UNIVERSITI TEKNIKAL MALAYSIA MELAKA

OPTIMIZATION PERFORMANCE OF FIBER OPTIC SENSOR ON FULLY SYNTHETIC TEST OIL FOR ENGINE TRADITIONALLY PURPOSE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Electronic Engineering Technology

(Telecommunication) (Honours.)

By

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FACULTY OF ENGINEERING TECHNOLOGY

2016

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Optimization Performance of Fiber Optic Sensor Fully Synthetic Test Oil for Engine Traditionally Purpose**

SESI PENGAJIAN: **2016/17 Semester 1**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunication) (Hons). The member of the supervisory us as follow:

…….

(Aminah Binti Ahmad)

ABSTRAK

Pada dasarnya, Reka bentuk eksperimen (DOE) adalah teknik statistik yang digunakan dalam kawalan kualiti untuk merancang, menganalisis dan mentafsirkan set eksperimen bertujuan untuk membuat keputusan yang bijak tanpa menanggung kos yang tinggi dan memakan banyak masa. Masalah-masalah yang berlaku boleh dianalisis dan tindakan penambahbaikan yang boleh dilakukan dengan serta-merta. Terdapat banyak kelebihan menggunakan teknik DOE dan untuk contoh bilangan ujikaji perlu dilakukan boleh menentukan dan dinyatakan dengan jelas mengikut kaedah-kaedah yang terlibat dalam teknik ini seperti Factorial penuh, kaedah Taguchi, Factorial pecahan dan lain-lain. Antara pelbagai jenis DOE, reka bentuk ekperimen Factorial adalah kaedah yang saya akan mengunakan dalam kajian saya ini. Rekan bentuk factorial dirancang untuk mengkaji fungsi-fungsi bebas-langsung dan sambungan antara faktor-faktor yang mempengaruhi tindak balas. Melalui kaedah Reka-bentuk faktoran, saya mampu untuk menentukan faktor yang optimum yang akan menyumbang kepada penderia gentian optic minyak mineral dan mengurangkan perubahan melibatkan, Akhirnya, kita boleh mendapatkan keputusan yang lebih tepat dan lebih baik dengan mengulangi menggunakan beberapa jenis factorial. Oleh itu, untuk melaksanakan experimen kaedah Reka bentuk faktoran, kita akan dibantu oleh beberapa parameter terpilih dalam menjana output berdasarkan perubahan kombinasi faktor-faktor yang berlainan. Pengesan gentian optic minyak mineral dilakukan didalam makmal gentian optic di Universiti. Selepas mengumpul data yang diperlukan, kita akan dapat untuk menjanakan graf dan memerhati keluaran supaya kita boleh mempunyai kefahaman yang lebih jelas tentang kepentingan setiap factor yang digunakan bagi mendapat keluaran yang optimum

ABSTRACT

Basically, Design of Experiment (DOE) is a statistical technique used in quality control for planning, analysing and interpreting sets of experiments aimed at making wise decisions without incurring a high cost and consuming much time. The problems occurred can be analysed and an improvement action can be done immediately. There are a lot of advantages of using DOE technique and for example the number of experiments need to be carried out can be define and stated clearly according to the methods that involved in this technique such as Full Factorial, Fractional Factorial, Taguchi Method and etc. Amongst the various types of DOE which is Factorial Design of Experiment is one of the methods in which my research design will be focusing on. Factorial design is planned to study non-direct functions and connections between factors influencing reaction. Through the factorial design method, I am able to determine the optimum factor which will contribute most to the fiber optic mineral oil sensor and reduce the variation involve. Ultimately, we could obtain a more precise and better result by repeating using several type of factorial. Thus, in order to perform the factorial design of experiment method, we will be assisted by tabulated parameters in generating outputs based on the variation of different combinations of factors. The optical fiber mineral oil sensor experiment is carried out within the university compound. After collecting the data needed, we are able to plot graphs and observe the output so that we could have a clearer understanding of the significance of each factor that we used in order to get an optimum output.

DEDICATION

Specially dedicated to,

My beloved parents, family members, and friends for supports, encouragements, understanding, guiding, and all the favour. May Allah bless all of you.

ACKNOWLEDGEMENT

First and foremost, I would like to express my greatest gratitude to my project supervisor, Associate Mrs. Aminah Binti Ahmad, for all the great supervision, supports, advises and guidance that help me lots with my final year project. His valuable advice is really useful for me.

