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Drinking Water and Health: A Unique Solution for Remediation of Contaminated Water for Sustainable Health

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Abstract—*Contamination of drinking water is a major concern as it has a great impact on human health. Its remediation for removal of contaminant through green and sustainable methodology can ensure to provide safer health. Rice husk is found to be very efficient and environmental benign adsorbent for the removal of heavy metal ions found in contaminated water. An easy protocol is achieved for the fixation of heavy metal ions. Use of waste material is an additional ecofriendly attribute of this methodology. Moreover easy formation of nanosilica from rice husk is an attractive feature of this paper.*

1. "INTRODUCTION"

It is a well-known fact that clean water is absolutely essential for healthy living. Adequate supply of fresh and clean drinking water is a basic need for all human beings on the earth, yet it has been observed that millions of people worldwide are deprived of this.

Freshwater resources all over the world are threatened not only by over exploitation and poor management but also by ecological degradation. The main source of freshwater pollution can be attributed to discharge of untreated waste, dumping of industrial effluent, and run-off from agricultural fields. Industrial growth, urbanization and the increasing use of synthetic organic substances have serious and adverse impacts on freshwater bodies. It is a generally accepted fact that the developed countries suffer from problems of chemical discharge into the water sources mainly groundwater, while developing countries face problems of agricultural effluent in water sources. Polluted water like chemicals in drinking water causes problem to health and leads to water-borne diseases.

Water sources (groundwater, lakes, streams and rivers) can be polluted by heavy metals leaching from industrial and consumer waste; acid rain can exacerbate this process by releasing heavy metals trapped in soils. Plants are exposed to heavy metals through the uptake of water; animals eat these plants; ingestion of plant- and animal-based foods is the largest sources of heavy metals in humans. Toxic heavy metals can bioaccumulate in organisms as they are hard to metabolize [1-9].

The most ubiquitous of toxic metals in drinking water is lead. Lead and copper can leach from water pipes and soldered joints which deliver water to our tap. This is especially a problem in older homes. The toxic effects of lead can lead to nerve and brain damage. Children are especially sensitive. Exposure may also lead to kidney damage, and blood disorders. The Environmental Protection Agency's maximum concentration level for lead is 0.005 mg/L in water. Copper, a by-product of pipe corrosion, acid mine drainage, iron and steel production, and sewage treatment can cause anemia, digestive disturbances and liver and kidney damage at high exposure levels. The MCL for copper in drinking water is 1.3 mg/L. Chromium, a by-product of mining, chrome plating, cement production, detergents, and incineration can cause liver and kidney damage. The MCL for chromium in drinking water is 0.05 mg/L [10-12].

Numerous water purification and treatment methods have been developed [13]. Adsorption is one of the most economically practical and technically simple methods [14]. Adsorbents obtained from agricultural wastes or by-products have attracted considerable research attention because of their low cost, availability, abundance, and renewability. Consequently, many low-cost adsorbents for wastewater treatment have been studied [15-27].

Rice husk (RH) is an abundant agriculture residue in rice-producing countries, with its global annual production reaching roughly 80 million tons, of which half is produced in China [28]. Thus, theefficient utilization of RH rather than wasting and burning poses a challenge. Fortunately, the unique properties, ecological safeness, and low cost of RH have rendered this material a promising adsorbent for Cr(VI) removal.

The chemical composition of RH has been found to vary from sample to sample. Any of the differences in various type of paddy, crop year, climatic and geographical conditions, soil chemistry, sample preparation, or method of analysis could be a reason for this variation. RH is an excellent source of high-grade silica [29-31]. The presence of silica in RH has been known since 1938 [32], ever sinceseveral efforts on preparation of silica from RH by researchers have been known internationally [33-40].This kind of silica has been shown to be a good material for the synthesis of very pure silicon, silicon nitride, siliconcarbide, magnesium silicide, and other applications[41].

