

Phosphorous Detection In Water Using Electromagnetic Sensor

Sheetal Mapare^{1,2}, Dr.G.G.Sarate^{1,3}

¹ Sant Gadge Baba Amravati University, Amravati,

²Vidyalankar Institute of Technology, Wadala, Mumbai,

³Government Polytechnic, Yavatmal. smapare@gmail.com, ggsanshu@rediffmail.com

Abstract: This paper introduces the phosphorous detection by means of electromagnetic planar hexagonal spiral coil sensor. To determine the sensor characteristics successions of experiments were performed. The reference set of readings with milli-Q water, and then phosphate was dissolved with milli-Q water in a number of different ratios. The results illustrate the detection capability of the sensor. The hexagonal sensors characteristics were compared and the phosphorous in water is tested successfully.

Keywords: Phosphate, Electromagnetic, spiral, sensor, Impedance.

1. INTRODUCTION

Phosphorus is considered as most important nutrients required by plants for proper growth. Phosphorus (P) is a naturally occurring element can be found in all living organisms as well as in water and soils in the environment. It is an essential component for many physiological processes. Phosphorus drain from crop growing land can be a major source of phosphorous entering lakes and streams which encourages wild plant and algae growth in water. The major worry with major phosphate levels in aquatic ecosystems is eutrophication, a process in which water bodies get overindulgence nutrients that stimulates excess plant growth in water [1]. Monitoring nutrient transformations in water on the surface is significantly reasonable and sustainable management of water resources, from both an environmental and on regular basis. Phosphate entering water resources by agricultural overspill and other anthropogenic sources vary depending on numerous provincial and seasonal factors. Optical sensing, such as Raman spectroscopy, uses reflectance spectroscopy to detect the level of energy absorbed or reflected by phosphorous particles and nutrient ions. Raman scattering is a spectroscopic technique where an concentrated monochromatic light source irradiates a sample and the scattered light is collected [4]. Electrochemical sensing uses ion-selective electrodes to generate a voltage or current in response to selected ions and their activity [5]. Biological sensing uses a phosphate sensitive layer of immobilized enzymes that are attached to an electrode or electrochemical cell to observe the reaction between phosphate and the enzymes in terms of oxygen reduction or hydrogen peroxide creation [6]. The chemical analyses required to create an



accurate scheme that accounts for extremely intensive and complex laboratory testing that demands a lot time and cost. In-field monitoring sensors provide real time data over a large area of land and have relatively low production costs. Thus, portable, long durable sensors with quick response time are essential if dynamic mapping of phosphates is to be done in order to optimize phosphate use and lower environmental concerns .

2. SENSOR CHARACTERISTICS

The spiral coil of hexagonal shape produces the field around it as shown in Fig.1. The impedance is measured initially as the impedance in air, then with milli-Q water and phosphate dissolved in milli-Q water whose impedances are measured that predicts the presence of phosphate in solution. The amount of freely available ions in solution is due to the availability of phosphate ions. The sensor is immersed in the water and also in solution containing phosphate.

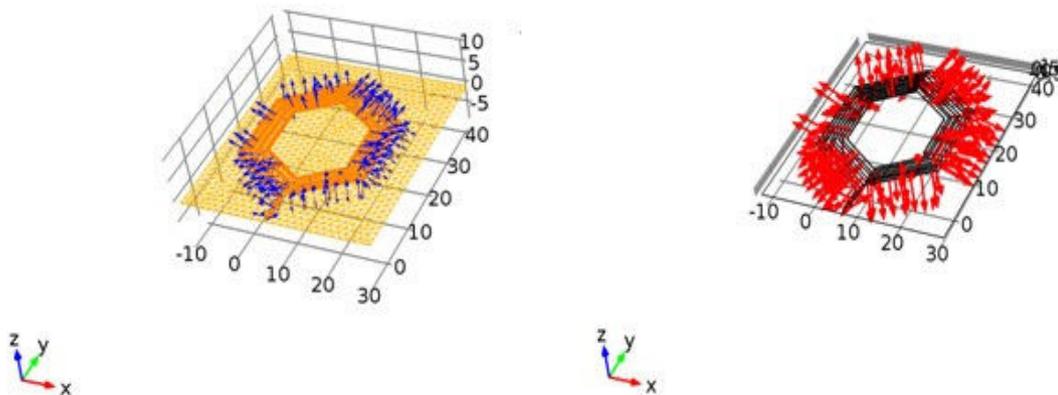


Figure 1. Magnetic lines flowing outwards

2.1 Principle of Measurement

The electromagnetic sensor that is a spiral inductor that produces the electromagnetic fields. The sensor is tested in free space that is air is tested at different frequencies as shown in Fig.2.