Besides, I wish to express my profound gratitude to Md Ashadi Bin Md Johari, the co-supervisor for my research for his good cooperation. He has allowed me to obtain the knowledge about fiber optic sensor and I've taken lots of advice from he. I will never forget his kindness.

I also wish to thank the Laboratory Technicians, En Izwan Bin Hamdan that help me lots in preparing the suitable equipment for conducting the test. They also help me lots while collecting sample in the field. With their help, my works become easier. Thanks to both of you!

Not forget to thanks all of the postgraduate students for their help, cares and advice who have given me useful guidance on writing the thesis.

For my parents, you are the best "things" that I have. I don't know what is the best word to describe your patience, love and cares towards me. Thanks for your moral support and encouragement.

For all my friends, thank you very much for helping me to finish this project especially to Mohd Shaiful Azri bin Nus and Muhammad Nur Faidhi bin Mahfor that always accompanied me to the laboratory early in the morning in order to finish the test.

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LIST OF SYMBOL AND ABREVIATION

DOE	=	Design of Experiment
OFAT	=	One Factor at a Time Method
TQM	=	Total Quality Management
TPM	=	Target Performance Measure
NPM	=	Noise Performance Measure
LED	=	Light Emitting Diode
FFD	=	Full Factorial Design
MMF	=	Multi-Mode Strands
SMF	=	Single-Mode Strands
PCS	=	Plastic-Clad Silica
ASE	=	Amplified Spontaneous Emission
OSA	=	Optical Spectrum Analyzer
ANOVA	=	Analysis of Variance
LRIS	=	Liquid Refractive Index Sensor
SPR	=	Surface Plasmon Reverberation
dB	=	Decibel
nm	=	Nanometer

CHAPTER 1
INTRODUCTION

1.1 Introduction

This chapter is covered some topics. There are many lubricant oil can be used of engine oil such as fully synthetic oil, semi synthetic oil and mineral oil. This project focus on the fully synthetic oil that need to be solved during experiment by using detection sensor of fiber optic. The project explain about how the study was conducted included the background of project's title, the objective, Problem statement faced of this project, work scopes, project significant and finally project's summary.

1.2 Project Background

fiber optic basically glass piece adapt as thin as human hair used for telecommunication. This piece deliver digital signal with light. Although fact that this link made of glass, they are mild and not soft. In Telephone transmission method communication used fiber optic cable. fiber optic dispatch power in the form of pulsating light. This technology is equal to coaxial cable, except that fiber optics can manage tens of thousands simultaneous conversations. In fiber optic, it can be used for medical. fibre optic that is very suitable for medical use. They could be done in very thin, flexible piece to be entered into blood vessel, lungs, and hollow parts another body. fibre optic used in a few instruments which enables doctor to see internal part of body without have to do operation. Because fibre optics basically is passive, fiber optic sensing system mechanical component, it contains not part that move or electric circuit and is clear something immune towards all electric form of disturbance. optic piece can be used as censor to measure pressure, temperature, weight and other quantities by

changing fibre so that quantity that want to measure by modulated intensity, phase, polarization, wavelength or transit light time in fiber. Sensor that different light power is that simplest, because only one basic resources and indicator required

lubricant oil used to increase perfomance vehicle.The performance engine synthetic oil usually durable especially in terms of pumpability low temperature and temperature that are high stability.These feature can assisted towards reduce thirsty engine, fuel economic potential and long engine life . Lubricant main purpose is to look after surface move apart from, so that friction and destruction resulting material reduced. Process reduce friction between move surfaces.The Function Lubricants is it reduces wear and tear surface by avoiding metal straight to metal acquaintance between surface rub, by introducing lubricant between two grounds, it reduces metal expansion because heat friction and material destruction, it acts as metal refrigerant because heat transfer media, it bypasses unsmooth's relative movement, it reduces maintenance cost and it also reduces lost power in internal combustion engine.Therefore,many vehicle user only depends on the date and notified by the mechanic.Due to that,Fiber optic sensor will be developed to detect concentration of fully synthetic oil inside the engine.Hence,in this way can help users easily and not only depend on the mechanic suggestion.There are many lubricant oil in the market such as fully synthetic oil,semi synthetic oil and mineral oil which is can increase the highest levels of performance of engine in vehicle and as an important substance for many modern engines.Each lubricant oil concentration is have own result of the concentration. Lubricant good oil features is boiling point highly, freezing point that is low, viscosity that is sufficient to like clockwork in service, resistance that is high to oxidation and heat, property not erode and stability to decomposition in operation temperature. Furthermore, design of experiment will be used to analyze the optimum concentration of this oil.

