

# **NATURAL AND WASTE MATERIALS AS ADSORBENTS IN OIL POLLUTION MANAGEMENT**

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Degree of Master of Science

Department of Chemical and Process Engineering

University of Moratuwa

Sri Lanka

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Thesis Submitted in Partial Fulfillment of the Requirements for the Degree Master of  
Science

Department of Chemical and Process Engineering

University of Moratuwa

Sri Lanka

March 2011

## DECLARATION OF THE CANDIDATE & SUPERVISORS

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Prof. (Mrs.) B.M.W.P.K.Amarasinghe

Signature of the supervisor: .....

Date.....

Prof. A.A.P.De Alwis

## Abstract

In this research, oil pollution management using natural and waste materials as adsorbents was studied. Most of the oil based industries emit oily wastewater rich in heavy oil particles. Therefore, this study was mainly focused to investigate a solution to the oily wastewater. Oil pollution management was achieved in two ways as oil recovery and oil treating using two different adsorbents in two stages.

In recovery stage, human hair was used as the adsorbent and experiments were carried out in two ways; as batch wise using hair pieces and continuously using a belt skimmer. Experiments revealed that human hair can recover 70.5% of oil from oily water and 1.35 mL of oil was recovered per gram of hair. The skimmer belt was prepared using human hair and the unit was used for continuous oil recovery. Skimmer Experiments showed that 75% of oil recovery after 30 rotations of the belt.

The dissolved and emulsified oil amount in wastewater was not reduced in recovery section. Therefore, in treatment stage, treating the dissolved and emulsified oil is the main objective and adsorption of oil onto carbonized rice husk was studied. Though carbonized rice husk was the main adsorbent in treatment stage other adsorbents, raw rice husk and saw dust, were also tested. The optimum carbonization temperature, 600°C and optimum carbonization period, 3 hours were used to prepare the carbonized rice husk. Batch experiments showed that carbonized rice husk has capability to adsorb 84% of dissolved and emulsified oil from aqueous solutions within 30 minutes when adsorbent dosage is 5g/L.

Batch experiments were examined in detail for carbonized rice husk to determine the factors affecting the oil adsorption. Experiments showed that Initial solution pH, initial oil concentration, contact time, adsorbent dosage and particle size affect on oil adsorption.

The adsorption kinetics of oil onto carbonized rice husk followed second order kinetic model confirming the chemisorption of oil particles onto carbonized rice husk and equilibrium data were satisfactorily fitted to Langmuir isotherm confirming monolayer oil adsorption onto the carbonized rice husk. Monolayer oil adsorption capacity of 2.24 mg of oil/ g of carbonized rice husk was observed.

Tests on oily wastewater samples from a service station showed that combination of these two units can be used effectively for treating the oily wastewater.

**Key words:** Oily wastewater, human hair, rice husk, oil recovery, oil adsorption

## DEDICATION

I dedicate this thesis to my parents with gratitude for their patience and dedication of their entire life for my education.



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**W.A.J.Anurangi**

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## LIST OF ABBREVIATIONS

<b>Abbreviation</b>	<b>Description</b>
API	American Petroleum Institute
BOD	Biochemical Oxygen Demand
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
COD	Chemical Oxygen Demand
CPC	Ceylon Petroleum Corporation
DAF	Dissolved Air Flootation
TDS	Total Dissolved Solid
TOC	Total Organic Carbon
TSS	Total Suspended Solids



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