UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPLICATION OF FIBER OPTIC SENSOR FOR SODIUM HYPOCHLORITE CONCENTRATION DETECTION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Telecommunications) With Honours

by

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TAJUK: **APPLICATION OF FIBER OPTIC SENSOR FOR SODIUM HYPOCHLORITE CONCENTRATION DETECTION**

SESI PENGAJIAN: **2016/2017 Semester 2**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirement for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) With Honours. The member of the supervisory is as follow:

……

(Mr. MD Ashadi MD Johari)

ABSTRAK

‘ANALISIS FIBER OPTIC KONSEP UNTUK MENDALAMI SENSOR SODIUM HYPOCHLORITE’ adalah untuk menyiasat sifat-sifat bahan-bahan kimia yang terkandung dalam sodium hypochlorite dan bertindak balas terhadap rawatan air yang telah digunakan di Malaysia pada masa ini. Untuk mengenal pasti setiap kuantiti kandungan sodium hypochlorite adalah sama atau tidak, laporan ini adalah berdasarkan sistem penderiaan direka untuk mengenalpasti kualiti air yang diedarkan kepada penduduk selepas proses Perawatan air. Pengesan ini telah dibangunkan daripada kabel gentian optik mod tunggal. Percubaan ini dibahagikan kepada dua bahagian. Bahagian pertama adalah untuk mengukur kualiti air paip mengedar oleh pembekal kepada pengguna dengan mengambil satu sampel bagi setiap negeri di Selatan Malaysia. Sampel air paip adalah dari Kuala Lumpur, Selangor, Negeri Sembilan, Melaka dan Johor. Bahagian lain adalah bertujuan untuk mengukur kepekatan berbeza pengesanan klorin. Terdapat empat sumber lampu untuk digunakan dalam ujikaji kedua-dua, 850nm, 1300nm, 1310nm, dan 1550nm. bagi tumpuan ia mempunyai kepekatan berbeza lima. Terdapat 10%, 20%, 30% 40% dan 50%. Hasil output akan melaksanakan daripada molekul pengesanan pada permukaan sensor dan melaksanakan sensitiviti dari sambutan daripada kehilangan kuasa. Sensitiviti akan menunjukkan molekul pengesanan khasiat air paip dan pengesanan bagi kepekatan yang berbeza. Hasilnya bagi keseluruhan air paip pengesanan, kepekaan yang tinggi kebanyakannya persembahan dalam air paip dari Negeri Sembilan dengan sensitiviti tertinggi ialah 0.1378. kepekatan berbeza pengesanan adalah menunjukkan sensitiviti tinggi sedang 40% penumpuan.

ABSTRACT

'ANALYSIS of FIBER OPTIC SENSOR into the CONCEPT for SODIUM HYPOCHLORITE' is to investigate the properties of chemicals contained in sodium hypochlorite and respond to water treatment that has been used in Malaysia at the moment. To identify each quantity of sodium hypochlorite content is the same or not, this report is based on sensing system is designed to identify the quality of the water distributed to residents after the water treatment processes. This sensor was developed from fiber optic single mode cable. The experiment was divide by two part. First part is to measure the quality of tap water distribute by provider to user by take one sample for each state in south of Malaysia. The tap water sample is from Kuala Lumpur, Selangor, Negeri Sembilan, Melaka, and Johor. Another part is to measure different concentration detection of chlorine. There were four light source to be use in both experiment, it is 850nm, 1300nm, 1310nm, and 1550nm. for concentration it has five different concentrations. There is 10%,20%,30%40% and 50%. The output result will perform of the detection molecule at surface of the sensor and perform the sensitivity from response of power loss. The sensitivity will show the molecule detection contain in tap water and detection for different concentration. As the result for overall tap water detection, the high sensitivity is mostly performing in tap water from Negeri Sembilan with the highest sensitivity is 0.1378. for different concentration detection is show the high sensitivity is in 40% of concentration.

DEDICATION

This research was dedicated to:

My parent

ABDUL AFRI BIN ABDUL LATIF

SITI ZALEHA BINTI OTHMAN

Which has a lot of encouragement and education and inspiration in success, pray and always love this self with sincerely heart.

My Supervisor

Mr MD ASHADI BIN MD JOHARI

Give me opportunity to do a thesis and guide me to complete final project

Thank you also to my brothers, sisters and friends it is worth from class 4BETT

They are always be my side, they are a great help during difficult and easy, feel confident, guidance, and advise you on which motivated to myself.

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Give thanks to Allah s.w.t for the bounty and the permissions, I can complete the task of final year project entitled Fibre Optic Sensor Application for Sodium Hypochlorite Concentration Detection. Final year project is an assignment to final year students in Universiti Teknikal Malaysia Melaka (UTeM) which is part of the curriculum of compulsory subjects for Bachelor of Electronics Engineering Technology (Telecommunications) With Honours.

