A Review on Micro Sensors for Detection of Nutrients in Water

Rajendra Singh, Mahendra Kumar
Department of Electronics and Communication, Ideal College of Engineering, Ghaziabad, India

Abstract— *Water provided to the consumers, must be safe and should meet each health quality standards and aesthetic needs like color, turbidity, style and odour. Current waste product observance techniques deem the employment of nutrients detection because the results of some reaction that is undesirable for long-run use in time period applications. Additionally, new legislation could render such systems obsolete if they can't dependably verify the quantity of nutrients in waste product relative to allowable levels. This paper makes an attempt to deal with this issue by considering the employment of microwave sensing techniques as another time period approach that has the potential to observe waste product nutrients like phosphate and nitrate. The tactic utilizes a broad vary of microwave frequencies (1-15 GHz) and is incontestable with 2 differing kinds of structure for this purpose, specifically a conventional resonant cavity and a versatile inter digitated conductor structure. Research lab read package used for analysis of captured information and for straightforward user interpretation of this information is additionally incontestable.*

Future work to be undertaken is mentioned in reference to rising the performance of the sensing element any, moreover as adding the aptitude to mechanically verify each the sort and concentration of nutrients in water solutions. A variety of experimental results square measure shown that validate the relevancy of the microwave sensing for detection phosphates and nitrates within the solutions.

Keywords— Sensors, Nutrients, Tactic sensors, Micro sensors

I. INTRODUCTION

Human health is affected, in several world regions, by vector-transmitted diseases associated with vector organisms that breed within the aquatic setting. This drawback is enormous since there square measure two hundred million individuals laid low with one such sickness alone, (i.e.) infestation. However, since the incidence of such diseases, and their containment, is closely connected to water resource

Pollution sources and effects; this issue isn't controlled during this book. Any info on these topics is found within the internationally recognized literature on the topic (WHO, 1980, 1982, 1983).

Pathogenic agents inflicting water-borne diseases embody microorganism and viruses similarly as Protozoa and helminths.

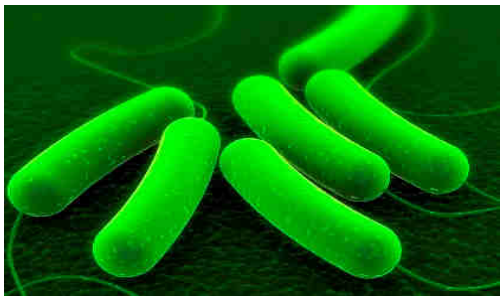
Though they interfere solely marginally with aquatic life in general, they cause severe public health issues and square measure thought of chargeable for most of the morbidity in developing countries.

Observation is typically done indirectly by distinctive and quantifying indicators of unclean pollution like the coliform teams. This guide follows constant conception and interested readers square measure brought up any background info within the relevant literature printed by the globe Health Organization (WHO, 1976, 1985, 1993).

II. EXPERIMENTAL PROCEDURE

(1) E.coli Preparation

Escherichia coli was inoculated into fifty mil of sterile nutrient broth (NB) and incubated for twenty-four hrs at thirty seven hɯC, 250 r/min.The optical density (OD) was measured at 550 nm (OD). OD550 of the long culture was 1.5 for the following incubation



.

(2) P. aeruginosa answer Preparation

P. aeruginosa was inoculated into fifty mil of sterile nutrient broth (NB) and incubated for twenty-four hours at thirty seven qC, 250 rpm.Following incubation, the optical density (OD) was measured at 550 nm (OD 550). OD 550 of the long culture was one.74. For the needs of experimentation, this work was diluted to associate degree OD 550 of one.0 to stop attainable obstructive of the sensing element since P.

Aeruginosa is especially known for its ability to stick to surfaces. For the needs of comparison with alternative techniques, a 1.0 OD 550 reading was found, via a filtration technique, to be appreciate zero.583 g/L -1.

(C) Microwave sensing element Head Structure

An interdigitated formed pattern written on FR4 substrate and operative at microwave frequencies was chosen for its versatile style that mixes simple producing with desired practicality .Gold was used as a metal material for each bottom layer, that acted as a ground plane, and high pattern to take care of chemical neutrality once the device is placed to bear with binary compound media with bacterium. The sensing element is connected to a cable via SMA connexion.This structure conjointly features a reservoir to contain zero.4 millilitre of an answer in situ, wherever the interaction with the magnetism field is that the strongest. A definite feature of this sensing element is its superior sensitivity to alter near the sensing element surface, with this sensitivity decaying apace with distance aloof from the surface. This is often advantageous because it reduces considerably the possibility of undesirable factors, like external magnetism signals, influencing sensing element response. However, since the operation is performed at microwave frequencies, the chances of such interference square measure low.

(D)Activity Setup

Rohde and Schwarz ZVA24 vector network instrument (VNA) shown in Fig. two was used for the needs of information acquisition from the sensing element, with this unit being suitably mark in step with manufacturer specifications. The information (60,000 points for every measurement) was captured within the frequency vary of zero.01-15 gigahertz for the mirrored (S11) signals. A Molex edge kind SMA connexion was wont to connect the sensing element via coax to the VNA.

