NOVEL SYNTHESIS OF NANOLUBRICANT BY ARC DISCHARGE PROCESS

By

Hesham Mohamed Mohamed El-Sherif Hassan

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Mechanical Design and Production Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

Novel Synthesis of Nanolubricant by Arc Discharge Process

Key Words:
Arc Discharge, Carbon Nanotubes, Carbon Blacks, Paraffin Oil, Nanolubricant.

Summary:

Recently, nanoparticles are used as additives to improve the tribological behavior of lubricating oil. This study is basically concerned with studying the tribological behavior of lubricated contents when introducing nano scale additive of carbon particles to lubricating oils.

A test apparatus was developed to synthesis carbon nanomaterials by arc discharge between two pure graphite electrodes in liquid medium of deionized water or paraffin oil. Also a microcontroller circuit was devised and attached to apparatus in order to maintain the arc with continuous and safe operation.

Carbon Nanotubes (CNTs) was produced by arc discharge process from the anode material by using deionized water as discharge medium. It was found that the efficiency of the arc process range between ~15% and ~35%. The CNTs were added to commercial oil from the local market. It was found that addition of 0.01% of CNTs into Mobil Oil (20W50) reduces the coefficient of friction by ~35%, and improves the wear scratch length and width with average ~18% and ~20% respectively at loads below normal load of 84 N.

Carbon Black (CB) was synthesized by arc discharge in Medical-Grade Paraffin Oil (MGPO) medium with 23.7 C.st. kinematic viscosity. The source of the Carbon Blacks was the paraffin oil medium itself. The yield rate was ~58 times greater than the total-yield rate in case of applying arc in deionized water medium. The as-prepared MGPO from the arc discharge was tested and results indicated to reduction in its kinematic viscosity at 40˚C by ~22%, increase in flash point by ~3%, reduction in coefficient of friction by ~29%, significant improvement in the wear scratch, and no effect on fire and pour points.

A set of experiments were conducted on an Industrial-Grade Paraffin Oil (IGPO) medium with 110 C.st. kinematic viscosity. Results from applying the arc discharge for 5 minutes indicates to decrease on the average oil kinematic viscosity at 40˚C by ~13.6%, decrease on the average coefficient of friction by ~7.4%, and no effect on the flash and pour points.

It may be contributed that nanolubricant can be produced directly by arc discharge process in liquid paraffin oil medium. The arc discharge in paraffin oil can be applied industrially as a new stage of arc discharge for introducing CB nanoparticles into the oil before the next stages of addition of other additives.

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Dedication

Dedicated to my beloved family …

Table of Contents