Firstly, I wish to thank to my supervisor final year project, Mr. Md Ashadi Bin Md Johari who is also a lecturer at the Faculty of technology engineering who has helped and give guidance in ensuring the success of this project. Thanks also to Mr. Izwan Bin Hamdan because has allowed and assist in conducting this project in the laboratory.

Thank you also to my parents who support and encourage. sibling who gave a positive view and spirit, and assistance and support from friends, housemate and classmate who helped me in completing this task.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

NaOCL	-	Sodium Hypochlorite (chlorine)
FOS	-	Fiber Optic Sensor
mg/L	-	milligram per litter
COD	-	Coefficient of determination

CHAPTER 1

INTRODUCTION

1.1 Project Background

Fiber optic is a kind of media communication that is often used in this century as can be seen in the use of internet media using optic fiber channel connections from branch as communication multimedia to users. Therefore, the user can access the internet quickly unlike 20 years ago the use of the phone wires made of copper wire as a medium of transmission of data. Fiber optic created special from fiber glass respond at light. With the advantage is with optic fiber through the speed of light, the data will be accepted quickly.

Fiber optic is now not only focused on telecommunication network as data transmission media. Fibre optic technology alternatives that can replace conventional cable signal function as electrical conductor. Where fibre optic is used as a sensor or with respect to the fibre optic sensors (FOS). Benefit from optical fiber as sensor has many advantages compared with electrical Sensors which have been used for many years. Fibre optic has some advantages, including a small diameter, lightweight, resistant against electromagnetic disturbance, can be used in the period as in included in high temperature or high tensile, high sensitivity and the ability to feel and to send help. In addition, the optical fiber is also not perishable, it has separate the electricity does not easily get fired or explosion as a result of an electron as a stepping stone on the occurrence of an electrical Sensor.

Sodium hypochlorite (NaCOL) is a mixture of chemical substances commonly used as a whitening, detergent, get rid of the smell as well as good whitening. In Malaysia, the use of sodium hypochlorite in general are familiar among the agencies assigned to treat water before being distribute to people in Malaysia. In addition to sodium

hypochlorite is not only used for the public, the industry also uses sodium hypochlorite, sodium hypochlorite usage rates but in larger industry than to the user consume. Sodium hypochlorite has advantages and disadvantages to humans among its advantages can be a detergent at home and disadvantages of the use with high consume of sodium hypochlorite can be unsafe to humans.

Therefore, a sensor has been developed based on optical fiber in communication system and better known as fibre optic sensors (FOS) for the purpose of measuring the rate of the quantity of sodium hypochlorite (chlorine) in tap water channelled to the residents of Malaysia is in line with the rate of standardize approved by the Ministry of health or not.

1.2 Objective

1. To study fiber optic sensor operation.
2. To develop fiber optic sensor (FOS) for various concentration detection of sodium hypochlorite.
3. To analyse performance of fiber optic sensor (FOS) for concentration detection activity.

1.3 Problem Statement

This experimentation is run on the basis of curiosity and to build a sensor based on fiber optic to test the rate of sodium hypochlorite content contained in tap water in Malaysia. The use of sodium hypochlorite as materials to water treatment in Malaysia can be said very extensively. But in terms of health to humans in the water treatment system is made by the parties involved must always comply with the set standards. The high use of sodium hypochlorite in water is very dangerous to the user, should exceed the syllabus approved by the Ministry of health. The rate of sodium hypochlorite (chlorine) that has been specified by the Ministry of health used in the water so the chlorine content can be reduced up to achieve free rate chlorine (FRC) is between 0.2-5.0 mg/L according to Syabas sdn bhd. One sensor has been developed by using fiber optic cable to detect the content of chlorine in tap water in Malaysia using tap water samples taken from five States in Malaysia. Normally people can

detect the available chlorine content in water by using fluids and litmus paper, but this time with the use of glass fiber on fiber optic sensor and with the speed of light is able to determine the content of chlorine in water.

1.4 Scope of Project

The scope of this project to study and to develop fiber optic sensor by application to sodium hypochlorite concentration detection in communication system. With the availability of this scope, it will facilitate the process of experimentation and as a guide to achieve our objectives. This scope, conducted to study fiber optic sensor, fiber optic, sodium hypochlorite concentration and construction. The main focus for this project can be classify as:

- The basic of fiber optic communication system.
- The implementation of fiber optic sensor for sodium hypochlorite.
- The system of fiber optic communication application.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

Literature review is a place where a study based on the title that had been discovered and discussed in detail based on the objectives and scope of the project to further strengthen the study, all processes, materials and tools that will be used to study based on theoretical and scholarly reference that is collected from books, Web sites, and journals. In Chapter 2, the tools used will be described as a prototype in which the use of fiber optic sensor (FOS) as media that will be used as a material to test, sodium hypochlorite is the main element to be test and for tap water is materials as refer to section content chlorine in water. In this study, the use of test methods because reading is not really accurate, so it needs to be tested several times to get the best results.

