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VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
Tel : +91 - 261 - 2227141 to 2227146, Toll Free : 1800 2333 011, Fax : +91 - 261 - 2227312
E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

DECLARATION

This is to certify that the work incorporated in the thesis entitled **"Sequestration of organic water pollutants using bagasse fly ash reused as zeolitic adsorbents"** submitted by **Mr. Olutayo Abiodun Oluyinka** (Registration No: 387 & Date: 26-08-2016) comprises the results of the original investigations carried out under the supervision of **Prof. Bhavna A. Shah**. It has not been submitted to any other University/ Institute for any degree or diploma.

Place: Surat
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Prof. Bhavna A. Shah
Supervisor

Olutayo A. Oluyinka
Candidate

Prof. N. B. Patel
Head of Department

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PREFACE

The more the world metamorphoses into a more and more inventive age, the more the environment is being interfered with in the wake of giving satisfaction to the modern needs of mankind. This has given birth to the establishment of industries whose manufacturing processes have been a major source of water pollution. In order to minimize the risks associated with water pollution and the associated costs of remediation, the application of low-cost techniques and materials are pertinent. In light of this, this research is focused on studies on the adsorption method of sequestrating the organic pollutants: **Aniline (AN), p-Nitroaniline (PNAN) and Nitrobenzene (NB)**, commonly used as raw materials or intermediates for the production of a wide range of consumer products and are usually the components of industrial effluents, from contaminated water. A sugar industry waste, **bagasse fly ash (BFA)** which was obtained at very little cost was used as the raw material for the synthesis of zeolitic composite materials and the materials studied for their sorption potentials for the aforementioned pollutants.

The goal of this research was to study the sequestration of **AN**; **PNAN**; and **NB**, by the porous zeolitic composite adsorbents that were synthesized from BFA. To achieve this, this work was directed toward the following objectives:

i. To synthesize zeolitic composite adsorbents using BFA, by **alkali fusion method** and **microwave alkaline hydrothermal method** with the incorporation of Ca(II) and Mg(II).
ii. To evaluate the sequestration performances of the synthesized adsorbents towards the pollutants from their respective aqueous solutions

iii. To characterize the adsorbents by their mineralogical constituents, surface morphologies, surface functional groups, thermogravimetric properties, and surface areas and porosities

iv. To investigate the effect of syntheses methods on the properties of the adsorbents and the adsorption performances

v. To investigate the possible mechanisms for the adsorption processes via adsorption isotherm models, kinetics models and thermodynamic studies.

The thesis is divided into **five** chapters followed by the conclusions. The description of each is given below:

i. Chapter-1: Introduction and Literature Review

This gives an overview of environmental pollution, causes and consequences. It identifies industrial activities as the main cause of water pollution, narrowing it down to the pollution caused by selected organic pollutants which include aniline, p-nitroaniline and nitrobenzene. It examines the possible methods of decontaminating water against these pollutants but portrays adsorption as a preferable method. It also examines the recent trend of exploiting industrial and agricultural wastes for the decontamination of polluted water and the benefits this could offer. The closing part of this chapter states the aim of the research and outlines its objectives.

ii. Chapter-2: Experimental

This chapter describes the experimental methods involved in the present research work. The approaches used for the syntheses of the zeolitic composite adsorbents from bagasse fly ash focus on the study of the comparative performance of two sets of adsorbents which were synthesized by two distinct synthetic methods (i) **Alkali Fusion Method** and (ii) **Microwave Alkaline Hydrothermal Method**. One

set of the adsorbents comprising **CaFZBFA** and **MgFZBFA** was synthesized by **Alkali Fusion Method** while the other comprising **CaMZBFA** and **MgMZBFA** was synthesized by **Microwave Alkaline Hydrothermal Method**. The syntheses were followed by adsorption experiments involving the adsorbents against the pollutants **AN, PNAN** and **NB** in their respective aqueous solutions and under different adsorption conditions such as pH; contact time; adsorbent dose; concentration of the pollutants; and temperature of the system, for the sake of performance optimizations for the real applications.

iii. **Chapter-3: Spectral Analysis**

This section contains the characterization of the synthesized sorbents by their mineralogical constituents, surface morphologies and surface functional groups. As portrayed by the instrumental techniques such as XRF, PXRD, FTIR and SEM.

iv. **Chapter-4: Thermal Analysis**

This section describes the stabilities of the adsorbents and the physical and chemical changes over a wide range of temperatures. Coats and Redfern method was used to evaluate the kinetic parameters that are associated with the physical and chemical changes in the adsorbents during the thermal treatments.

v. **Chapter-5: Results and Discussion**

This part examines the adsorption performances of the adsorbents against the pollutants at several experimental conditions such as pH, contact time, initial concentration, adsorbent dose and temperature. It also inspects the possible mechanisms for the adsorption processes via the consideration of isotherms, kinetics and thermodynamic studies.

vi. **Conclusions**

This section contains the concluding remarks from this research.

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