1.3 Problems Statement

Many vehicle users have a problem to determine where the concentration of oil that can be adopted if do not have any better sign.They often depends on the date notified by the mechanic.For example, there are a lot of lubricant oil that can be used of engine oil is mineral oil, semi synthetic oil and fully synthetic oil.So this project use for fully synthetic oil to conduct of this research.Therefore it can be used for highest levels of performance and an important substance for many modern engines. Moreover, user do not know the condition of lubrication oil in engine Is good or bad. Other than that, to become again problem of this project can fiber optic become as a sensor to detect lubricant oil? So, one of fiber optic senser could be developed to detect the performance of lubricant oil which is used according to the levels of energy whether it is good, less good and very concentrated.Due to that,the lubricant oil should be changed every few kilometers away.Each lubricant oil concentration is have own result of the concentration.Furthermore,with the fiber optic sensor can help users to solve problems that depend only on the date and notified by mechanic. Then, with a sample of fully synthetic oil experiment, experimental data can be applied as an indicator developed by fiber optic sensor.The lubricant engine oil has three type of engine oil is mineral oil, semi synthetic oil and fully synthetic oil. Engine oil is very important material to allow the engine to function more smoothly.So, one fiber optic sensor was developed to detect the thickness fully synthetic oil. By developing of this fiber optic sensor, it can be applied inside the engine to easy vehicle user.

1.4 Project Objectives

The step to make this project success related in study of Fiber Optic Sensor which are have three the main of project objectives. The objectives of this project are:

i. To study Fiber Optic Sensor(FOS)
ii. To develop Fiber Optic Sensor to detect the condition in fully synthetic oil
iii. To analyze performance of Fiber Optic Sensor using design of experiment(DOE)

1.5 Project Scope

In order to complete the objective of the project, the scope have been listed which is related of the objective project. In BDP 1, study about project research on the concept of fiber optic sensor and need to study about the lubricant oil to be use as a parameter of the experiment. Besides literature review and methodology has been included which more related about the project research. Next, for PSM 2 will focus on experiment result, discussion on how project is carried out, analyze data and conclusion.

The scope of work in this project are given:

1. Understanding of fiber optic sensor
2. Fiber optic design to be used as a sensor.
3. Understanding the effects of the use of fully synthetic oil on fiber optic
4. Obtain the optimization for FOS in lubrication oil using Design of experiment (DOE)
5. The result can be analyzed and studied.

1.6 Summary

In this chapter briefly describes the introduction of projects to be carried out. Through this project, the background of the research, objective, problem statement and project scope are mentioned. In the background of the research briefly explain about lubricant oil, fiber optic and design of experiment. Besides, for the problem statement is a situation to be resolved in order to make it easier for individuals to pass up a job. The project scope tells the scope that need to be done that related with the objective project that need to be achieved.

CHAPTER 2.
LITERATURE REVIEW

2.1 INTRODUCTION

This chapter is about literature review that is related to this final year project. This part will explain about understanding on the fibre optic sensor, technique used in fibre optic sensor, design of the fibre optic sensor for lubricant oil concentration and optimization and design of experiment.

2.2 Fiber optic

2.2.1 Basic Fiber Optic Communication System

Fiber optic is medium to bring information start from another point future as light. Not at all like delivery copper type, fibre optic not electric in nature. A fibre optic groundwork framework consist of transmitter which vary from electrical signal to light signal, fibre optic link which lit, and recipient which receive light signal and change on him again to electrical signal. (Choi & Ph, 2014)

