

Dedication

This research is dedicated to my
Mother, father, wife, my daughter yumna, brothers, sisters and friends
with best wishes

ACKNOWLEDGMENTS

All praises and thanks are first due to Almighty Allah for giving me the opportunity to complete this work.

I would like to express my gratitude to my major advisor, Dr. Qurashi AbdAlla Gasselssed, for his sincere supervision and guidance throughout the supervision of this study. His word of advice and support meant a lot to me. I would also like to thank and to extend my appreciation and gratitude to Dr. Ibrahim Hassan Mohammed Elamin for this help and support. It was an honor to work with them.

I would like to express my gratitude and love to my parents, to whom their children's happiness is their meaning in life and for their patience.

I deeply acknowledge the encouragement, support, guidance and patience of my brothers and sisters.

Special appreciation goes to my wife and my daughter Yomna for their permanent moral, their support and love.

Words of thank to the staff members of (ERC) and especially for engineer Musaab.

My thank are due to staff members of Khartoum Refinery Company(KRC) limited for their help and especially to engineer Shalal and technician Ahmed Fathi.

Special thank to my colleagues and friends.

ABSTRACT

The chemical analysis of the parameters; hydrogen value (pH), total dissolved solid (TDS) dissolved oxygen (D.O), total hardness (TH), chemical oxygen demand (COD), and biological oxygen demand (BOD), of Elobied Refinery Company (ERC) waste-water and treated waste-water by Bagasse adsorbent were studied. The effects of particle size and voids fractions on loading and flooding points are also investigated. Skimming the oil from waste-water is conducted using an API pilot plant. The pilot plant of a channel length of 65.0 cm, width of 2.0 cm and depth of 14.0 cm under gravity flow. The ability of Bagasse material to adsorb emulsified oil from oily refinery waste-water was studied in a fixed packed bed column. Fixed packed bed experiments were conducted, using four different volumetric flow rates and four different packed heights at various packed weights. Low flow rate and high heights of packed bed were found to be more effective for the adsorption of oil under all the tested conditions, giving an efficiency of 87.6%. Optimum adsorption of oil was at a flow rate of 0.40 L/min, packed bed weight of 30 g and packed bed height of 40 cm with percentage removal of 87.0%. The same removal efficiency was obtained at ambient conditions with long residence time. Small values of voids fraction were found to be more efficient than high values but the problem is the flooding point. In column studies, it was observed that the decrease in flow rate resulted in an increase in the adsorption efficiency. The Bagasse adsorbent materials were found to be an efficient media for the removal of oils in continuous mode using fixed bed column. Different column design parameters like adsorption rate and adsorption capacity were calculated. It was found that the adsorption rate, voids of packing and adsorption capacity enhanced the efficiency of oil separation. A scale-up of the pilot plant data were used for a Bagasse filter design and the cake is utilized as an energy source for steam and electricity generation, with an improved caloric value.

