

# Pengaruh penambahan aditif pemodifikasi gesekan jenis molibdenum disulfida terhadap karakteristik gesekan dan perlindungan keausan minyak lumas dasar HVI 60 = The influence of molybdenum disulfide friction modifier fm addition on the friction and wear characteristic of HVI 60 base oil

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## Abstrak

### [<b>ABSTRAK</b><br>

Tesis ini membahas pengaruh penambahan aditif pemodifikasi gesekan serbuk MoS<sub>2</sub> ukuran 1 5 m dengan jumlah mulai 0 05 0 1 0 5 1 dan 2 berat dan ukuran 90 nm sebesar 0 05 0 1 0 5 pada minyak lumas dasar mineral HVI 60 terhadap karakteristik gesekan dan perlindungan keausannya Aditif ukuran 90 nm dan minyak lumas dasar dicampur dan diaduk menggunakan magnetik stirrer selama enam puluh menit pada suhu 50oC setelah itu dimasukkan ke dalam ultrasonic homogenizer selama satu jam sedangkan aditif ukuran 1 5 m pada suhu 75oC tanpa menggunakan ultrasonic homogenizer Campuran yang dihasilkan diuji karakteristik gesekan dan perlindungan keausannya menggunakan mesin uji four ball dan mesin uji SRV Analisis dilakukan pada material bola uji menggunakan optical emission spectroscopy OES goresan permukaan bola uji menggunakan scanning electron microscope SEM dan minyak lumas sisa pengujian dengan alat uji rotating disk electrode RDE Hasil penelitian menunjukkan bahwa penambahan aditif meningkatkan perlindungan keausan dengan dosis optimal sebesar 0 1 berat dengan rincian ukuran 1 5 m perbaikannya sebesar 23 dan ukuran 90 nm sebesar 11 Pengamatan permukaan goresan menunjukkan mekanisme keausan terjadi secara adesif dan abrasif Data yang diperoleh dari penelitian ini bisa digunakan sebagai dasar dalam pembuatan minyak lumas untuk aplikasi tertentu dengan mutu yang lebih baik

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### <b>ABSTRACT</b><br>

This thesis discusses the influence of MoS<sub>2</sub> friction modifier FM addition in the form of powder with two different mesh sizes i e 90 nm and 1 5 um on the friction and wear characteristic of HVI 60 base oil The variation of MoS<sub>2</sub> were 0 05 0 1 0 5 weight whereas MoS<sub>2</sub> 1 5 um were 0 05 0 1 0 5 1 and 2 weight MoS<sub>2</sub> additive 90 nm was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 50oC and homogenized in ultrasonic homogenizer for 1 hour For the MoS<sub>2</sub> 1 5 um the additive was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 75oC without using ultrasonic homogenizer Friction and wear characteristic of these mixtures were tested using four ball and SRV test rig Ball specimen surfaces were analyzed by using optical emission spectroscopy OES the wear scars were analyzed by using scanning electron microscope SEM while used mixtures from the test were analyzed by using rotating disk electrode RDE The results of the tests showed that the addition of 0 1 weight MoS<sub>2</sub> additive both in 90 nm and 1 5 um resulted in an optimum increase in friction and wear characteristic of 23 and 11 respectively Observation on the wear scar showed that adhesive and abrasive wear mechanism were involved in the wear process The results of this research could be applied in production of lubricating oils for certain applications to improve their quality ;This thesis discusses the influence of MoS<sub>2</sub> friction modifier FM addition in the form of powder with two different mesh sizes i e 90 nm and 1 5 um on the friction and wear characteristic of HVI 60

