SCREENING OF BIOADSORBENTS FOR NO_2 REMOVAL FROM AQUEOUS SOLUTION

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Abstract:

The current paper describes the development of bioadsorbents that are environmentally friendly for removing NO_2 from aqueous solutions. Powdered adsorbents were made from Eclipta Alba leaves, Vettiveria zizanoides zizanoides roots, Musa paradisiaca fruit peel, Hyacinth Bean Peel, and Allium Sativum husk. The batch adsorption experiments with these adsorbents for NO_2 removal were carried out at room temperature. The process of NO_2 adsorption is carried out using unmodified, physically modified (Microwave treated), and chemically modified materials in order to assess their efficiency in removing NO_2 from aqueous solution. Adsorbents Eclipta Alba, Vettiveria zizanoides, and Musa paradisiaca demonstrated exceptionally high NO_2 adsorptivity. The order of efficiency of selected adsorbed material is Eclipta Alba> Vettiveria zizanoides> Musa paradisiacal> Hyacinth bean seed>Allium sativum. The samples are treated in the following order of efficacy: microwave treated samples>chemically treated samples>untreated samples (adsorbents). Because the efficacy of Eclipta alba leaf powder, Vettiveria zizanoides, and Musaparadisiaca is high, they were chosen for further research. Because there is little difference between physically/chemically treated samples, physically modified adsorbents will be used to develop the catalytic tube for controlling air pollution caused by vehicular exhaust.

Keywords: Bioadsorbents, adsorption, environmental, economical, batch method, efficiency, pollution, catalytic tube, vehicular exhaust.

Introduction

Urbanization is a transformation that has largely gone unnoticed by most developing-country policymakers. This is unavoidable because it is inextricably linked to the process of economic development. On the one hand, while urbanisation has benefited economic development, employment, and income levels, it has also brought with it drawbacks such as insufficient water supplies, sanitation, waste disposal issues, traffic congestion, air and water pollution, and a hazardous environment.

In comparison to water and sanitation issues, air pollution is a relatively new concern in Indian cities. Pollution from industry and automobiles exposes ordinary city dwellers to illness and health risks. Mining for fossil fuels like coal and petroleum products captures the enormous amount of energy stored in fossil fuels, allowing industrial civilization to emerge. The use of these fuels contributes to a variety of pollution in the atmosphere. The most common air contaminant is SO_2/NO_2.

Environmental scientists and management are considering environmental sustainability as urbanisation in India is accelerating at an alarming rate, putting stress on natural resources and resulting in inescapable environmental effects. Even when growth is done responsibly, environmental determination in the future or present is inevitable in order to give the underprivileged segment of society a decent standard of living. There has been extensive harm and degradation as a result of the trend of rural-urban migration in recent years.

An inclusive urbanisation approach is needed, in which waste products must be collected for efficient solid waste management, in order to spread the idea of zero waste among urban inhabitants. In accordance with the 3R's, the present idea reduces air pollution caused by SO_2/NO_2 by using inexpensive waste products (Reuse-Reduce-Recycle). A low-cost, ecologically friendly air filter that may be installed was created using waste and inexpensive components that were first screened.

Materials and Methods

1. **Eclipta Alba leaf powder**

All over India, in wastelands that are moist or humid, the plant can grow up to 2000 metres in the hills. It is a white-flowered, branching herb that can be upright or prostrate. Wedelolactone[1.6%] and demethyl wedelolactone2 are abundant Coumestan derivatives in Eclipta alba's chemical makeup. Although all plant parts, including the seeds, stems, roots, and leaves, have a wide range of therapeutic benefits. The leaves include stigmasterol, a-terthienymethanol, wedelolactone (1.6%), desmethylwedelolactone, and desmethyl-wedelolactone-7-glucoside 4.

2.Vettiveria zizanioides.

In most grasses, fibrous roots extend from the underground portion of the culm and hold the soil in a horizontal position. In contrast, the main root, secondary root, and fibrous ramifications of Vettiveria zizanoides all penetrate the soil vertically. The most commercially beneficial and biologically necessary part of Vettiveria zizanoides are its roots. The roots of Vettiveria zizanoides aid in the absorption of toxic substances, chemical fertilisers, pesticide residues, and heavy metals, as well as the enhancement of physical elements and organic matter decomposition. Additionally, they regulate soil moisture and gather water. Their plants help regulate soil health and conserve soil and water as a result (Anonymous, 1996). They are an important source for aromatic essential oils, which are used for a variety of medical and

perfumery applications. A range of household items and crafts are made using dry roots as a basic material (Lavania, 2003).

3. **Bananapeel/Musa paradisiaca fruit peel powder as an adsorbent**

Banana fruit peel was gathered in Mehdipatnam, Hyderabad, Telangana, India's Gudimalkapur Fruit Market. Before being used as an adsorbent to extract NO2 from an aqueous solution, the banana peel underwent physical and chemical modification.

Before being processed in a home grinder, the banana peel was allowed to air dry for ten days. The powder was stored in an airtight container for later usage.

Banana peel was partially dehydrated in a home microwave oven with 10 distinct power settings ranging from 90 to 900 watts. The product was dehydrated at 180W for 2 minutes to increase its shelf life.