2.2 Fiber Optic

Fiber optics is significant building obstructs in the telecom base. In 1880 Alexander Graham Chime and his partner Charles Sumner Tainter made an initial move towards optical fiber correspondence, the Photophone, at Ringer's recently settled Volta Research facility in Washington D.C. Initially created in the 1970s, fiber-optic correspondence frameworks have reformed the information transfers industry and have assumed a noteworthy part in the coming of the Data Age. The fiber optics upset at America started in the mid-1980s.At that time frameworks worked at 90Mb/s. At this information rate, a solitary optical fiber could deal with around 1300 synchronous voice channels. Today, frameworks normally work at 10 Gb/s and past. Due to its focal points over electrical transmission, optical strands have to a great extent supplanted

copper wire correspondences in center systems in the created world. As a development that changed the scene of worldwide interchanges, optical fiber has a future as splendid as the influxes of light it bars all through the world. Because of its similarity with different innovations, developing cost-adequacy, and almost boundless transmission capacity, optical fiber has the ability to develop and adjust to future shopper requests for voice, information, and video capacity. The development of the fiber optics industry in the course of recent years has been dangerous. Examiners expect that this industry will keep on growing at a gigantic rate well into the following decade and past.

2.2.1 Benefits of Fiber Optics

Optical fiber systems have many advantages over metallic-based communication systems. These advantages include:

Long-distance signal transmission. The low constriction and unrivaled sign honesty found in optical frameworks permit any longer interims of sign transmission than metallic-based frameworks. While single-line, Unlike the system link UTP STP still raises the likelihood of tapping, this can't be utilized for optical fiber link system as it can submit information with no diversions or intrusions.

Fiber optic system link can be redesigned effortlessly without modifying the current link framework. voice-grade copper frameworks longer than a few kilometers (1.2 miles) require in-line signal for agreeable execution, it is not irregular for optical frameworks to go over100 kilometers (km), or around 62 miles, with no dynamic or inactive handling.

Large bandwidth, light weight, and small diameter. Today's applications require an always expanding measure of transmission capacity. Thusly, it is vital to consider the space imperatives of numerous end clients. It is ordinary to put in new cabling inside existing pipe frameworks or channel. The moderately little distance across and light weight of optical link make such establishments simple and down to earth, sparing profitable channel space in these situations.

Non-conductivity. Today's applications require an always expanding measure of transmission capacity. Thusly, it is vital to consider the space imperatives of numerous end clients. It is ordinary to put in new cabling inside existing pipe frameworks or channel. The moderately little distance across and light weight of optical link make such establishments simple and down to earth, sparing profitable channel space in these situations.

Security. Not at all like metallic-based frameworks, the dielectric way of optical fiber makes it difficult to remotely recognize the sign being transmitted inside the link. The best way to do as such is by getting to the optical fiber. Getting to the fiber requires intercession that is effectively distinguishable by security reconnaissance. These circumstances make fiber amazingly alluring to legislative bodies, banks, and others with real security concerns.

Designed for future applications needs. Fiber optics is reasonable today, as gadgets costs fall and optical link valuing stays low. As a rule, fiber arrangements are less excessive than copper. As data transfer capacity requests increment quickly with mechanical advances, fiber will keep on playing an indispensable part in the long haul accomplishment of telecom.

(Nick Massa, 2000)

2.2.2 Advantages and Disadvantages

2.2.2.1 Advantages of Optical Fibers

It is a very high information carrying capacity.

1. Less attenuation (order of 0.2 db/km).
2. Small in diameter and size & light weight.
3. Low cost as compared to copper (as glass is made from sand ...the raw material used to make optical fiber is free….).
4. Greater safety and immune to EMI & RFI, moisture & corrosion.
5. Flexible and easy to install in tight conducts.
6. Zero resale value (so theft is less).

7. Is dielectric in nature so can be laid in eclectically sensitive surroundings.
8. Difficult to tap fibers, so secure.
9. No cross talk and disturbances.

2.2.2.2 Disadvantages of Optical Fibers

1. The terminating equipment is still costly as compared to copper equipment.
2. Of is delicate so has to be handled carefully.
3. Last mile is still not totally fiber-ised due to costly subscriber premises equipment.
4. Communication is not totally in optical domain, so repeated electric –optical – electrical conversion is needed.
5. Optical amplifiers, splitters, MUX-DEMUX are still in development stages.
6. Tapping is not possible. Specialized equipment is needed to tap a fiber.
7. Optical fiber splicing is a specialized technique and needs expertly trained manpower.
8. The splicing and testing equipment are very expensive as compared to copper equipment.

(Dr. Thaira Zakaria Abbas, 2011-2012

2.2.3 Way of fiber optic Works

Operation of an optical fiber relies on upon the standard of total inside reflection. Light reflects (bounces back) or refracts (changes its course while invading another medium), dependent upon the time when it strikes a surface.

One perspective about this thought is to envision a man looking at a lake. By looking down at a grandiose edge, the individual will see fish, rocks, vegetation, or whatever is underneath the surface of the water (in a to some degree deformed range as a result of refraction), tolerating that the water is for