UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SODIUM ALGINATE CONCENTRATION DERECTION USING FIBER OPTIC COMPONENT AS SENSOR ELEMENT

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

By

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I hereby, declared this report entitled “Sodium Alginate Concentration Detection Using Fiber Optic Component as Sensor Element” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

…………………………………………………………

(Mr. Md Ashadi Bin Md Johari)

ABSTRAK

Sensor gentian optik dikenali sebagai mempunyai keupayaan utama yang luas EMI, suhu yang tinggi, penggunaan bahan, berat badan yang tinggi, dan voltan tinggi. Demikian juga ringan dan saiz yang kecil. Dengan sedemikian , ia mempunyai pelaksanaan yang hebat dan tinggi serta mempunyai kapasiti penghantaran yang besar. Tambahan pula , teknologi termaju isyarat pemprosesan dan sistem inovasi akan memberi kuasa kepada teknologi tertinggi sistem sensor gentian optik. Projek akhir ini dijangka dapat membantu memberi analisa yang sangat berguna kepada industri kesihatan yang juga membantu pakar bioperubatan untuk menentukan tahap kepekatan dan mengenal pasti natrium alginate yang paling aktif dalam pelbagai kepekatan dan sewajarnya menggunakan kadar sebenar kepekatan ini untuk sebab-sebab kesihatan.

ABSTRACT

Fiber optic sensors is known as having domain ability which is broad EMI, high temperature, substance consumption, high weight, and high voltage. It is likewise light weight and little size. Along these lines, it has a superb execution which is high affectability and huge transmission capacity. Furthermore, propelled signal preparing and system innovation will empower high thickness fiber optic sensor systems. This anticipate examination information would incredibly add to the health commercial ventures which help biomedical specialist to decide the concentration level and identify the most active sodium alginate within various fixation and accordingly utilize an exact rate of this concentration for health reason.

DEDICATION

Every challenging work needs self-efforts as guidance of elders especially those who were very close to our heart.

My humble effort I dedicate to my only sweet and loving

Father and Mother,

Louis anak Muli

Margaret anak Benar

Whose affection, love and encouragement and prays of day and night make me able to get such success and honor,

Along with all hard working and respected Supervisor

Mr. Md Ashadi bin Md. Johari

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 2: LITERATURE REVIEW

CHAPTER 3: METHODOLOGY

CHAPTER 4: RESULT AND DISCUSSION

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

In this chapter, the topics covered are the background of the project title, project's objectives, problem statements faced, work scopes, project significant and lastly conclusion of this project.

1.1 PROJECT BACKGROUND

Optical fiber or known as "fiber optic" is alludes to the medium and innovation, which is equipped for transmitting data onto light waves along a glass or plastic strand or fiber. Fiber optic regularly comprises of two sorts, which is single mode fiber that being utilized for a more extended separations and multimode fiber which is utilized for a shorter separation. Fiber regularly being utilized because of its little size, or on the grounds that no electrical force is required at the remote area, or on the grounds that numerous sensors can be multiplexed along the length of a fiber by utilizing light wavelength shift for every sensor, or by detecting the time delay as light goes along the fiber through every sensor by relying upon the application.

(Kist & Sohler, 1983) defines that a Fiber-Optic sensor (FOS) consists essentially of a light source, a fiber link and connectors, a detector, and a sensor element. This sensor element might be localized or distributed and is exposed to the light modulating action of the measured or parameter of interest.

From the article under title *Fundamentals of Optical Fiber Sensors* (Zujie Fang, 2012) stated that optical fiber sensor technology has grown into a large-scale industry, with its research and development becoming a trending field. Optical fiber sensor has found varied applications in human social activities and daily living, from industrial production to cultural activities, from civil engineering to transportation, from medicine and health care to scientific research, and from residence security to national defense.

