CHARACTERIZATION OF FRINGING ELECTRIC FIELD (FEF) AS OIL SENSOR

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ABSTRACT

A fringing electric field (FEF) sensor is one of the sensors that have been used to measure the material properties such as viscosity, moisture content, temperature, hardness and degree of cure. This project is a study about the steps on designing, fabricating and testing fringing electric field (FEF) as oil sensor. Detailed explanations on how the FEF sensitivity to the oil due to the effects of the electrode size is presented. Simulations are using Finite Element Method Magnetics (FEMM) and the FEF sensor then has been fabricated on the printed circuit board (PCB). This paper also contains the performance between three type sensors and compared based on the width of fingers. Experiment is conducted using Dual Display LCR Meter. The simulation and experimental data obtained is to characterize the FEF sensor by comparing it. The final results show that the greater width of FEF finger, the higher capacitance it will be.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

This project is aimed at developing applications for measuring the viscosity of oil and to empower field units to determine oil quality on demand and provide complementary oil condition information. This is because there exist a critical need in the market.

Nowadays, fringing electric field sensors are widely used for non-destructive measurements of material properties. A simple of fringing field sensor consists of a sensor head, a current or voltage source, an impedance measurement circuit, and data processing. The sensor head is usually a patterned array of electrodes or windings on an electrically insulating substrate. While for the voltage or current signal, it has applied to the electrodes and creates electric fields in the space around the electrodes or windings. Then, this field penetrates into the material near to the electrodes or windings [1]. For the oil, it can be penetrated by the electrodes so that the viscosity can be detected. The factor of FEF sensor is depend on the geometry which is can be typically evaluated based on their penetration depth, signal strength, measurement sensitivity and linearity [2].

Viscosity usually can be defined as the thickness of the liquid: the higher the viscosity the thicker the liquid, the lower the viscosity the thinner the liquid [5]. This definition also can be applied to the oil but it depends on the size of the molecules. The larger the molecule structures, the thicker, or higher, or heavier the viscosity. The size and structure of mineral oil molecules are different, so the average molecule size states the viscosity [6]. Then, for this project it focuses on how the different of the viscosity in the oil can be detected at the FEF fingers.