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Bagasse-Based Cellulose Nanocrystals-magnetic iron oxide nanocomposite for removal of Chromium (VI) from Aqua Media

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INTRODUCTION & AIM

- Sugar cane bagasse is an agro-based dry pulpy residue after the extraction of juice from sugar cane (Khan, Ali, & Ayub, 2001).

Environmental problems;

- *Production of bad odors when it ferments.*
- *Breeding habitats for pathogens and microbes causing diseases.*
- *Costs the industry on both storage and disposal.*

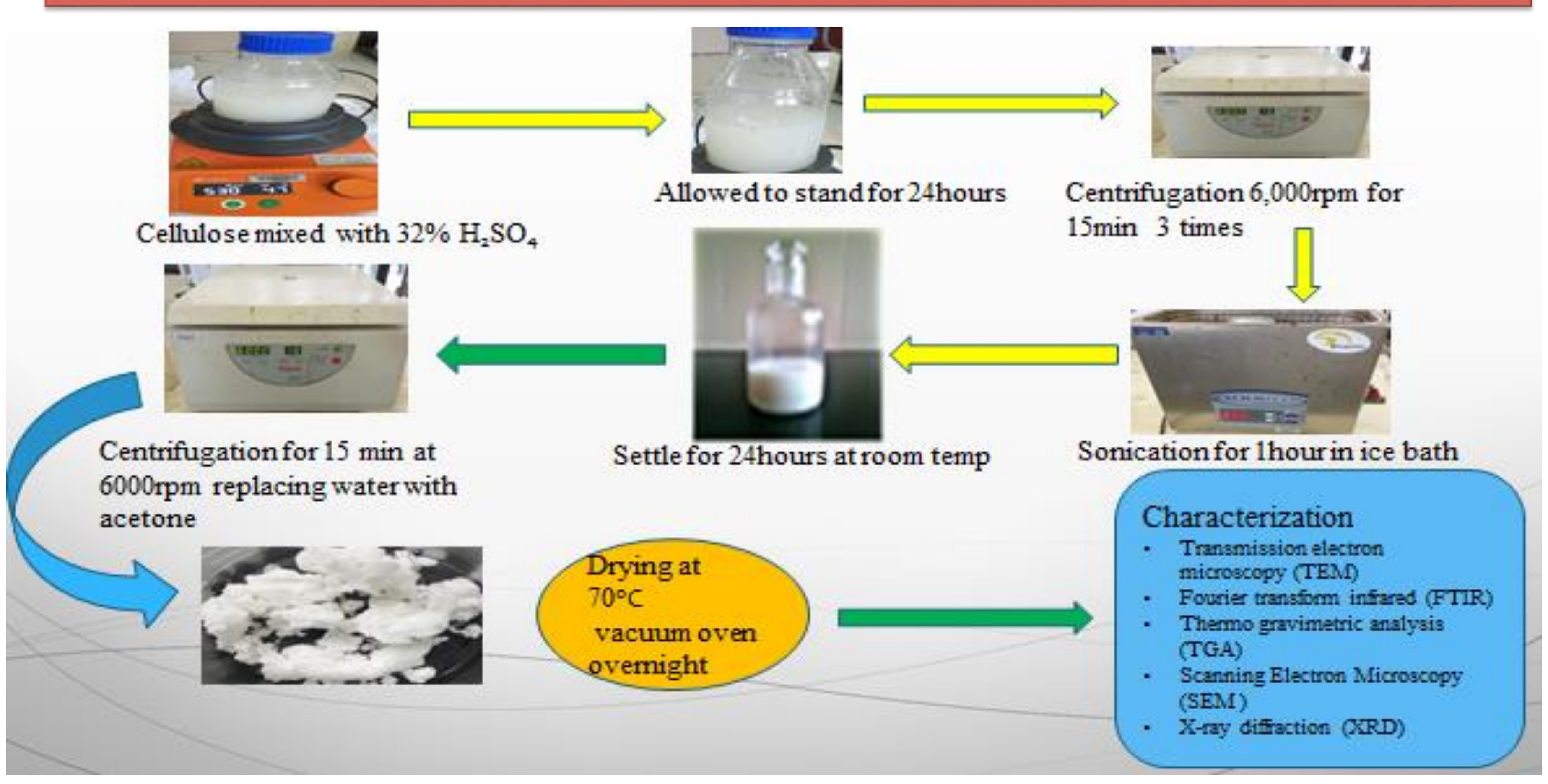
Bagasse accumulation from sugar processing industry

