Synthesis of Agro waste Nano Composites Using coconut and rice husk for adsorption of chromium ions

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Abstract
As India is the second largest country producing wheat and rice in the world resulting in production of large amount of residue. Agro Residue burning has become biggest environmental problem in India causing air pollution, global warming as well as health issues. As nanotechnology is most fascinated area in every field including pharma, food and cosmetics so scientists are trying to utilize these agro residues in the field of nanotechnology. In this study, agro residues specifically coconut husk, rice husk and rice straw were subjected to alkaline and bleaching treatment which further resulted in nano cellulose-composites which have application in heavy metal adsorptions. In this study nano-composite of coconut and rice husk has capacity of about 97-100% absorption of chromium heavy metal ions.

Keywords: Agro waste, metal ions, nanoparticles, green synthesis

Introduction

As we know, huge quantity of cellulose based wastes are generated in each community which left largely undigged, one of these is agricultural waste. Agricultural waste also known as agro-waste consists of food waste, animal waste, crop waste, etc. As rice is the most cultivated cereal crop so rice husk and rice straw are the potential agro-wastes generated in huge quantities in all over the world [1-3]. Open burning of such agro wastes create environmental related problems like air pollution, global warming, etc. Reuse is the best component for minimizing these wastes or residues because economic values of these wastes are much less than that of their collection, transportation and processing for favorable use. Agricultural waste such as husk, shells, straw, bark, bagasses and leaves can be of better use in the field of nanotechnology because of their high cellulose content [4-6].

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As cellulose is a non-toxic, bio-degradable polymer with high tensile and compressive strength, it has extensive use in various areas such as cosmetics, nanotechnology, pharmaceutical industry, paper industry, food industry, textile and drug-delivery systems in treating cancer and other diseases [7-8]. Processing of these agro-food residual materials for the production of nano-cellulose can be a beneficial way for the manufacturing of green materials [9-10].

Nowadays, nanotechnology is the most growing area in each and every field. Cellulose molecules with at least one dimension in nanoscale, 1–100 nm are referred as nanocellulose. Micro-crystalline cellulose is most commonly used cellulose derivatives in the cosmetics, food, pharma industry, etc [11-13]. and is an important excipient due to its tableting and binding properties [14-15].Nanocellulose and its applications receive high attention in both industrial & research areas due to its unique properties such as high crystallinity, high strength, large surface area, rich hydroxyl groups for alteration and natural properties with 100% environmental friendliness. Use of nanocomposites is beneficial due to their low density, low cost and huge variety of cellulose sources. Nanocellulose have many applications like anti-microbial agent, strength enhancer, coating and pharmaceutical excipient. Adeeba and coworker (2019) also syntheisised nanopartciles from agro waste similarly [16] Jeetu Dubey and Ajay Singh in 2019 also syntheised nanoparticles from fruit waste on similar pattern.

In this study, synthesis of nano composites have been done by using agro residues such as rice coconut husk and rice straw by extraction method and then so formed nano-composite was applied for adsorption of heavy metals ions(specially chromium ions).

Materials and Method

Materials

Rice husk, rice straw and coconut husk were collected from nearby milling industry and local market and then dried in sunlight. These dried residues were then grinded to fine size and passed over 40 or 60 mesh sieve.

Equipments: magnetic bead, magnetic stirrer, whatman filter paper, vacuum pump, oven. Chemicals: sodium hydroxide (NaOH), glacial acetic acid (CH_3COOH), hydrogen peroxide (H_2O_2).

For whole experiment, distilled water is used.

Method

Preparation of cellulose nano composites: By using 5% NaOH solution, cellulose was extracted from coconut husk, rice husk and rice straw. Transfer 10g of each sample in different conical flask and then add 150-200ml NaOH solution (5%) to each conical flask and then place these flasks on magnetic stirrer for about 3 hours at 80-1000C. After this, samples were filtered by using vacuum pump and washed continuously with distilled water for the complete removal of alkali. Filtered samples were taken out in petri dish and kept in air circulating oven for drying at 600C for about 5-6 hours. After alkali treatment, process of delignification is carried out. Different samples were treated with hydrogen peroxide (30%) solution at 500C for 3 hours. Again, resulting fibers were filtered by vacuum pump and washed continuously with distilled Many researcher have used this method for preparation of nano composites [17-19].