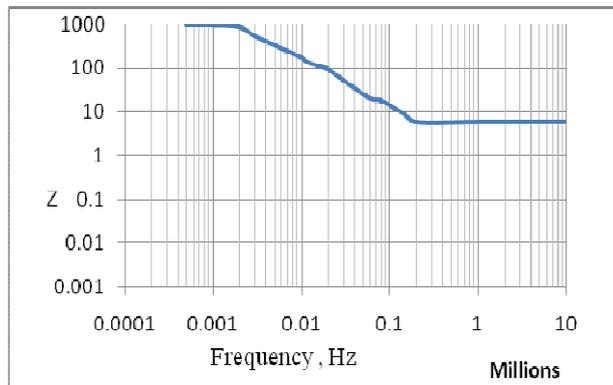


Figure 2. Impedance in Air

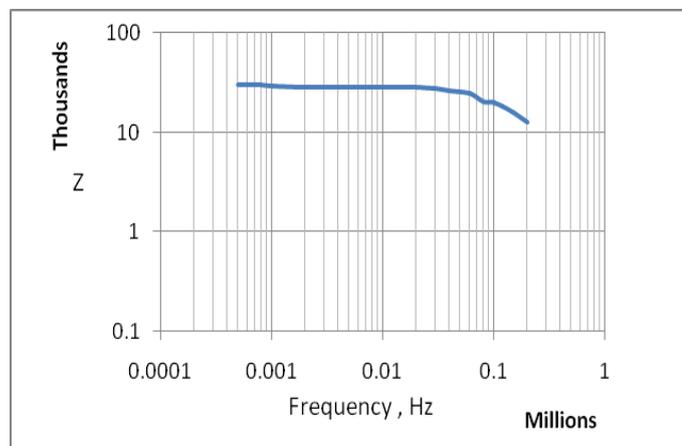


Figure 3. Impedance in Milli-Q water

The sensor is then inserted into milli-q water the impedance is measured at different frequencies. The conduction in water is negligible as impedance at different frequencies remains almost constant. The electromagnetic field penetration is less and the Fig.3 shows resistive behavior of the solution.

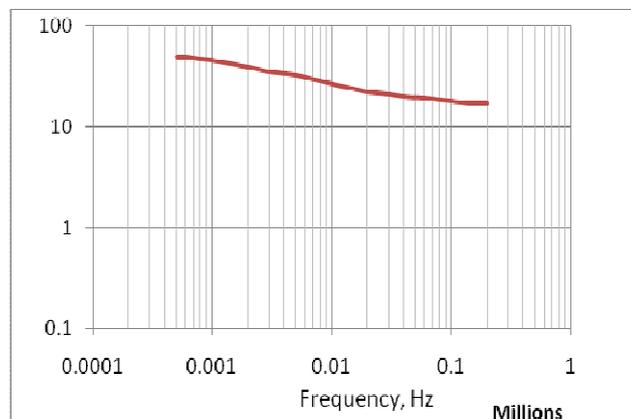


Figure 4. Impedance of milli-Q and phosphate

The difference in the impedance values of milli-Q water and the solution of milli-Q and phosphate mixture is the detection of phosphate present in solution as in Fig.4. The solution is prepared by adding ammonium phosphate to the milli-Q water. The measurements are done at frequencies from 50Hz to 200 KHz

3. CONCLUSION

The spiral hexagonal coil shows the knack of detection of phosphate in terms of variation in electrical parameter that is impedance. The sensor response is measured for a wide range of frequency that enables its use over a wide frequency band. The impedance drops to a considerable level as compared to impedance of air and milli-Q water due to less availability of ions in them. But the conduction in phosphate solution increases due to the availability of freely available phosphate ions the increases the conduction in turn reduces the impedance at the output that is equal to the amount of phosphate present in the solution. The calibration is required in future to exactly convert the measured impedance to the phosphate content.

4. REFERENCES

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