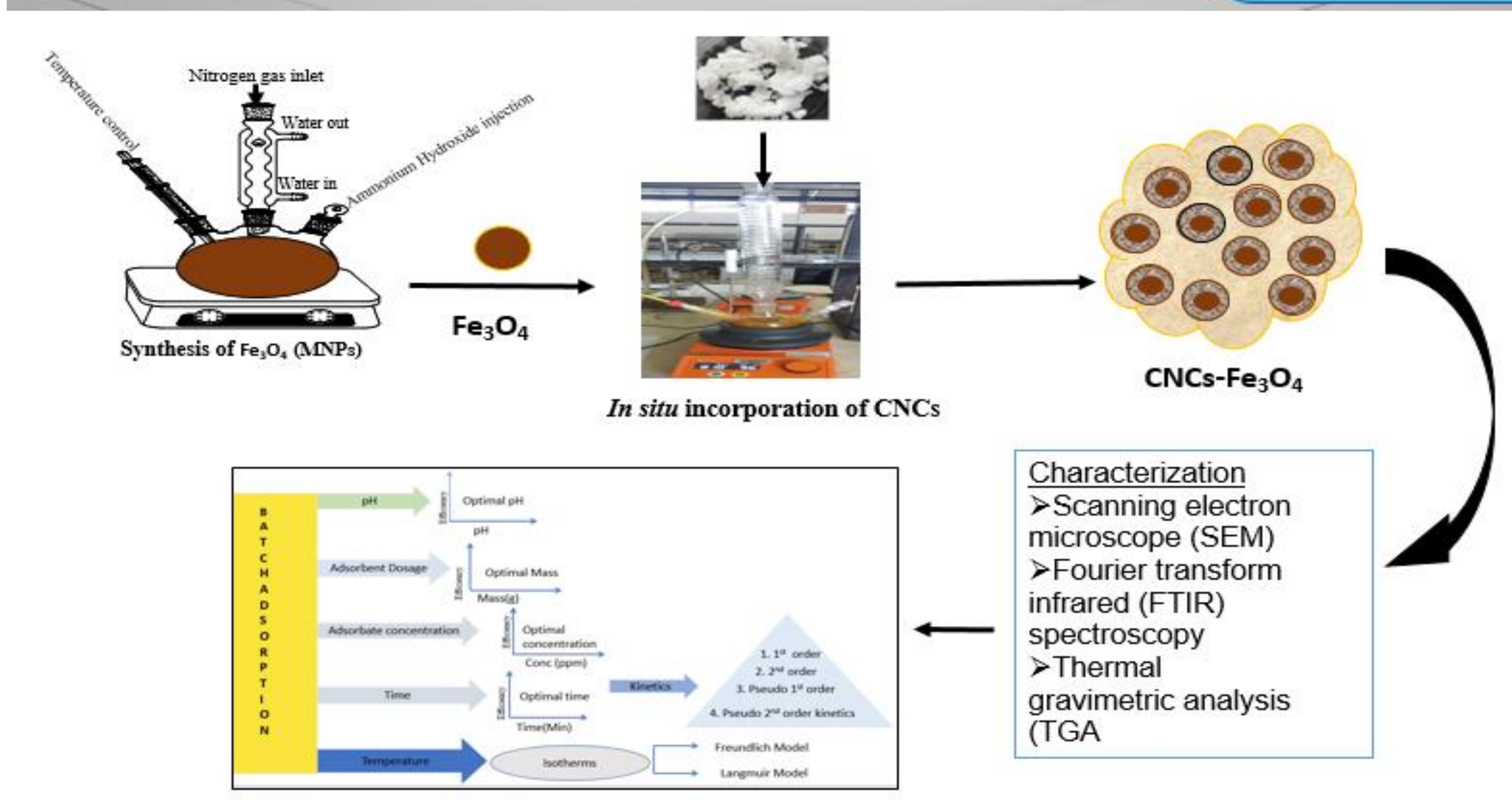
Effluents from sugarcane industry

Bagasse from small scale juice blenders

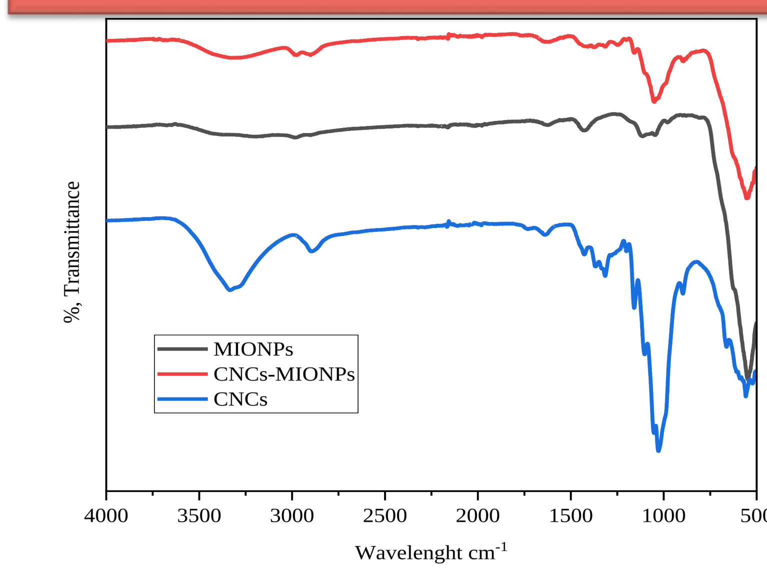
- Adsorption technologies has been studied on removal of the heavy metals, but the methods used are expensive like use of activated carbon and some even leads to environmental degradation example the use tamarind bark (Gayathri, Thirumarimurugan, & Kannadasan, 2013).
- Permissible limits of Chromium ions in both livestock consumption and irrigation water are 1.0 and 0.05 mg/L, respectively(Sayyed & Sayadi, 2011).
- Nanotechnology enhances removal of sediments, chemical effluents, charged particles, bacteria and other pathogens from wastewater even at trace levels (Langley *et al*,.2010).
- Incorporation of magnetite onto CNC's aims at increasing its adsorption efficiency. Also after adsorption it will be easier to remove the pollutants by the use of a magnet.