Fig-1

Fig-2

Fig-3

Fig-1 shows cellulose nano partciles of coconut husk only, Fig. 2(II) cellulose nano partilces of rice straw, and III) showm cellulose nano composites of rice husk and coconut husk. Fig.3 Composite formed (III) is yellowish in color and appears to be spongy.

Result and Discussion: In the proposed work we elaborate the green synthesis of cellulose nanoparticles by using agro waste the synthesized nanoparticles are structurally analyzed by using various analytical tools.

Scanning Electron Microscopy (SEM) Analysis: For obtaining morphological data of synthesized nanoparticles the three dimensional images were obtained by using SEM Analysis, which is shown in figure 4. By SEM analysis it is clear that nanocomposites particles are in the range of 70 to 90 nm of nanocellulose particles obtained from coconut husk and rice husk.

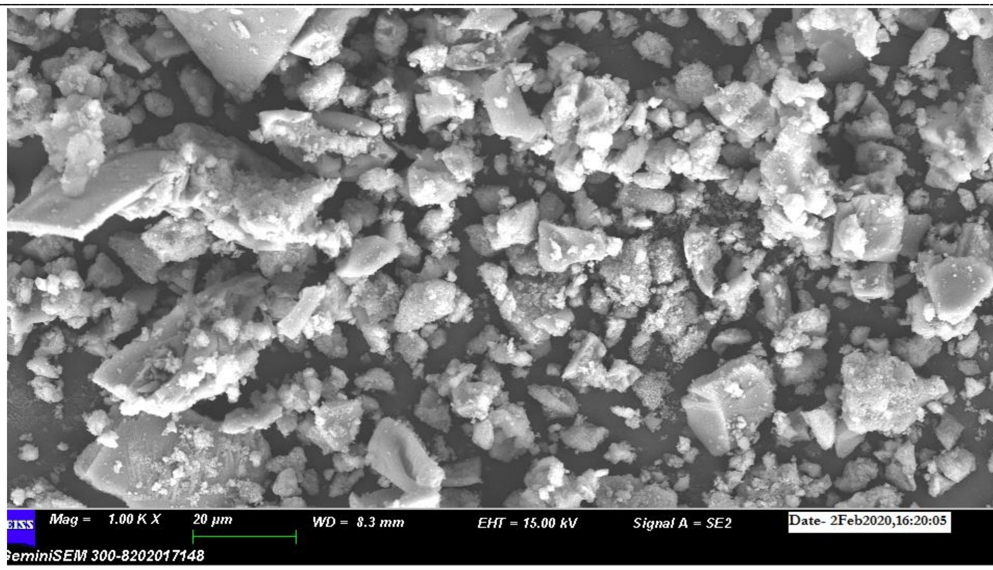

Fig.4: SEM of Nanoparticles

Further heavy metals adsorption was done by preparing synthetic std solution of chromium ion by using Pottasium Chromate salt. Four different solutions were prepared (Cr-1, Cr-2, Cr-3 & Cr-4). In each solution fixed amount of so formed nano composite was added and mixed properly and kept for 1 hr so that adsorption can take place properly. After one hour samples were filtered and sent for metal ion determination by AAS (Perkin Elmer Atomic Absorption Spectrophotometer AAS-200.Results are shown in table 1.From the results it is clear that so formed nano composite is very effective for adsorption of heavy metals ions specially chromium. Chromium ions could be adsorbed upto 100% from 5.25 ppm waste water while about 97% reduction was obtained from more than 20 ppm chromium waste water solution.

Table1: Shows cr content, cr after adsorption and Percentage reduction

S.No.	Sample	Cr content (PPM)	Cr After adsorption	% Reduction
1	Cr-1	5.25	0.0	100
2	Cr-2	9.82	0.25	97.4
3	Cr-3	16.24	0.44	97.3
4	Cr-4	20.40	0.62	96.9

Conclusion

In the present work we use agro waste material to synthesize novel nanoparticles. These nanoparticles are characterized by using standard analytical techniques. The synthesized nanoparticles was used in the treatment of water contaminated with heavy metal ions and the result of our study clear indicate that our synthesized nanoparticles was effective in the removal of chromium ion from waste water.

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