

**RE-REFINING OF USED LUBRICATING OIL
USING SOLVENT EXTRACTION AND
VACUUM DISTILLATION**

By

Eng. Mohamed Sayed Abdo Mohamed

**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
Chemical Engineering**

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Keywords:

Used oil, Re-refining Solvent extraction, butyl alcohol, isopropyl alcohol, Vacuum distillation, Experimental design, Optimization, Net profit.

Summary:

This thesis was objected to make a semi complete study about re-refining of used lubricating oil by solvent extraction, using butyl alcohol and isopropyl alcohol as solvents, followed by fractional vacuum distillation.

Experimental work was held in "Egyptian Petroleum Research Institute". Used lube oil which is the feed of experimental work is taken as a sample from "Suez Oil Processing Company".

The target of experimental work is to make treated lube oil specifications meet the European and Egyptian specifications of neutralize oil (treated used oil), and determine the optimum operating variables, then make calculation of factorial experimental design and corresponding net profit.

The results of experimental work revealed that: Treated oil with solvent extraction followed by vacuum distillation will meet Egyptian and European specs.



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Dedication

I dedicate my dissertation work to Prof. Dr. Hamdan's Soul,
A special feeling of gratitude to him whose words of
encouragement and push for tenacity ring in my ears, I will
always appreciate all he has done.

"May his soul rest in peace"

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Abbreviations

APC: Alex Petroleum Company.

ASTM: American Society for Testing and Materials.

CFR: Code of Federal Regulations.

DIFM: Do It For Me.

DIY: Do It Yourself.

DOE: Department Of Energy.

DWO: De-Waxed oil.

EP: Extreme pressure.

EPA: Environmental Protection Agency.

FDA: Food and Drugs Administration.

ICAT: International Association for Clean Technology.

KTI: Kinetics Technology International.

GCD: Gas Chromatography Distillation.

GNP: Gross National Product.

MEK: Methyl Ethyl Ketone.

MIBK: Methyl Isobutyl Ketone.

MIDOR: Middle East Oil Refining Company.

NAAQS: National Ambient Air Quality Standards.

NMP: N-Methyl-2-pyrrolidone.

PCB: Poly Chlorinated Bi-Phenyls.

PROP: Phillips' Re-Refined Oil Process.

RCRA: Resources Conservation and Recovery Act.

S.A.E: Society of Automotive Engineers.

S/F: Solvent to Feed Ratio.
TAN: Total Acid Number.
TBN: Total Base Number.
TCT: Thermal Clay Treatment.
TDA: Thermal De-Asphalting.
TFE: Thin Film Evaporator.
VDU: Vacuum Distillation unit.
VCFE: Vacuum Cyclone Flash Evaporator.
VI: Viscosity Index.
VPS: Vacuum pipe still.
VM: Viscosity Modifier.