METHOD

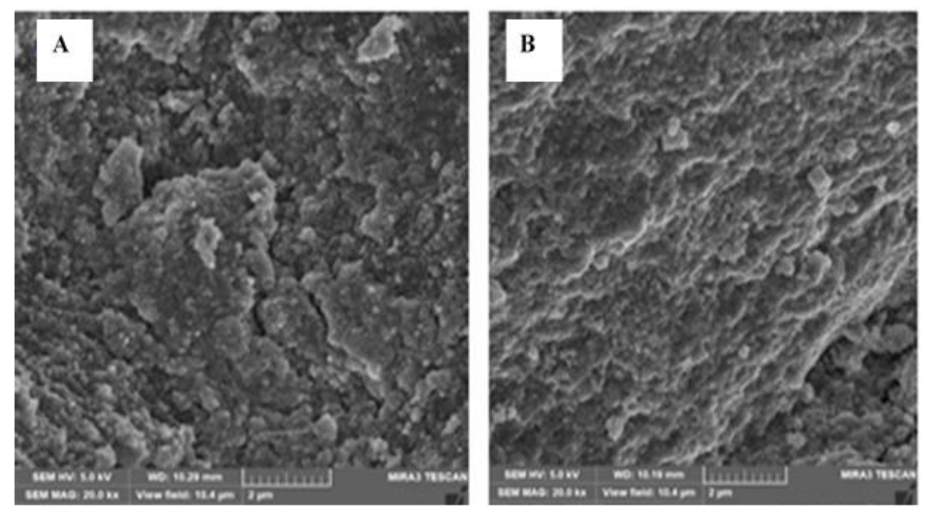




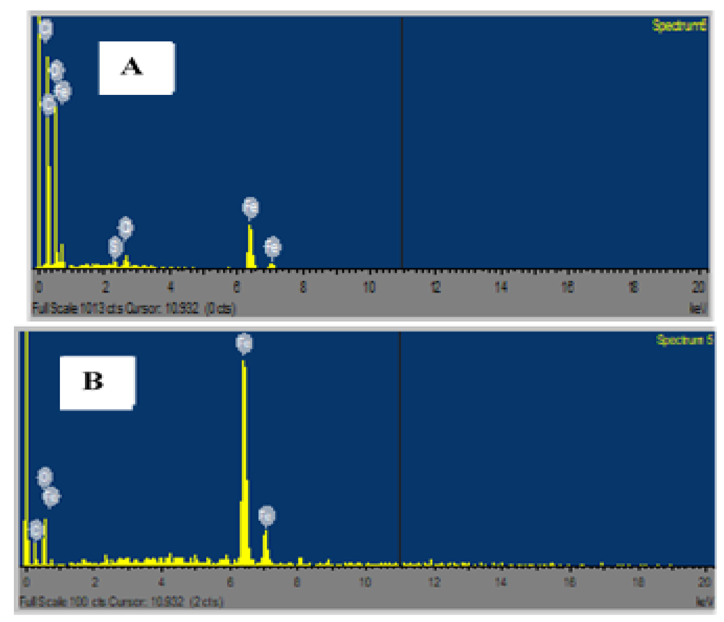
RESULTS & DISCUSSION



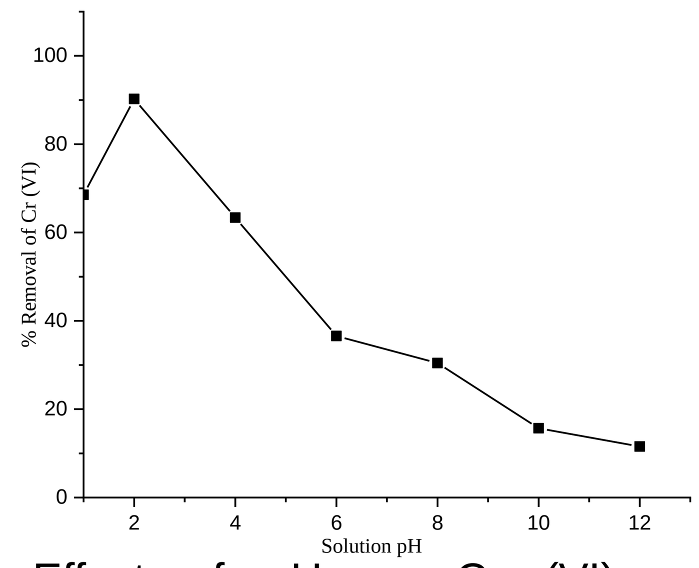
FTIR spectra for CNCs, MIONPs, and CNCs-MIONPs.



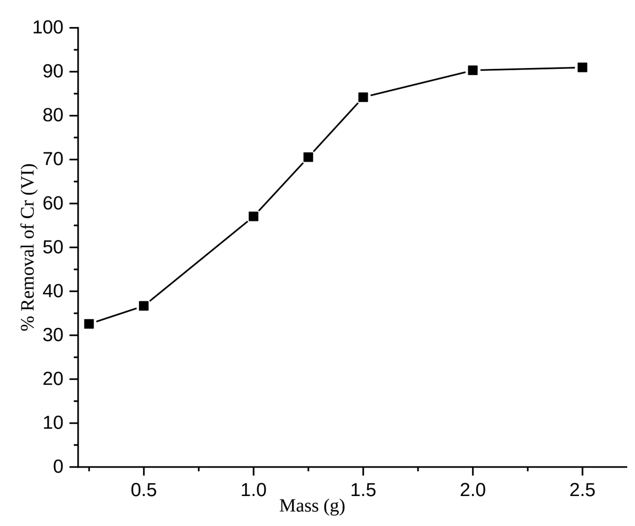
SEM images of CNCs-MIONPs before adsorption (A), CNCs-MIONPs after adsorption (B).