الخلاصة

لقد تم إجراء التحاليل الكيميائية للعناصر التالية الرقم الهيدروجيني (pH)، المواد الصلبة الذائبة (TDS)، الأكسجين الذائب (D.O)، العسر الكلي (T.H)، مطلب الأكسجين الكيميائي (COD) ومطلب الأكسجين الحيوي (BOD) للمياه الملوثة لشركة مصفاة الأبيض المحدودة وكذلك للمياه التي تمت معالجتها بواسطة العمود المحشو بالبقاس. أجريت الدراسة أيضا علي تأثير حجم الجزيئات وكسور الفراغات للبقاس الذي استخدم في اذالة الزيت من المياه الملوثة للمصفاة و تحديد معدلات تدفق المياه الملوثة التي يحدث عندها الفيضان. تمت اذالة وقسطن النفط الطافي فوق المياه الملوثة بواسطة الحوض التجريبي الذي صمم لذلك و الذي يتكون من قناة طولها 65 سنتيمتر، عرضها 2 سنتيمتر وعمقها 14 سنتيمتر تحت تدفق الجاذبية. مقدره مادة البقاس لادمصاص الزيت الملوثة من المياه الملوثة الزيتية للمصفاة قد تمت دراستها بواسطة عمود الادمصاص المحشو الثابت. التجارب علي العمود المحشو الثابت اجريت باستعمال أربعة معدلات تدفق حجمية مختلفة للمياه الملوثة وأربعة ارتفاعات مختلفة للعمود المحشو و بوزان محشوة مختلفة. معدلات التدفق المنخفضة وكمية البقاس الكبيرة التي استخدمت في العمود المحشو اثبتت فعالية عالية في ادمصاص الزيت تحت كل الظروف التجريبية، حيث وصلت الكفاءة الي 87.6%. الامتلية لادمصاص الزيت من المياه الملوثة كانت بمعدل تدفق للمياه الملوثة يساوي 0.40 لتر في الدقيقة، كمية البقاس المحشو في عمود الادمصاص وزنها يساوي 30 جرام و ارتفاع البقاس في العمود يساوي 40 سنتيمتر حيث وصلت الكفاءة الي 87%. الكفاءة العالية لإذالة الزيت يمكن الحصول عليها بوقت السكن الطويل. القيم الصغيرة لفراغات مادة البقاس تبين بأنها كانت أكثر كفاءة من القيم العالية لكن المشكلة تكمن في حدوث الفيضان. في دراسات العمود المحشوة بالبقاس، يلاحظ أن النقصان في معدل تدفق المياه الملوثة يؤدي إلى زيادة في كفاءة الادمصاص. مادة البقاس اثبتت كفاءة عالية في إذالة الزيوت من مياه المصافي الملوثة و يمكن استعمال هذه الطريقة بمر مستمر في العمود المحشو. بارامترات تصميم العمود المختلفة مثل معدل وقدره الادمصاص يجب ان تحسب. وجد ان نسبة الادمصاص، فراغات المادة المحشوة و قدرة الادمصاص تزيد كفاءة إذالة الزيت من مياه المصافي الملوثة. الدراسة اثبتت ان البيانات التي تم الحصول عليها يمكن تطويرها لتصميم وحدة متكاملة لمعالجة مياه المصافي الملوثة حيث اثبتت الدراسة امكانية ذلك و جدواها الاقتصادية. يعتبر البقاس ملسد عمل في اذالة الزيت مصدر طاقة للبخار وتوليد الكهرباء.

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ABBREVIATIONS

pH Hydrogen value

TDS Total Dissolved Solid

DO Dissolved oxygen

TH Total hardness

TSS Total Suspended Solid

TOC Total Organic Carbon

TOD Total Oxygen Demand (TOD)

COD Chemical oxygen demand

BOD Biological Oxygen Demand

BOD5 Biological Oxygen Demand is a measurement of the amount of oxygen consumed by microbial degradation of wastes over a five day period of time.

API-type separator. A separator that uses gravity to remove undissolved oil from the water stream.

EDTA Ethylene Di amine Tetra Acetic Acid

EPT Eri chrome black T indicator.

API American Petroleum Institute

PP Polypropylene pp

CPI Corrugated Plate Interceptor

PPI Parallel Plate Interceptor

ERC Elbied Refinery Company

KRC Khartoum Refinery Company

DAF Dissolved Air Flotation

IAF Induced Air Flotation

RO Reverse Osmosis

GAC Granular Activated Carbon

PAC Powder Activated Carbon

BVs the number of bed volumes

ϵ the void fraction or porosity

ρ_s = Particle density

ρ_b = bed density

Δp = pressure drop

D_p = Particle diameter

μ = Viscosity

ΔL = Length

v' = Superficial velocity

V_w^* = Gas mass flow rate per unit column cross-sectional area, kg/m

F_p = Packing factor

μ_L = Liquid viscosity, Ns/m²

$L, \rho =$ Liquid and vapour density, kg/m^3

$g =$ Gravitational force

$\rho =$ Density of particle

$S, \phi =$ Shape factor

$h =$ height of cylinder

$D =$ Diameter of cylinder

$t =$ Thickness of cylinder.

$P_i =$ Internal pressure = $1.013 \text{ N/m}^2 = 1.013 \times 10^5 \text{ N} \times 10^{-6} = 0.1013 \text{ N/mm}^2$

$D_i =$ Inside diameter of cylinder = $2.5 \times 10^3 \text{ mm}$

$F =$ joint factor 165 N/mm^2

$N_{Re} =$ Reynolds number