According to the article under title *Fiber Optic Essentials* (Thyagarajan & Ghatak, 2007) stated that although the most important application of optical fibers is in the field of communication, optical fibers are finding more and more applications in the area of sensing. The use of optical fibers for such applications offers the same advantages as in the field of communication: lower cost, smaller size, rugged, higher accuracy, greater flexibility with multifunctional capabilities, wide range of sensor gauge lengths, and greater reliability. Compared to the conventional electrical sensors, such fiber optic sensors are immune to the external electromagnetic interference and can also be used in hazardous and explosive environments. Using fiber optic sensors, it is possible to measure almost any external parameter, such as pressure, temperature, electric current, magnetic field, rotation, acceleration, strain, and chemical and biological parameters, with greater precision and speed. These advantages lead to increased integration of such fiber optic sensors into such civil structures as bridges and tunnels, process industries, medical instruments, aircrafts, missiles, and even cars.

ECC Stanford is an English scientist which is the initially concentrated on and found sodium alginate in 1881 when he licensed its extraction from seaweed. Sodium Alginate is a characteristic polysaccharide item which is extricated from brown seaweed that develops in cool water regions. Sodium alginate is dissolvable in icy and heated water with solid fomentation and can thicken and bind. Sodium alginate shapes a gel without the need of warmth within the sight of calcium. Sodium Alginate is the main non-surgical treatment that can physically forestall reflux sickness regardless whether it is acidic or not. Alginates works quickly, are enduring, economical, and it is known not no symptoms.

According to the article under the title *Medical Botany: Plants Affecting Human Health* (Walter H. Lewis, 2003) stated that in modernist cuisine, sodium alginate is mostly used with calcium salts to produce small caviar-like and large spheres with liquid inside that burst in the mouth. Sodium Alginate is also used in the food industry to increase viscosity and as an emulsifier. It is also used in indigestion tablets and it has no discernible flavor. Alginates have long been used for treating heartburn and significantly reducing gastrointestinal acid reflux episodes.

This project is focusing on how Sodium Alginate concentration detection by using Fiber Optic component as sensor element. This project would greatly contribute to biomedical researcher to use an accurate percentage of this chemical for health purpose. As more and more fiber optic sensing systems are installed and as increasing numbers of engineers from different industrial areas become acquainted with this technology, it will most certainly experience increasing commercial success (Thevenaz, 2011).

1.2 OBJECTIVE

The main objectives of this project:

1. To study and understand the usage of fiber optic sensor.
2. To develop fiber optic sensor for Sodium Alginate in various concentration.
3. To analyze the performance of fiber optic sensor for Sodium Alginate concentration.

1.3 PROBLEM STATEMENT

It is proven by biomedical researcher that sodium alginate helps to reduce the health problems related to the stomach. Heartburn or acid reflux is an obnoxious condition which can be to a great degree excruciating that some individuals depict the sensation as feeling like they are encountering a heart attack. Hydrochloric corrosive is actually present in the stomach that processes the nourishment and eliminate microscopic organisms. The stomach should be acidic and this helps it separate sustenance and gives some resistance against microscopic organisms and infections and it is just when this corrosive getaway from the stomach into the throat that it might prompt issues. Consuming sodium alginate in various concentration levels help to reduce the stomach pain and in order to neutralize the acid in the stomach, the appropriate amount of sodium alginate should be taken. So throughout this project, fiber optic sensor is used to determine the appropriate concentration level of sodium alginate and detect the most active sodium alginate within various concentrations. This project would help biomedical researcher to use an accurate percentage of this chemical for health purpose.

1.4 SCOPE PROJECT

The scope of this project is to develop a Sodium Alginate concentration detection using fiber optic component as sensor element. Besides that, the scope of this project is to analyze the performance of fiber optic sensor for Sodium Alginate concentration. This project would contribute greatly biomedical researcher to use an accurate percentage of this chemical for health purpose. At last, yet vitally, the scope of this project is able to achieve the main objectives of this project.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

The characteristics and some information of the devices being used in the project are discussed in this chapter. The research topics that had been discussed in this chapter are basic structure of an optical fiber, fiber optic sensor, sodium alginate and new technology in fiber optic.