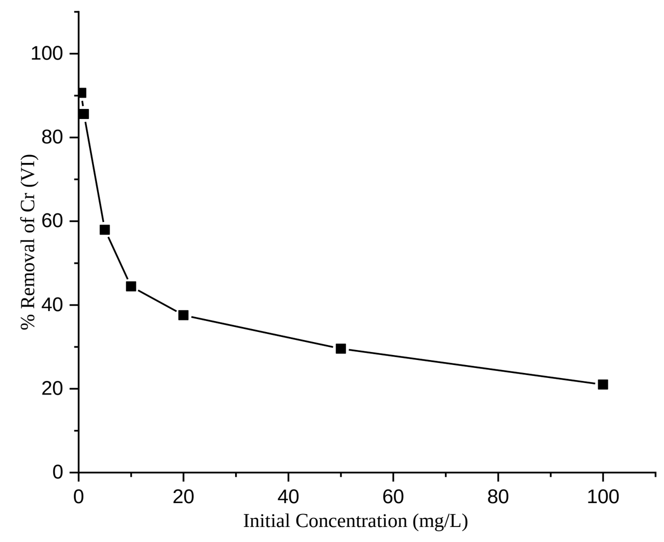
EDS analysis of CNCs-MIONPs before adsorption (A), and after adsorption (B).



Effect of pH on Cr (VI) uptake, adsorbate mass 0.2 g, shaking time 90 min, and agitation rate of 250 rpm with initial Cr (VI) 0.5 mg/L.



Effect of adsorbent dosage; pH 2, shaking rate 250 rpm, duration 90 min, Cr (VI) 0.5 mg/L at room temperature



Effect of contact time with Cr (VI) solution pH 2, of adsorbent dose 0.2 g, agitation time 90 min, and adsorbate feed of 0.5 mg/L

Models	**Kinetic values**			
	q_e (exp)(mg/g)	q_e(calc)(mg/g)	R^2	K_1 K_{id}
Pseudo-first order	76.34	0.69	0.9785	0.050
Pseudo-second order	16.32	5.26	0.9999	0.1327
Inter-particle diffusion model	18.32	10.89	0.9942	2.33

CONCLUSION

- High sorption efficiency at pH 2, 0.5 mg/L dose, 250 rpm, 90 minutes at room temperature was achieved.
- Pseudo-second-order kinetic model indicated chemisorption as the rate-limiting mechanism.
- Cellulose nanocrystals' modification method significantly improved chromium removal effectiveness, promising for wastewater purification.

FUTURE WORK / REFERENCES

- Future work will focus on scaling up the nanocomposite synthesis for industrial wastewater treatment applications.

1. B. Weber-Lewerenz, "Corporate digital responsibility (CDR) in construction engineering ethical guidelines for the application of digital transformation and artificial intelligence (AI) in user practice," *SN Appl. Sci.*, **2021,** vol. 3, pp. 1–25.
2. S.F. Ahmed, M. Mofijur, S. Nuzhat, A.T. Chowdhury, N. Rafa, M.A. Uddin, A. Inayat, T.M.I. Mahlia, H.C. Ong, W.Y. Chia, and P.L. Show, "Recent developments in physical, biological, chemical, and hybrid treatment techniques for removing emerging contaminants from wastewater," *J. Hazard. Mater,* **2021,** vol. 416, p. 125912.
3. F. O. Ajibade *et al.*, "Environmental pollution and their socioeconomic impacts," in Microbe mediated remediation of environmental contaminants, *Elsevier,* **2021**, pp. 321–354.