This SMA kind was chosen because it is meant to excite a written IDE sensing element horizontally to maximize the on the market signal. The sensing element and associated equipment were all nominative for 50Ÿimpedance. All the measurements were performed at a continuing temperature of eighteen qC, with all the samples being zero.4 millilitre in volume for consistency, because the microwave spectra depend upon the degree / thickness of the take a look at samples every answer, specifically deionized water, Escherichia coli, sterile nutrient broth and genus Pseudomonas aeruginosa was measured various times and therefore the results were repeatable with but five-hitter deviation and reproducible. when every activity when the binary compound sample was off from the sensing element, its response came back to the first baseline worth, specifically the air spectra.

This means that there was no irreversible interaction between the solutions and therefore the sensing element itself and thus it is often faithfully reused. Notably, average sensing element responses square measure represented within the graph shown within the following section.

OTT Concentration (ppm)	Exposure Time (min)	Count (cfu/ml)	Percent survival
2	10	1.2*10^6	27
2	20	1.47*10^4	0.7
2	30	1.25*10^2	0.02
1	10	3.2*10^6	85
1	20	2.21*10^6	58
1	30	1.14*10^4	1
0	10	3.75*10^6	100

III. RESULTS AND DISCUSSION

Signal distribution recorded from the customized microwave detector in zero.01-15 G Hz frequency vary once in grips with deionized water, E.coli, sterile nutrient broth and P. aeruginosa solutions. All four spectra, every representing the common of multiple measurements, area unit planned on common graph as an instance that the planned nonparticulate radiation sensing system has the potential to differentiate between numerous unhealthful bacterium. Joined will see, every sample encompasses a distinctive response to the microwave signal leading to resonant peaks occurring at completely different frequencies and having different signal amplitudes. Thus, the primary major resonant peak for deionized water was recorded at frequency of 5.56 GHz, whereas it absolutely was four.39 G Hz for E.coli, 2.81 G Hz for nutrient broth and a couple of.22 G Hz for P. aeruginosa. At higher frequencies, within the region of eight.5-10 GHz, the most important resonant peaks were recorded for all the solutions. These are: 9.63 G Hz for deionised water, 9.82 G Hz for E.coli, 8.21 G Hz for nutrient broth and eight.44 G Hz for P. aeruginosa. Having maintained all alternative experimental parameters constant, the sole rationalization to those shifts is that they\'re connected with the properties of

the answer beneath the take a look at,namely its composition or bacterium. This specific feature makes the developed detector a lovely choice for period of time observance of bacterium presence within the liquid media.

IV. CONCLUSION

In this paper we reviewed reports on a bespoken electromagnetic radiation sensing technique that's capable to sight and establish the presence of assorted morbific microorganism in liquid media. The system was tested on deionized water, E. coli, sterile nutrient broth and Pseudomonas aeruginosa solutions. The distinct feature of the projected system is that the detection is performed in real time, while not the necessity for added sample process or chemicals. This microorganism detection technique would be of profit in a very broad varying of applications, starting from water quality observance in waste product treatment facilities to safety assurance in health care and food industries.

REFERENCES

[1] W. Bourgeois, J.E. Burgess, R.M. Stuetz, On-line monitoring of wastewater quality: a review, Journal of Chemical Technology & Biotechnology, 76 (2001) 337-348.

[2] A. Mason, O. Korostynska, and A. I. Al-Shamma'a, "Microwave Sensors for Real-Time Nutrients Detection in Water," in Smart Sensors for Real-Time Water Quality Monitoring, S. C. Mukhopadhyay and A.

[3] Mason, Eds., ed: Springer Berlin Heidelberg, 2013, pp. 197-216

[4] "Coli". Oxford English Dictionary (3rd ed.). Oxford University Press. September 2005.

[5] Singleton P (1999). Bacteria in Biology, Biotechnology and Medicine (5th ed.). Wiley. pp. 444–454. ISBN 0-471-98880-4.

[6] "Escherichia coli". CDC National Center for Emerging and Zoonotic Infectious Diseases. Retrieved 2012-10-02.

[7] Bentley R, Mega Nathan R (1 September 1982). "Biosynthesis of vitamin K (menaquinone) in bacteria". Microbial. Rev. 46 (3): 241–80. PMC 281544. PMID 6127606.

[8] Hudault S, Guignot J, Servin AL (July 2001). "Escherichia coli strains colonizing the gastrointestinal tract protect germ-free mice against Salmonella typhimurium infection".Gut 49 (1): 47-55. doi:10.1136/gut.49.1.47. PMC 1728375. PMID 11413110

[9] I. D. Ogden, D. R. Fenlon, A. J. A. inten, and D. Lewis, "The fate of Escherichia coli O157 in soil and its potential to contaminate drinking water," Internation Journal of Food Microbiology, vol. 66, pp. 111-117, 2001.