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A REVIEW ON RECENT POTENTIAL APPLICATION OF COST EFFECTIVE, ECO – FRIENDLY ADSORBENTS FOR REMOVAL OF HEAVY METALS

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ABSTRACT

Heavy metal contamination is a major environmental issue and a health concern too. These metals are persistent in the environment, contaminate the food chain and are toxic. There are various promising techniques for their removal but adsorption is an ideal alternative to other expensive methods. This review article focuses on different types of low cost adsorbents and their efficiency. There are many remediation methods but adsorption is efficient and cost effective. Adsorption using low cost adsorbents like agricultural waste and marble waste is an innovative solution for heavy metal removal. Agricultural waste are cheap and abundant, these have important benefits over commercial activated carbon. Marble waste is an environmental issue, as this industry is growing, waste disposal has become a huge concern and threat to the environment and human health. This utilization converts the agricultural and marble wastes into value-added product and at the same time decontaminates the environment. This industrial waste reutilization has a major impact on the economic growth of the country.

Keywords: *Heavy Metals, Adsorption, Low Cost Adsorbents, Zeolite, Agricultural Waste, Marble Waste, Industrial Waste.*

Introduction

The term “heavy metal contamination” refers to the direct or indirect release of hazardous heavy metals into the environment. Their tenacity makes it an international issue.

New contaminants are emerging along with growing industrialization, causing serious health and environmental hazards on a worldwide scale.

Numerous hazardous materials, including heavy metals (Pb, Ni, Cu, Hg, Cr, etc.), are included in this industrial waste.

Because heavy metals are hazardous to both individuals and the environment, they are a serious problem. In the environment, heavy metals do not biodegrade due to their high density.

Conventional approaches to treat heavy metals include oxidation, reduction, ultrafiltration, electro dialysis, and ion exchange. However, these approaches have a number of drawbacks, including low efficiency and the inability to completely remove the heavy metals at higher concentration.

These methods are based on different principles and processes, like reverse osmosis uses cellophane membranes, the process of ultrafiltration works on size exclusion principle.

Chemical precipitation involves the usage of chemical reagents and coagulants, electro dialysis works on the basis of potential difference.

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Apart from all these usual methods, there is a new way of separating these metals, that is adsorption.

Adsorption is an eco-friendly, economical, and efficient alternative to all of these techniques.

The process of adsorption involves the accumulation of atoms or molecules on a surface; the material deposited is referred to as the adsorbate, and the surface is referred to as the adsorbent.

Adsorption using low cost adsorbents is very economical, one such low-cost adsorbent is industrial solid waste, which can be used for adsorption.

Adsorption using inexpensive adsorbents, such as those derived from industrial solid waste and agricultural waste, is one of the most effective ways to remove heavy metals.

High bio sorption capacity is demonstrated by cellulose-containing agricultural waste and plant wastes in both modified and unmodified forms can be utilised.

An inexpensive substitute for commercially available activated carbon is agricultural waste.

Natural stones like marble are formed using a variety of methods. The increasing demand is causing the marble business to grow steadily. The entire process consists of several steps, and after the polished marble is finished, marble dust is also created.

When marble trash is disposed of in landfills, it pollutes the environment in several ways.

There is a solution to this, as waste marble has the ability to function as zeolite and an adsorbent.

The importance of garbage has changed due to growing environmental and public health concerns; recycling waste is the most sustainable option.

This paper reviews the different types of low cost adsorbents, their efficiency and combinations:

- Zeolite from marble waste
- Sugarcane waste (bagasse)
- Coconut husk
- Groundnut shell
- Rice husk

Importance of Heavy Metal Removal

Pollutants found in industrial discharge (waste) include heavy metals, which are particularly dangerous since they can cause cancer. Both the environment and living beings are harmed by these.

When heavy metals are combined with other environmental factors like soil, water, or air, they can become extremely poisonous. The heavy metals Pb, Zn, Cu, As, Cr, Ni, Cd, and Hg are most commonly detected in industrial waste.

Usefulness of these metals cannot be denied but their excess amount is very harmful.

Like copper is necessary for the creation of enzymes, but it's excessive use can be harmful. Numerous cancers can occur by arsenic. Nickel can lead to lung fibrosis and gastrointestinal irritation. As a neurotoxic, mercury has an impact on the nervous system. Chromium has carcinogenic properties. Pb can lead to number of different body system dysfunctions.

Since commercial zeolite is expensive, creating zeolite from leftover marble powder is an innovative method.

Hydrated crystalline alumino silicates are what natural zeolite is made up of. Waste marble powder can be utilised as a zeolite due to its significant silica and alumina content. A possible adsorbent can be formed by agricultural waste, including peanut shells, rice husk, coconut husk, and sugarcane bagasse.

These materials are abundant, inexpensive, and environmentally benign, among their numerous benefits.

Bagasse, or around 25% of the total weight, is recovered as a residue after sugarcane is ground for juice extraction. It is a potential adsorbent.

The disposal of groundnut shell, a carbonaceous fibrous solid waste, is a challenge. It is capable of becoming an adsorbent.

32% cellulose, 20% hemicellulose, 21% lignin, and 20% additional organic materials, such as protein and fat, are found in rice husk. It have the ability to adsorb.

The husk of coconuts has bio adsorbent properties.

Each of the adsorbents listed above are both economical and effective.

When treating industrial waste, using waste materials adsorbent will be more cost-effective than using other more involved techniques. The amount of waste marble that is produced at various phases is so much that storage becomes an issue. This method of using marble trash will not only reduce pollution to the environment but also have economic benefits.

The adsorbents derived from the components listed above are practical and reasonably priced : Marble trash and composite agricultural waste.

- A combination of marble debris and agricultural waste composite could work well as an adsorbent.
- The review of the literature indicates that heavy metal removal has been extensively studied.
- There are numerous traditional techniques for removing heavy metals.

Research has been done on the adsorption of industrial waste by utilising agricultural waste. A composite of agricultural waste has been examined utilising KCl as an activating agent for Pb(ll) and As(ll) adsorption. Coconut husk, both raw and acid-treated, shown a good capacity to adsorb Cr and Ni.

Groundnut shells are effective bio adsorbent for the elimination of heavy metals and the treatment of waste.

The effectiveness of sugarcane bagasse as an adsorbent for heavy metals is 89.31% for Pb (ll) ions and 96.33% for Ni(ll) ions, respectively. For the removal of Zn and Fe, it demonstrated 89% and 91% efficiency, respectively. It also shows adsorption of Fe2+ ions.

Adsorption of heavy metal ions from waste water utilising various techniques was demonstrated by rice husk. For Cu (ll) removal, rice husk treated with H3O4 is utilised.

Cu and Ni were successfully absorbed by rice husk and orange peel, and using a batch adsorption procedure, rice husk powder adsorbed Cr, Pb, and Zn.

Activated carbon and natural zeolite were successful in removing Pb2+ and Cd2+ ions.[30] The zeolite-like compounds made from marble powder exhibited encouraging adsorption capabilities. With an effectiveness of 96.01%, marble powder was able to remove zinc effectively.

Conclusion

Massive industrialisation is accompanied with the emergence of new pollutants posing severe health problems and environmental issues globally.

There is a need for an improved quality treatment for the removal of hazardous materials and metal ions from the environment.

A review of various adsorbents for heavy metal removal shows that adsorption by the help of low cost adsorbents shows good efficiency in elimination of heavy metals from industrial waste.

These low cost adsorbents are cost effective and environment friendly.

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