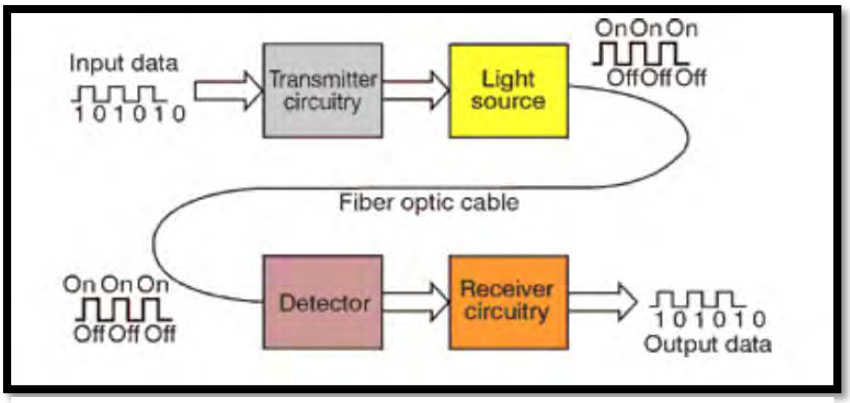

Figure 2.1 Basic fiber optic communication system

In the case to understand how fiber optic applications work, it is essential to comprehend the segments of a fiber optic connection. There are four fundamental parts in a fiber optic connection (Awad, 2012)

- Optical Transmitter
- Optical Fiber
- Connectors
- Optical Receive

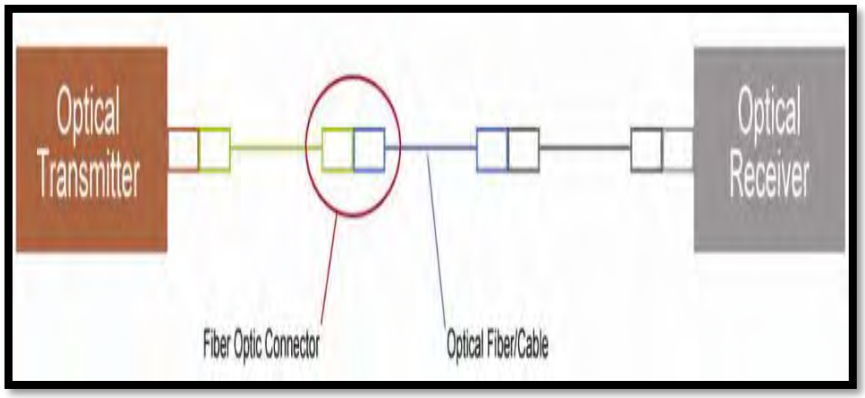

Figure 2.2: Simple Fiber Optic Link

2.2.2 Basic Fiber Optic

fiber optic basically glass piece adapt as thin as human hair used for telecommunication. This piece deliver digital signal with light. Although fact that this link made of glass, they are mild and not soft. They can crooked type of wire and very solid. When hundreds or thousands piece are arranged in pack,

it is called optic cable. Optic fiber cable is cable which contains a or over optic piece used to relay light. Fibre optic component that usually solely covered with plastic layer and which include in protection suitable fund for environment where cable will be used. like various cables used for various applications, long distance example telecommunication, or give information association that is quick between various section of the building. Glass cable mortgagees by running defence that is extraordinary called cladding. It is produced using material which reflects light again into core or cable centre. Ini cladding makes mirror line divisor. fibre optic work use internal reflection number of principles. At the moment when light disseminated into glass cable, light which rebounded from reflective cladding beside glass cable, so that light can move on around angle. In other word meaning, light which rebounded from inside cable until it reach his destination. There are more than part for fibre optic framework from cable. The main thing is that transmitter. It relays signs will over cable. Actually, light signal repeated and another with qualities that equally sent by regenerator. Finally, there is optic recipient. It obtains light signal and encode them into structure that is readable for tool to final direction.

Fiber optics have lots of uses. The Internet utilizes fiber optic cable. It is an impeccable application since it is advanced data and the fiber optic cables send digitally. Phones were one of the primary uses for fiber optics. Many times, internet and phone signals go over the same cable. Digital television (cable TV) is regularly transmitted by fiber optic cables. Different utilizations are restorative imaging, mechanical examination. What's more, to inspect pipes and sewer lines. Fiber optic cable without optical regenerators can be up to around one kilometer long. With regenerators, they can go on until the end of time. They can be set in structures, up on electrical cables, covered in the ground or even put in the sea. Fiber optic cables are not impeccable; they can break. In some cases, when groups are burrowing, they inadvertently can tear up the cables. They can be repaired utilizing a system called splicing. It is when a worker cuts off the broken ends and reconnects it utilizing special adhesives, heat, or special connectors.(Ifiber, 2012)

2.3 Optical Fiber Basics

An optical fiber is composed of three parts; the core, the cladding, and the coating or buffer. The basic structure is shown in Figure.