2.1 FIBER OPTIC

2.1.1 Basic Structure of an Optical Fiber

(Laboratory of Laser Molecular Spectroscopy University of Lodz n.d.) The optical fiber is a waveguide used for transmission of light. It consists of a dielectric fiber core, usually from glass, surrounded by a layer of glass or plastic cladding characterized by the refraction index lower than that of the core. The light transmitted through the optical fiber is trapped inside the core due to the total internal reflection phenomenon. The total internal reflection occurs at the core-cladding interface when the light inside the core of the fiber is incident at an angle greater than the critical angle Θcr and returns to the core lossless and allows for light propagation along the fiber. The amount of light reflected at the interface changes depending on the incidence angle and the refraction indexes of the core and the cladding. Figure 1 presents the idea of the light propagation in the cylindrical optical fiber due to the total internal reflection.

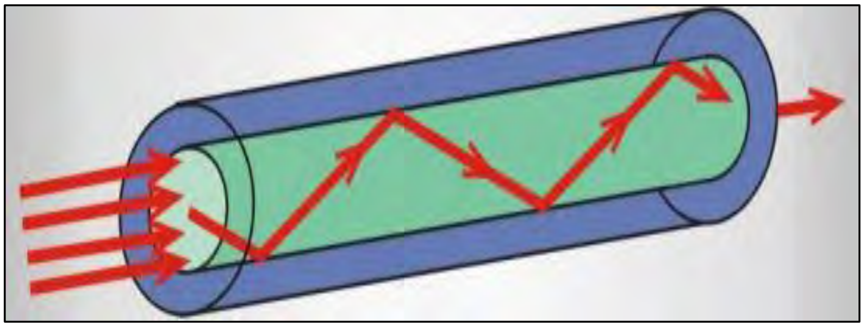

Figure 2.1: Figure of Cylindrical Optical Fiber

According to (Rongqing Hui, 2009) Optical fiber is the most important component in fiber optic communication systems as well as in many fibers based optical measurement setups. The basic structure of an optical fiber is shown in Figure 2 which has a central core, cladding, and an external coating to protect and strengthen the fiber.

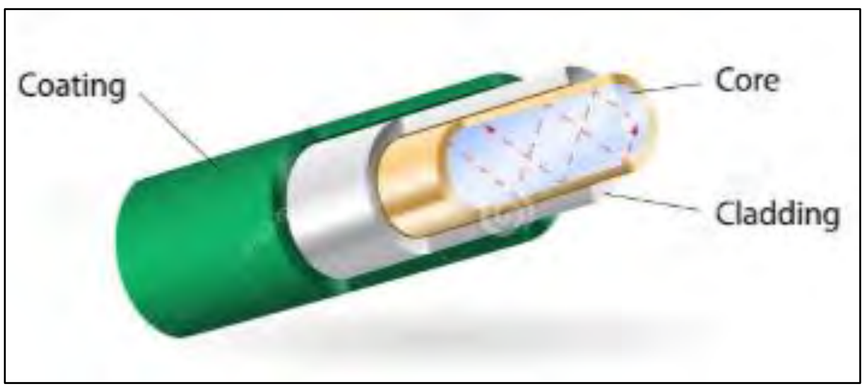

Figure 2.2: Basic Structure of an Optical Fiber

The core is a round and hollow bar of dielectric material. Dielectric material leads no power. Light propagates mainly along the core of the fiber. The core is generally made of glass. The core is surrounded by a layer of material called the cladding. Despite the fact that light will propagates along the fiber center without the layer of cladding material, the cladding does perform some vital capacities.

The cladding layer is made of a dielectric material with an index of refraction n_2. The index of refraction of the cladding material is less than that of the core material. The cladding is generally made of glass or plastic. The cladding performs the following functions:

1. Reduces loss of light from the core into the surrounding air
2. Reduces scattering loss at the surface of the core
3. Protects the fiber from absorbing surface contaminants
4. Adds mechanical strength

For additional assurance, the cladding is encased in an extra layer called the coating or buffer. The covering or support is a layer of material used to shield an optical fiber from physical harm. The material utilized for a buffer is a kind of plastic. The buffer layer (once in a while called the coating) has nothing to do with light transmission and is utilized just for mechanical strength and protection.

