



Faculty of Engineering

**EFFECTS OF VIBRATION ON SUSPENDED SOLID - SALINE
WATER SEPARATION**

Chung Yun Lee

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SEPARATION

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Author : Chung Yun Lee

Matric number : 16131

has been read and certified by:

Prof. Law Puong Ling

(Supervisor)

Date

**EFFECT OF VIBRATION ON
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SEPARATION**

CHUNG YUN LEE

This project is submitted in partial fulfillment of
the requirements for the Degree of Bachelor of Engineering with
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ABSTRACT

A solids-water separator equipped with multiple series of inclined coalescence plates (CPSI) was recently developed for removal of Total Suspended Solids (TSS) from water or wastewater. The design of separator by principles of the application of coalescence plates would enhance uniform flow of water or wastewater throughout the entire flow cross-section. The performance can be affected by factors such as influent concentration, flowrate, viscosity and specific gravity, rising properties, temperature, and the detention time of wastewater in the system. In this research, in addition to the experimental works that had been carried out to “proof-of-concept” on the effects of vibration on solids-water (saline water) separation, comparisons with other coalescence separators of different designs were also included. From this research, it can be concluded that vibrating CPSI could enhance suspended solids-water separation. However, in order to separate Suspended Solids (SS) from saline water effectively, optimal vibration frequency and amplitude need to be chosen for a specific known distribution of particle sizes in water, in addition to specific gravity of solid particles and viscosity of the liquid.

ABSTRAK

Penapis pepejal-air yang dilengkapi dengan plat bertautan condong berbilang siri (CPSI) telah dimajukan untuk menyingkirkan Pepejal Terampai Jumlah daripada air atau air sisa. Rekabentuk penapis ini menggunakan prinsip plat bertautan bagi menambahkan keseragaman pengaliran air sepanjang keseluruhan keratan rentas aliran. Kecekapan pemisah ini dipengaruhi oleh faktor luaran seperti kepekatan influen, kadar aliran, kelikatan dan graviti tentu, suhu, dan masa tahanan bagi air sisa dalam sistem itu. Dalam penyelidikan ini, sebagai tambahan kepada kerja-kerja eksperimen yang telah dijalankan untuk "membuktikan-konsep" bagi kesan-kesan getaran ke atas penapisan pepejal-air (air laut), termasuk juga perbandingan penapis bertautan yang berlainan rekabentuk. Hasil penyelidikan penyelidikan ini, dapat disimpulkan bahawa getaran pada CPSI dapat meningkatkan pemisahan pepejal-air. Walaubagaimanapun, untuk menyingkirkan pepejal terampai dan air laut dengan berkesan, frekuensi dan amplitud yang optimum harus dipilih untuk saiz zarah-zarah partikel tertentu dalam air, sebagai tambahan kepada graviti tentu partikel pepejal dan kelikatan dalam bendalir.

To my beloved parents

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LIST OF ABBREVIATIONS

TSS	-	Total Suspended Solid
CPSI	-	Circular Phase Separator with Inclined Dual Angles
SHO	-	Simple Harmonic Oscillator
ppt	-	parts per thousand
<i>v</i>	-	settling or rising velocity of the solid particle or oil droplet, m/s
<i>g</i>	-	acceleration due to gravity, m/s ²
<i>μ</i>	-	dynamic viscosity of continuous liquid, Pa.s
<i>ρ_{s/o}</i>	-	mass density of the solid particle/oil droplet, kg/ m ³
<i>ρ</i>	-	mass density of continuous liquid, kg/m ³
<i>d</i>	-	diameter of solid particle/oil droplet, m

Chapter 1

Introduction

1.1 Background

Suspended Solids (SS) are solids that either float on the surface of, or are in suspension in, water, wastewater, or other liquids, and which are largely removable in laboratory filtering. For instances, SS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. For most cases, high concentrations of suspended solids can cause many problems especially for stream health and aquatic life.

To maintain low level of suspended solids (SS) is important to both river and

lake ecosystems for ecological and water quality reasons. High concentrations of suspended solids degrade optical water quality by reducing water clarity and decreasing light available to support photosynthesis. Suspended solids can alter predator-prey relationships (for example turbid water might make it difficult for fish to see their prey (e.g., insects)). Suspended solids also influence metabolic activity and provide surface area for the sorption and transport of an array of constituents. Deposited solids alter streambed properties and aquatic habitat for fish, macrophytes, and benthic organisms. Deposited sediment may be available for resuspension and subsequent transport during periods of increased stream discharge suspended solids in most freshwater systems originate from watershed sources, pollutant point sources, and sediment resuspension. High stream solid particles can impact water quality and deposition in downstream lakes and reservoirs.

1.2 Problem Statement

In the market today, numerous types of oil remover or separator are being produced by an array of different manufacturers. From the vast body of available literature, there were a few aspects that had not been thoroughly researched or

well-studied with respect to vibration for enhancement of oil removal from water. There is a lack of research about the relationship between effects of vibration versus removal of SS from water. In short, it is the relationship of vibration on SS-saline water separation efficiency due to frequency and amplitude impacted into the water loaded with suspended solids.

Removal of solid particles from water is a liquid-solid separation carried out almost exclusively by gravity separation using settling of solid particles to remove it from water, either natural or enhanced. Enhanced gravitational separation can be accomplished with centrifugal units, air floatation and flocculation units, and in various type of coalescing plate separators (Burns and Mohr, 2000).

1.3 Objective of the study

The primary objective of this research is to analysis and observed the effect of vibration on the separation of suspended solid-saline water using Inclined Dual Angles Coalescence Plates.

1.4 Hypotheses

It is strongly hypothesized that when vibration is applied to the mixture of SS and saline water, the vibration motion would induce the suspended solids and water molecules to break up the bonding force between them after receiving sufficient energy to encounter the bonding, and thus the suspended solids would settle faster; a means of enhancement of removal of SS water.

1.5 Outline of Structure of Final Year Project Chapters

The thesis of the effect of vibration on SS-Saline water separation consists of six chapters which is introduction, literature review, methodology, result and analysis, discussion, conclusion and recommendation

1.5.1 Introduction

This chapter consists of background about this study that covers the general idea of SS, problem statement, objectives of the study and hypotheses of experiment

1.5.2 Literature Review

This chapter describes the characteristics of vibration, SS and saline water. This chapter reviews previous researches conducted by other researchers in an attempt to gain better understand in field related to vibration induced separation between solid particles and a liquid such as saline water.

1.5.3 Methodology

Further more, this chapter describes about the methods, procedure, equipments, experimental setup, analytical apparatus (especially for solid particles in water analysis) used in the course of this experimental exercise.

1.5.4 Result , Analysis and Discussion

Experimental results recorded methods of analysis are included in this chapter. The data were analyzed and presented in the forms of tables and graphs. The discussion section covers criteria such as the possible parameters or variables that could have influenced the outcomes of the experimental results.

1.5.5 Conclusion and Recommendation

This chapter covers the preliminary conclusions (not conclusive yet) that can be drawn from this research or study. Recommendations on the improvement research works for future study are also included.

Chapter 2

Literature review

2.1 General

Vibration is an oscillating motion of a particle or body about a fixed reference point. Saline water is a general term for water that contains a significant concentration of dissolved salts (NaCl). Suspended solids is an inorganic fraction (silts, clays, etc.) and an organic fraction (algae, zooplankton, bacteria, and detritus) that are carried along by water as it runs off the land. The attenuation of light in sea water (saline water) is related to the concentration of suspended solid matter inside the sea water. As the flow of sea water, the SS may settle to the bottom of sea.