Core: This central area, made of silica or doped silica, is the light transmitting locale of the fiber. The core is a tube-shaped pole of dielectric material and is for the most part made of glass. Light propagates for the most part along the core of the fiber

Cladding: This is the principal layer around the core. It is additionally made of silica, however not the same structure as the core. This makes an optical waveguide which confines the light in the core by total internal reflection at the core-cladding interface. The cladding layer is made of a dielectric material with an index of refraction. The index of refraction of the cladding material is not as much as that of the core material. The cladding is by and large made of glass or plastic. The cladding executes such function as diminishing loss of light from core into the surrounding air, decreasing scattering loss at the surface of the core, protecting the fiber from absorbing the surface contaminants and adding mechanical strength.

Coating: The coating is the principal non-optical layer around the cladding. The coating normally comprises of one or more layers of polymer that secure the silica structure against physical or ecological harm. The coating is stripped off when the fiber is connectorized or fusion spliced. The coating or buffer is a layer of material used to shield an optical fiber from physical harm. The material utilized for a buffer is a sort of plastic.

Buffer: The buffer is an imperative component of the fiber. It is 900 microns and helps protect the fiber from breaking amid establishment and is situated outside of the coating. The buffer is elastic in nature and averts scraped areas.(Awad, 2012)

Strengthening Fibre: These segments secure the core against crushing forces and excessive tension during installation. The materials can run from Kevlar to wire strands to gel-filled sleeves

Outer Cable Jacket: This is external layer of any cable. The jacketed fiber is generally enclosed, with a bundle of flexible fibrous polymer strength members like aramid in a lightweight plastic spread to shape a straightforward cable. Every end of the cable might be ended with a particular optical

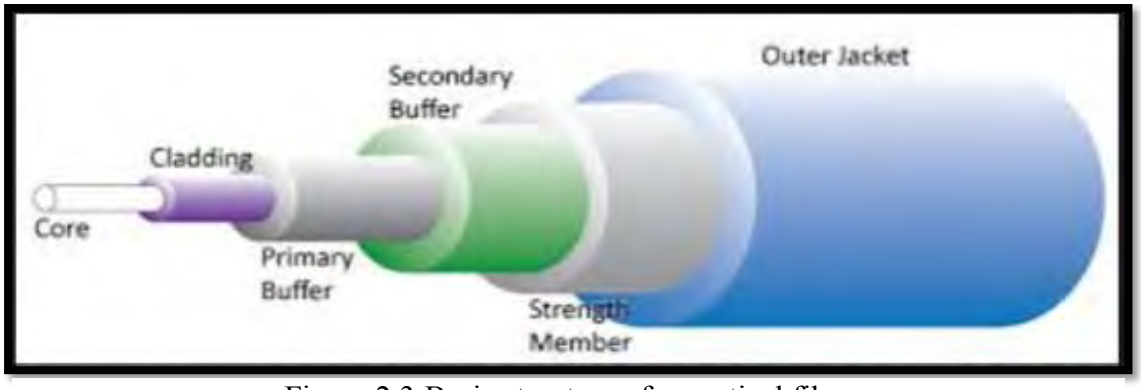

Figure 2.3:Basic structure of an optical fiber

2.4 Type of Fiber Optic

Single-mode and multi-mode are the two fundamental sorts of fiber optic cable. Single-mode fiber cable sends signals utilizing laser light. They are littler in thickness than multi-mode. A single-mode fiber has a little core that strengths the light waves to stay in the same way, or mode. This keeps the light signal going further before they should be beefed up, or amplified. Most long- distance, or long-haul, fiber optic phone lines use single-mode fiber. Multi-mode fibers send signals utilizing light-emitting diodes or LEDs. They are bigger in thickness or diameter than the single-mode cables. A multi-mode fiber has a much bigger core than single-mode fiber. This gives light waves more space to ricochet around inside as they go down the way. The additional development in the long run causes the beats to spread, and lose data. That implies multimode fiber signals can't go as far before they should be cleaned up and re-increased. Multimode fibers can carry only a third or less the information-carrying capacity or bandwidth than single-mode fiber. (such as in LANs) (Choi & Ph, 2014)