base oil The variation of MoS<sub>2</sub> were 0.05, 0.1, 0.5 weight whereas MoS<sub>2</sub> 1.5  $\mu$ m were 0.05, 0.1, 0.5, 1 and 2 weight MoS<sub>2</sub> additive 90 nm was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 50°C and homogenized in ultrasonic homogenizer for 1 hour For the MoS<sub>2</sub> 1.5  $\mu$ m the additive was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 75°C without using ultrasonic homogenizer Friction and wear characteristic of these mixtures were tested using four ball and SRV test rig Ball specimen surfaces were analyzed by using optical emission spectroscopy OES the wear scars were analyzed by using scanning electron microscope SEM while used mixtures from the test were analyzed by using rotating disk electrode RDE The results of the tests showed that the addition of 0.1 weight MoS<sub>2</sub> additive both in 90 nm and 1.5  $\mu$ m resulted in an optimum increase in friction and wear characteristic of 23 and 11 respectively Observation on the wear scar showed that adhesive and abrasive wear mechanism were involved in the wear process The results of this research could be applied in production of lubricating oils for certain applications to improve their quality ;This thesis discusses the influence of MoS<sub>2</sub> friction modifier FM addition in the form of powder with two different mesh sizes i.e 90 nm and 1.5  $\mu$ m on the friction and wear characteristic of HVI 60 base oil The variation of MoS<sub>2</sub> were 0.05, 0.1, 0.5 weight whereas MoS<sub>2</sub> 1.5  $\mu$ m were 0.05, 0.1, 0.5, 1 and 2 weight MoS<sub>2</sub> additive 90 nm was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 50°C and homogenized in ultrasonic homogenizer for 1 hour For the MoS<sub>2</sub> 1.5  $\mu$ m the additive was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 75°C without using ultrasonic homogenizer Friction and wear characteristic of these mixtures were tested using four ball and SRV test rig Ball specimen surfaces were analyzed by using optical emission spectroscopy OES the wear scars were analyzed by using scanning electron microscope SEM while used mixtures from the test were analyzed by using rotating disk electrode RDE The results of the tests showed that the addition of 0.1 weight MoS<sub>2</sub> additive both in 90 nm and 1.5  $\mu$ m resulted in an optimum increase in friction and wear characteristic of 23 and 11 respectively Observation on the wear scar showed that adhesive and abrasive wear mechanism were involved in the wear process The results of this research could be applied in production of lubricating oils for certain applications to improve their quality ;This thesis discusses the influence of MoS<sub>2</sub> friction modifier FM addition in the form of powder with two different mesh sizes i.e 90 nm and 1.5  $\mu$ m on the friction and wear characteristic of HVI 60 base oil The variation of MoS<sub>2</sub> were 0.05, 0.1, 0.5 weight whereas MoS<sub>2</sub> 1.5  $\mu$ m were 0.05, 0.1, 0.5, 1 and 2 weight MoS<sub>2</sub> additive 90 nm was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 50°C and homogenized in ultrasonic

homogenizer for 1 hour For the MoS<sub>2</sub> 1.5 µm the additive was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 75°C without using ultrasonic homogenizer Friction and wear characteristic of these mixtures were tested using four ball and SRV test rig Ball specimen surfaces were analyzed by using optical emission spectroscopy OES the wear scars were analyzed by using scanning electron microscope SEM while used mixtures from the test were analyzed by using rotating disk electrode RDE The results of the tests showed that the addition of 0.1 weight MoS<sub>2</sub> additive both in 90 nm and 1.5 µm resulted in an optimum increase in friction and wear characteristic of 23 and 11 respectively Observation on the wear scar showed that adhesive and abrasive wear mechanism were involved in the wear process The results of this research could be applied in production of lubricating oils for certain applications to improve their quality , This thesis discusses the influence of MoS<sub>2</sub> friction modifier FM addition in the form of powder with two different mesh sizes i.e 90 nm and 1.5 µm on the friction and wear characteristic of HVI 60 base oil The variation of MoS<sub>2</sub> were 0.05 0.1 0.5 weight whereas MoS<sub>2</sub> 1.5 µm were 0.05 0.1 0.5 1 and 2 weight MoS<sub>2</sub> additive 90 nm was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 50°C and homogenized in ultrasonic homogenizer for 1 hour For the MoS<sub>2</sub> 1.5 µm the additive was mixed with base oil and stirred with magnetic stirrer for 60 minutes at 75°C without using ultrasonic homogenizer Friction and wear characteristic of these mixtures were tested using four ball and SRV test rig Ball specimen surfaces were analyzed by using optical emission spectroscopy OES the wear scars were analyzed by using scanning electron microscope SEM while used mixtures from the test were analyzed by using rotating disk electrode RDE The results of the tests showed that the addition of 0.1 weight MoS<sub>2</sub> additive both in 90 nm and 1.5 µm resulted in an optimum increase in friction and wear characteristic of 23 and 11 respectively Observation on the wear scar showed that adhesive and abrasive wear mechanism were involved in the wear process The results of this research could be applied in production of lubricating oils for certain applications to improve their quality ]