Recently, nanotechnology has aroused considerable scientific interest because of new potential uses of particles on a nanometric scale. Thus, industries may be able to reengineer many existing products to function at unique levels. The production of reactive nanoscale silica from RH is a simple process compared to other conventional production techniques such as vapor phase reaction, sol-gel process, *etc*. [42]. The emphasis of this paper is to optimize the conditions for the preparation of highly purified rice husk ash (RHA), of which nanosilica is then extracted, and to study its application for the removal of heavy metal ions(*e.g.* Cd, Cu, Hg, Cr, Pb, Zn and Ni) from waste water.

2. "RESULTS AND DISCUSSIONS"

2.1. Materials

The raw material was obtained from a rice mill of Uttar Pradesh (India). All reagents used were of analytical grade, and their solutions were made up in twice distilled, deionized water. HCl, NaOH, were of laboratory grade from Merck.

In course of our search for exploration of adsorption power of rice husk; we tried to extract silica from it. For extraction of silica we tried various methodologies given by various chemists. But by changing some of the steps we got maximum yield of silica from rice husk.

2.2. Methods

a) "Tap water washing and acid treatment"

RH was washed thoroughly with water to remove the soluble particles, dust, and other contaminants present, whereby the heavy impurities such as sand are also removed. Rice husk was then filtered through ordinary sieve used in kitchens. It was then dried in an air oven at about 110°C for 24 h. The dried RH was refluxed with an acidic solution of HCl (1N) for nearly 90 min by stirring frequently. It was cooled and kept intact for about 20 h. It was then decanted and thoroughly washed with warm distilled water until the rinse became free from acid, and this was designated as RH'. The wet RH' was subsequently dried in an oven at 110°C for 24 h.

b) "Thermal treatment"

A weighed RH' as well as RH were subjected to heat treatment to obtain the ash. Samples were burned inside a programmable furnace (Nabertherm controller B 170, Nabertherm GmbH, Lilienthal, Germany at different temperatures (500°C, 700°C, and 1,000°C) and rates (2°C/min, 5°C/min, and 10°C/min) were checked. We designated these as ashes (RHAs).

c) "Extraction of silica"

A sample of 20.0 g RHA was stirred in a 160 mL, 2.5 M NaOH solution. The solution was heated in a covered beaker for 3 h by stirring constantly and filtered; the residue was then washed with 40 mL of boiling distilled water. The obtained viscous, transparent, and colorless solution was allowed to cool down to room temperature, and 10 M H_2SO_4 was then added under constant stirring at controlled conditions until it reached pH 2; NH_4OH was added up to pH 8.5 and was allowed to stand at room temperature for 3 h.

d) "Preparation of nanosilica"

Nanosilica was prepared by reflux technique of the above extracted silica with 6.0 M HCl for 4 h and then washed repeatedly using deionized water to make it acid free. It was then dissolved in 2.5 M NaOH by stirring. H_2SO_4 was added until it reached pH 8. The precipitate silica was washed repeatedly with warm, deionized water to make it alkali free and then dried at 50°C for 48 h in the oven.

The high mechanical strength, chemical stability and granular structure of pretreated rice husk make them efficient adsorption material for treating heavy metals from waste water. By using the rice husk, remediation of waste water can be done by removing toxic heavy metals such as Cd, Cu, Hg, Cr, Pb, Zn and Ni from it.

2.3. Purificaton of waste water

In order to show the merit of this protocol, synthesized nanosilica is packed in the glass column by proper tapping waste water is then passed through the column slowly. Metal ions bound with silica and pure water is obtained.

3. "CONCLUSIONS"

This environmental benign procedure offers several promising features for the treatment of waste water. The application of rice husk for waste treatment can evolve as economically sustainable and environmental friendly approach to remove toxic metals from water and soil. One waste becoming scavenger for another waste material can be well emphasized by this paper.

4. "ACKNOWLEDGEMENT"

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