UNIVERSITI TEKNOLOGI MARA

CFD MODELING OF ULTRASONIC WAVE PROPAGATION IN NON-CONSOLIDATED POROUS MEDIA

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ABSTRACT

Produce sand or oil sludge production is one of major solid waste and it needs to be removed to avoid future problem. Ultrasonic cleaning attracts main company in oil and gas industry due to the precision cleaning thus shown strong promise, but distance from transducer to material used, frequency used, diameter and wall thickness of material to need to be determine in order to enhance high efficiency cleaning. A cleaning reactor was designed with the ultrasound transducer installed at the bottom of the reactor. The pressure distribution, temperature, flow and effect on porous media were studied in this paper. Flow behavior of liquid was investigated using CFD calculation and simulation by ASNYS FLUENT software. Liquid in the reactor was exposed with sound waves with frequency of 68 kHz from transducer installed. Comparison between simulation results and experimental result was evaluated in term of pressure and cavitation field also temperature distribution. The modeling results showed the pressure and cavitation fields, temperature distribution was aligned with experimental values. Velocity vectors were used to investigate the mixing of the liquid exposing the ultrasound waves. The modelling shows flow behavior of 20kHz, 68kHz and 150kHz frequency, and velocity factor from 68kHz ultrasonic transducer used is compared. Porous media condition when transducer us activated also investigated in this project. Last but not least, some suggestion can be done to improve the efficiency of cavitation process when transducer is activated to enhance more cleaning activity in the designed reactor.

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CHAPTER 1
INTRODUCTION

1.1 RESEARCH BACKGROUND

Oil and gas still maintain as dominant energy resource in the world, finding a new source of energy is still in development phase and will take years to meet a good one. Oil and gas demand keep uprising day by day and it push major player in the oil and gas industry to search a newer technology to exploit the resource at lower price, high efficiency and safer to environment. Recent years show rapid declining in global crude oil price since 1973 since new phenomena known as Shale Revolution in the U.S. where global crude oil price decline more than 73% and its being predicted that the oil price in the future will remain in between U.S.$35 and U.S.$50 per barrel **[1]**

Ensuring oil and gas company can monetize the resource maximumly is by enhancing the production process. There are many things that can be contributing to enhancing the production process and controlling sand production is one of the way to control maintenance cost of equipment. Resist productivity, erode completion components, impede wellbore access and many other difficulties faces when unwanted sand production is being produce **[2].** Based on the fluctuation economy life of oil and gas industry, better separation process of produce sand and crude oil need to be found to operators can increase their desire crude products in high quality.

The viable disposal of producing sand from the oil and gas industry during petroleum transportation, storage, and refinery process is an around the world issue **[3]**. The sand producing sand can be removed by using ultrasonic cleaning technology. Produced sand also known as oily sludge needs to be removed to ensure the equipment used throughout the process always in its high efficiency. Separation of crude oil and producing sand using ultrasonic standing wave length have cause wide attention for the past decades due to its advantages of efficiency and simplicity **[4]**. The ultrasound wave propagates in sand producing medium, it creates compressions and rarefactions **[3]**. The pressure cycles apply a positive weight on the fluid by