UNIVERSITI TEKNOLOGI MARA

SENSOR AS TACTILE TECHNIQUE IN ULTRASONIC CLEANING REACTOR

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ABSTRACT

An "ideal sensor" which is robust enough to withstand bubble jetting is proposed. Such sensor could be used to investigate temperature, pressure and acoustic pressure of water which can be used to measure cavitation effects, generated by ultrasound. In this experiment, DS18B20 Digital Temperature Sensor, MAX4466 Hydrophone Amplifier and SKU 237585 Pressure Transducer Sensor were connected to Arduino Uno to form sensors systems which were tested at 3 different depths namely at the bottom (0 cm), at the middle (3.5 cm) and at the top of a beaker (7.5 cm), to determine the performance of the sensors. Based on the result, DS18B20 Temperature Sensors provided consistent readings as the standard deviation was in between 0.08 to 0.38 which was less than 1% from the average values. However, SKU237585 pressure transducer sensor gave inconsistent readings as the standard deviation was more than 1% which was 0.01 to 0.56 from the average values. The result also showed MAX4466 Hydrophone Amplifier was insufficient to detect the acoustic emission signal due to its' small bandwidth. In addition, the temperature and negative of pressure at the bottom of container produced the highest reading compared at the top and the middle similar to the study conducted by other researchers.

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CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

In petroleum industry, many challenges and obstacles faced by engineers. The formation of produced sand occurs in the petroleum industry in transportation, refinery process and storage [1]. The higher concentration of produced sand has raised safety issues as it is considered hazardous to human health and environment thus requires necessary treatment [1-2]. One of the feasible options to manage this waste is by oil recovery as its not only generate profit by extracting the remaining oil from the waste but also reducing waste volume and ensure the eco-friendly treatment to environment [3].

Ultrasonic cleaning is an evolving research especially in the manufacturing industries. Ultrasonic cleaning research is booming due to application and the fact that it is shown as an effective method for critical cleaning and extraction of remaining oil [4]. Potential application of ultrasonic cleaning is due to the cavitation bubbles, which is induced by high frequency pressure waves of ultrasound horn. There are other countless methods to treat the produced sand involving land farming, pyrolysis, oxidate thermal treatment, centrifugation using cyclotrons and electrode emulsification [5]. Regardless of these treatments, it can cause environmental pollution and soil contamination. Other than that, they also can be ineffective, time consuming and expensive due to high emulsion and high PHC concentration [5].

The cavitation which is induced during the cleaning process can be detected by several method. The detection of cavitation is crucial to detect and quantify the degree of acoustic cavitation in order to establish the effectiveness of ultrasonic cleaning vessel throughout of its volume [6]. The first research about the cavitation bubbles by erosion is in 1917 by Rayleigh [6]. Example of cavitation detection is by using aluminium foils erosion test, as it will record the erosion that occur to the aluminium foil due to explosion of the cavitation [6]. Besides that, the detection of cavitation also can used by SonoCheck^{TM} as it acts as an indicator based on the degradation of chloroform concentration by cavitation