IDENTIFICATION OF FUEL OIL ADULTERATION WITH USED LUBRICANT OIL

BY

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DECLARATION

The work described in this Thesis was carried out by me in the Department of Chemistry, University of Sri Jayawardenapura, Sri Lanka under the supervision of Mr. Nimal Rathnasiri Deputy Manager, Technical Services Laboratory, Ceylon Petroleum Co-operation and Dr. Champa D Jayaweera Senior Lecturer, Department of chemistry, University of Sri Jayawardenapura and a report on this has not been submitted in whole or in part to any University or any other institution for another Degree/Diploma.

Date: 05./07./2016

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Signature of the Candidate

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

1. Name and signature of the supervisor

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DEDICATION

For my supervisors, thank for your guidance and sharing knowledge with me.

For Lanka IOC PLC management and staff, Thank for giving laboratory to use for analyzing samples.

For Lecturers and staff department of chemistry University of Sri jayawardenapura, Thank for supporting in many ways.

For Lindle laboratory, Thanks for giving data and reports on time.

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Thanks to: Lanka IOC PLC management and staff for providing me the laboratory facilities to use the ED-XRF instrument equipment and chemicals, Lindle Laboratory management and staff for providing information and data essential to proceed with my research.

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LIST OF ABREVIATIONS

AAS	: Atomic Absorption Spectroscopy
Ca	: Calcium
CO	: Carbon Monoxide
CPC	: Ceylon Petroleum Cooperation
Cps	: Counts Per Second
Cu	: Copper
D_2	: Deuterium
DE	: Degree Of Freedom
ED-XRF	: Energy Dispersive X-Ray Fluorescence
FO	: Fuel Oil
IEC	: International Electrotechnical Commission
IOC	: Indian Oil Cooperation
ISO	: International Standard Organization
KeV	: Kilo Electron Volt
LB	: Lab Blend
Li	: Lithium
LOI	: Loss on Ignition
Lube	: Lubricant
Mg	: Magnesium
NIST	: National Institute of Standards and Technology
P	: Phosphorous
Pb	: Lead
PET	: Polyethylene Terephthalate
S	: Sulfur
SE	: Standard Error

Si	: Silicon
UL	: Used Lubricants
ZDDP	: zinc dialkyldithiophosphates
Zn	: Zinc

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ABSTRACT

This thesis seeks to identify fuel oil adulteration in Sri Lanka. Fuel oil can be adulterated by using waste lubricants, waste products and by-products. Adulterated fuel oil creates significant issues especially in the industries where fuel oil is being used for manufacturing and on their day to day functions. This research focuses to obtain details from fuel oil consumers about the quality of the fuel oil, which they have purchased from the suppliers and to discuss about the problems they have faced during usage.

Additives are used in the manufacturing of lubricants and these contain Zn, Ca and/or P. Hence used lubes contain Zn, Ca and/or P and can be determined by ED-XRF analysis. Reference fuel oil does not contain those elements. Presence of those elements in marketed fuel oil can be considered as adulterated fuel oil with used lubes. Suspected fuel oils were collected from Industries, Tankers and sale points. Reference fuel oil samples were collected from Ceylon Petroleum Corporation. Reference fuel oil was analyzed for elements Calcium, Zinc and Phosphorous using ED-XRF installed in Lanka IOC PLC Trincomalee and it was confirmed that Ca, Zn and P were not contained in pure fuel oil. Used lubricants were tested using the same ED-XRF method and it was found that those elements contained in some used lubricants oil samples. Marketed fuel oils were analyzed using the same instrument and method and determined the content of Ca, Zn and P. Presence of a significant level of element content in Fuel oil could be identified as adulterated fuel oil using waste lubricants.

Same selected fuel oil samples (10 numbers) were analyzed in an outside laboratory for the confirmation of the accuracy of the readings taken from ED-XRF. Lindel Industrial Laboratories Limited (ISO/IEC 17025 certified) laboratory was selected as outside laboratory and AAS test method was used to determine the content of Calcium and Zinc in fuel oil samples. Statistical analysis was used to compare the readings taken from ED-XRF and AAS. It was observed that 26 fuel oil samples out of 40 samples were adulterated with used lubricant.

Laboratory blends in certain percentages of reference fuel oil and used lubricant were used to get an idea about the adulterated percentages of used lubricant in fuel oil.