The banana peel underwent chemical processing by being submerged in $KMnO_4$ for 12 hours. An effective oxidising agent that quickens the oxidation process is $KMnO_4$. Ethylene is removed from horticulture products using MnO_4 scrubbers. Numerous studies indicate that $KMnO_4$ treated materials will increase the shelf life of products. Because of the pectin, lignin, and viscous substances present1,2, super morphology studies carried out by earlier researchers revealed that the unmodified/untreated banana peel lacked any micro porous structure. The presence of $KMnO_4$ has changed the surface's structure. The surface was uneven with numerous connections and open pores. The surface has been altered by oxidation and the creation of extra hydroxyl and carboxyl groups. All three of the treated banana peels were used in a comprehensive analysis that took into account all of these factors.

Characteristic properties of Banana peel (Untreated)

Numerous authors have examined banana peel using FTIR analysis, and the findings show that there are several functional groups (1-4). In the experiments, functional groups of alcohols, phenols, and carboxylic acids were found in free hydroxyl groups of polymeric materials like lignin or pectin. A banana peel that had not been treated by SEM was found to have spherical particles that were heterogeneous in character at the surface and had an amorphous material structure.

4. **Hyacinth bean seed powder**

Asia, especially India, grows the tropical African perennial bean known as the hyacinth bean as a food crop. In Telangana, India, hyacinth plants are frequently grown. In rural Telangana, it serves as a protein source. It is a native of Africa and a member of the Fabaceae family. All over the tropics, it is utilized for food.

Hyacinth seed powder-based coagulants are frequently used in waste water treatment techniques. Hyacinth seeds are polymers and polyelectrolytes and include a number of functional groups. Hyacinth seed powder was selected for evaluating adsorbents for removing NO_2 from aqueous solutions in light of this. Hyacinth seed powder's solubility, foaming ability, and emulsifying activity are all excellent functional characteristics. Hyacinth peel powders come in three different kinds, and they are used in adsorption studies. Although untreated, hyacinth seed powder is microwave-irradiated and chemically altered with potassium permanganate before usage.

Hyacinth seed powder:
Using a domestic grinder, hyacinth seeds that were purchased from a nearby store and sun dried for a week was mashed into powder. The powder is sieved and kept until use in an airtight container.
Physically modified Hyacinth powder:
The market-purchased hyacinth seed was sun-dried before being processed into powder in a home grinder. The powder is cooked in a home microwave for 35 minutes at 180 watts after sifting. Insect prevention and long-term storage both benefit from microwave heating.
Chemically modified Hyacinth powder:
Prior to being dried and processed into powder with a domestic grinder, hyacinth seeds were first immersed in a $KMnO_4$ solution for a day. The powder is kept in an airtight container for later usage.
Hyacinth powder is used without any treatment it is physically modified by microwave irradiation and it is chemically modified by potassium permanganate.

5. Allium Sativum peel powder (Garlic waste) (Unactivated)
The raw material for the adsorbant, garlic peel, was procured at the Gudimalkapur market in Hyderabad, Telangana, India. The dry waste was crushed and sieved. To be used later, garlic powder was created and kept in an airtight container.

The following are the physiochemical features of Allium Sativum:

S.No	Characteristic property	Percentage(%)
1	Cellulose	19.6
2	Protein	14.98
3	Carbohydrate	0.32
4	Moisture Content	7.9

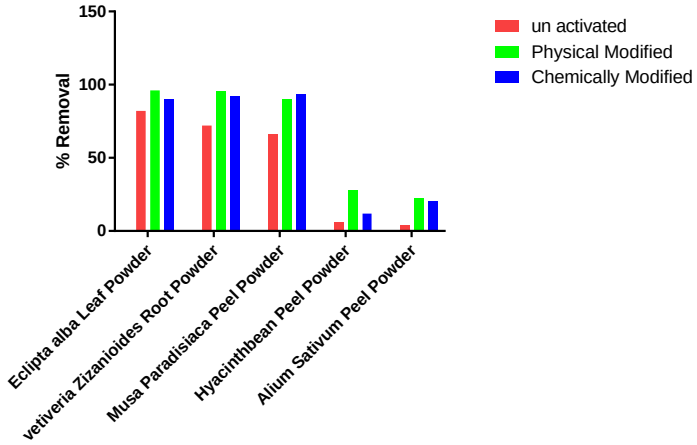
Characteristic properties of Allium sativum
The physiochemical properties of garlic have been discussed by a number of authors. Allium sativum peel powder was analysed using FTIR to identify alcohols, phenols, aliphatic hydrocarbons, phosphotes, triazone compounds, primary amines, and aromatic substances.

SEM anlaysis of Garlic peel powder:
Allium Sativum peel/skin powder includes the polysaccharides cellulose, hemicelluloses, and lignin. An XRD analysis reveals that Allium Sativum is amorphous. Conduction and distribution tubes in plant tissues have been arranged in tiny structures that could help porous suction develop.
Physically activated /modified Allium Sativum:
For two minutes at 180 watts, allium sativum powder is heated to enhance its physical and adsorption qualities. the chemical surface affects the surface chemistry of carbon-plant-based materials, it is necessary to modify the existing surface in order to activate the hetero atoms found in bioadsorbents.
Chemically modified Allium Sativum:

The Allium sativum bulbs were air dried before being submerged in $KMnO_4$_ solution for 3–4 minutes (and microwave heated). They were utilised to screen adsorbants for extracting NO_2 from aqueous solution to control NO_2 emissions from vehicle exhaust.

Results and Discussions:

For the removal of NO_2 from aqueous solution using microwave activated, unactivated, or chemically modified Allium sativum, a high proportion of the peel is removed. Order of efficiency is microwave > chemically altered > unaltered



Order of Efficiency of Adsorbents for the Removal of NO_2

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