According to the article under title *Technician's Guide to Fiber Optics* (Donald J. Sterling, 2011) stated that the cable buffer has two types that are loose buffer and tight buffer. The loose buffer uses a hard plastic tube having an inside diameter several times that of the fiber. One or more fibers lie within the buffer tube. The tubes isolate the fiber from the rest of the cable and the mechanical forces acting on it. The buffer becomes the load-bearing member. As the cable expands and shrinks with changes in temperature, it does not affect the fiber as much. A fiber has a lower temperature coefficient than most cable elements, meaning that it expands and contracts less. Typically, some excess fiber is in the tube; in other words, the fiber in the tube is slightly longer than the tube itself. Thus, the cable can easily expand and contract without stressing the fiber. The tight buffer has a plastic directly applied over the fiber coating. This construction provides much better crush and impact resistance. It does not, however, protect the fiber as well from the stresses of temperature variations. Because the plastic expands and contracts at a different rate than the fiber, constructions caused by variations in temperature can result in loss-producing microbends. Another advantage to the tight buffer is that it is more flexible and allows tighter turn radii. This advantage can make tight-tube buffers useful for indoor applications where temperature variations are minimal and the ability to make tight turns inside walls is desired.

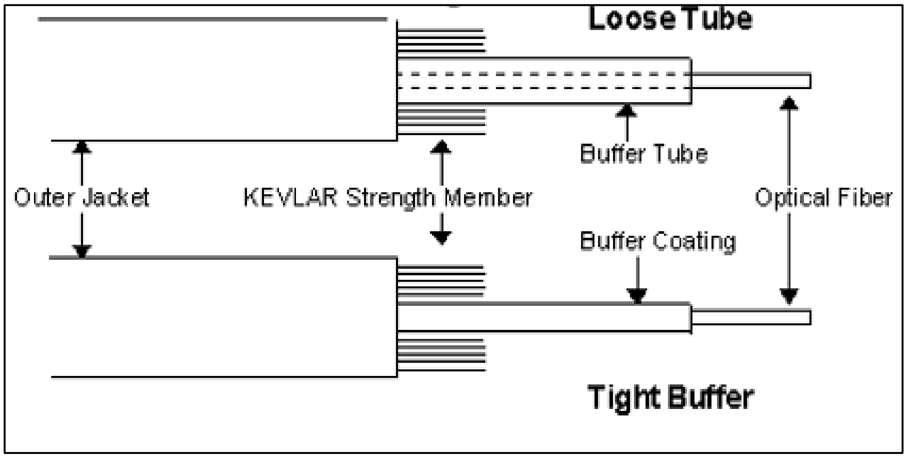

Figure 2.3: Basic Structure of the Loose Buffer and Tight Buffer

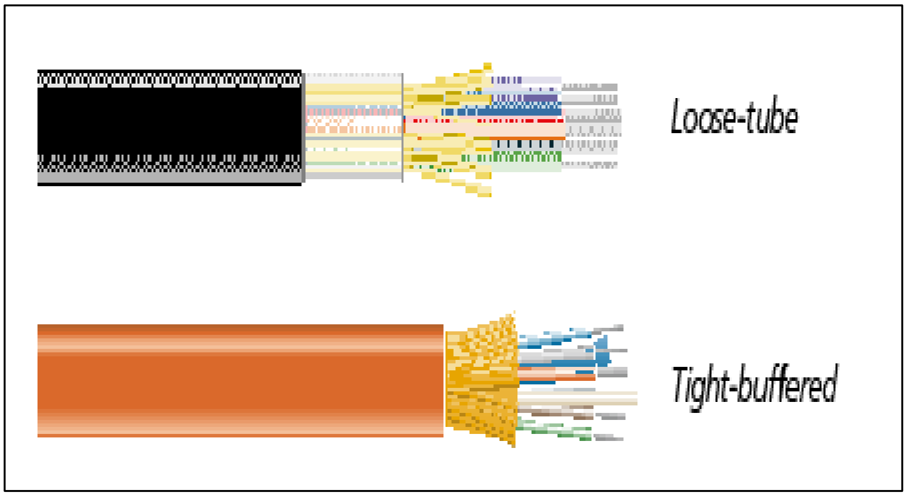

Figure 2.4: Loose Buffer Cable and Tight Buffer Cable