Adsorption of Oxalic Acid on Activated Charcoal; the Langmuir and Freundlich Adsorption Isotherms

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Declaration

I, Mbulamwana Ivan, declare that this research work is my original work otherwise cited, and where such has been the case, reference has been made and that the same work has not been submitted for any academic award to any other academic institution.

Signature…….. Date ..12th/04/2023

Mbulamwana Ivan

Approval

This research work has been submitted for examination and has been approved my supervisor.

Dr. Egor Moses

Signature: ..... Date: 12/04/2023

Dedication

I dedicate my work to my loving mother Ms. Nantenza Dinah and my lovely father Mr. Kawujju Moses for the endless efforts and supports towards my education.

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List of Acronyms and Abbreviations

CWAO	-	Catalytic Wet Air Oxidation
CO	-	Catalytic ozonation
BT	-	Biological treatment
AC	-	Activated Charcoal
K_f	-	Freundlich Adsorption Isotherm
Q_e	-	Mass adsorbed on unit Mass of the Absorbent
C_e	-	Is the Equilibrium Adsorbent Concentration in solution
n	-	Freundlich Exponent
K_1	-	Langmuir affinity coefficient

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Abstract

The aim of this research is to demonstrate the experiment of oxalic acid on activated charcoal prepared from eggshells and eggshell membranes, in a medium of aqueous solution and the determination of either the Langmuir or Freundlich adsorption isotherms. The current report enhances the study of adsorption, chemisorption and physisorption. Different samples of oxalic acid were prepared and different masses of activated charcoal from eggshells and eggshell membranes was added and left on an electric shaker for about an hour until equilibrium was attained. Furthermore, the samples were filtered and then titrated against standard sodium hydroxide solution in order to deduce the concentration. Using the given equations related to the experiment, a graph of $\log \frac{1}{Q_e}$ vs $\log \frac{1}{C_e}$ in which the slope is 244.1 indicating that the Langmuir isotherm was determined and hence adsorption was monolayer. Hence activated charcoal from chicken eggshells acted as a good adsorbent for the removal of oxalic acid in wastewater.

CHAPTER ONE: INTRODUCTION

1.1 Background

Currently environmental pollution is one of the biggest issues in many countries. Environmental pollution may be in form of air pollution, water pollution and others. Water pollution contributes the major environmental pollution in many countries which shows a great impact to human life and biodiversity (Sharad, Supriya, Venkatesh, & Srihari, 2016). Among the potential sources of ground and surface water pollution are effluents that are always discharged from industries and agricultural processes. Both organic and inorganic pollutants can be found in waste water depending on the nature of activities that are always carried out at the source (Mdoe, 2014). This is because industries of various fields are releasing acids, scrap lumber, oils and pesticides as their waste into water bodies which are in turn causing pollution of these water bodies (Aziz & Baba, 2018).

Most organic pollutants found in wastewater originate from the effluents that are usually discharged from textile, pulp and paper, pharmaceutical, chemical and Petro- chemical industries. These organic pollutants when in the environment usually undergo oxidation yielding carboxylic acids and dicarboxylic acids, oxalic acid is an example of a dicarboxylic acid and is toxic to both human life and biodiversity when it is at high concentrations in water (Ishaq, Saeed, Ahmad, Shakirullah, & Khan, 2011) Waste oxalic acid is produced by the bleaching process during pulping, paper making, textile, dyeing and agricultural industries. The composition of waste oxalic acid is very different from that of ordinary wastewater such as ground water and municipal water (Manzoor & Sharman, 2020). Oxalic is an organic acid with a systematic name ethanedioc acid and formula (HO_2CCO_2H), it is a simplest dicarboxylic acid which is a white crystalline solid that forms a colorless solution in water. Oxalic acid undergoes many of the reactions characteristic to dicarboxylic acids, it forms esters such as dimethyl oxalate.

It is showed that oxalic acid it being a waste which is emitted in water bodies after various industrial process, has got a very low p^H and other harmful ions existing (Yagub et al., 2014).The presence of this acid in water at high concentrations causes human health problems being responsible for mutagenesis and leading to several pathologies such as carcinogenesis and jaundice (Alver & Metin, 2017). Some of the human health problems caused by this acid include the following explained below; It results into severe diseases like kidney stones (where you experience nausea, severe pain and blood in the urine as stones

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