABSTRAK

Penjanaan dan pelupusan minyak sisa meningkat dari tahun ke tahun menyebabkan masalah persekitaran serta kekurangan sumber semula jadi. Antara langkah terbaik untuk mengatasi isu ini adalah dengan menukar minyak sisa menjadi produk seperti minyak pelincir. Penyelidikan ini bertujuan untuk merumuskan gris dari WEO kerana tiada kajian yang dilakukan oleh penyelidikan terdahulu mengenai penghasilan gris dengan menggunakan campuran *waste engine oil (WEO)* dari pelbagai jenis. Rawatan minyak untuk menghilangkan bahan cemar dan pencirian (sifat bendalir, tahap komponen dan analisis komponen) juga dilakukan untuk memastikan bahawa *WEO* dapat digunakan sebagai minyak asas minyak. Proses rawatan *WEO* merangkumi pemendapan, penapisan dan pemanasan dapat menghilangkan bahan cemar sehingga tahap dan kelembapan yang dibenarkan menjadikannya sesuai untuk dijadikan minyak asas dalam perumusan gris. Analisis mengenai formulasi natrium dan *fumed silica* (FS) gris (SG_{96}, SG_{94}, SG_{92}, SG_{90}, SG_{88}, FG_{85}, FG_{84}, FG_{83}, FG_{82}, FG_{81} & FG_{80}) menunjukkan bahawa kandungan WEO dalam gris berkadar sonsang dengan konsistensi gris tetapi berkadar terus dengan *oil bleeding* dan *oil separation* gris. SG_{96} dan FG_{85} mempunyai nombor konsistensi terendah iaitu NLGI 0 dan SG_{88} dan FG_{80} mempunyai nombor konsistensi tertinggi iaitu NLGI 4-5. *Oil bleeding* dari gris menunjukkan ianya berada dalam had kecuali FG_{84} pada suhu bilik iaitu -16.48%. Ujian *oil separation* menunjukkan bahawa semua pemisahan minyak gris berada dalam had kecuali FG_{85} yang memiliki 5.75%. Gris juga menunjukkan standard karat kelas 1 semasa diuji dengan jalur tembaga. Berdasarkan beberapa syarat, SG_{94} dan FSG_{83} dipilih sebagai gris yang memenuhi kriteria yang diperlukan dan perbandingan dengan gris dari industri menunjukkan bahawa sifat gris yang dipilih adalah setanding dengan sifat gris industri. Gris yang dipilih dengan penambahan aditif (Polytetrafluoroethylene (PTFE) dan grafit) menunjukkan bahawa sifat gris tidak berubah kecuali untuk fungsi tambahan aditif. Perubahan hanya dapat dilihat pada spektrum *Fourier-transform infrared spectroscopy* (FTIR) gris natrium apabila terdapat puncak di kawasan cap jari (<600 cm^{-1}) gris. Walau bagaimanapun, kehadiran aditif banyak mempengaruhi sifat tribologi gris di mana natrium gris mempunyai sifat anti-haus yang baik berbanding dengan gris FS. Gris natrium tanpa bahan tambahan juga menunjukkan sifat anti-haus lebih baik berbanding dengan gris natrium dengan aditif menjadikan penambahan aditif dalam gris natrium menjadi tidak relevan. Ini berbeza dengan gris FS di mana penambahan aditif menunjukkan bahawa sifat anti-haus dari gris bertambah baik. Walau bagaimanapun, sifat anti-haus kedua-dua gris masih lagi berada dalam standard industri. Sebagai kesimpulan, sifat gris yang dihasilkan dari WEO adalah baik dan setanding dengan standard industri, dan penambahan aditif dalam perumusan gris mempengaruhi sifat tribologi gris. Bagi kajian pada masa hadapan, sumber WEO didapatkan dari sumber yg pelbagai dan berbeza.

ABSTRACT

The generation and disposal of waste oil increase year by year are causing environmental problems as well as depletion of natural resources. One of the ways to tackle this problem is by converting waste oil into a product such as lubricating grease. This research aimed to formulate lubricating grease from waste engine oil (WEO) as no study done on producing grease by using a mixture of WEO from a different type. Oil treatment to remove contamination and characterisation (fluid properties, components level and component analysis) also carried out in order to make sure that WEO can be used as the grease base oil. The treatment process of WEO include sedimentation, filtration, and heating is able to remove the contaminants until allowable level and moisture, making it is suitable to be base oil in grease formulating. Analysis on formulated sodium grease (SG) and fumed silica grease (FSG) (SG_{96}, SG_{94}, SG_{92}, SG_{90}, SG_{88}, FG_{85}, FG_{84}, FG_{83}, FG_{82}, FG_{81} & FG_{80}) showed that WEO content in grease is inversely proportional to grease consistency but directly proportional to oil bleeding and separation of the grease. SG_{96} and FG_{85} have the lowest consistency number which is NLGI 0 and SG_{88} and FG_{80} have the highest consistency number which is NLGI 4-5. The oil bleeding of the greases are within the limit except for FG_{84} in room temperature which is -16.48%. Oil separation test showed that all of the greases oil separation is within the limit except for FG_{85} which have 5.75%. the greases also showed a corrosion standard of class 1 when tested with copper strip. Based on a few requirement, SG_{94} and FSG_{83} are selected as a grease that fulfilled the required criteria and comparison with industrial grease showed that the selected grease properties is comparable to industrial grease properties. The selected grease with the addition of additives (Polytetrafluoroethylene (PTFE) and graphite) showed that grease properties do not change except for intended additives used characteristic. The changes can be seen only on Fourier-transform infrared spectroscopy (FTIR) spectrum of sodium grease when there a presence of peak in fingerprint region ($<600\ cm^{-1}$) of the grease. However, the presence of additives heavily influenced the tribological properties of the grease where sodium grease have a good anti-wear property compared to FS grease. Sodium grease without additives also showed a better antiwear properties compared to sodium grease with additives making the addition of additives in sodium grease to be irrelevance. This is different from FS grease where addition of additives showed that the anti-wear properties of the grease improved. However, the anti-wear properties of both greases is still within the industrial standard. As a conclusion, the properties of greases produced from WEO is good and comparable to industrial standard, and addition of additives in grease formulation effect the tribological properties of the grease. It is recommended the collection of WEO is vary from different sources for future study.

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