Fast and Efficient Removal of Arsenic through Supercritical Carbon Dioxide Assisted Modified Magnetic Nanoparticles

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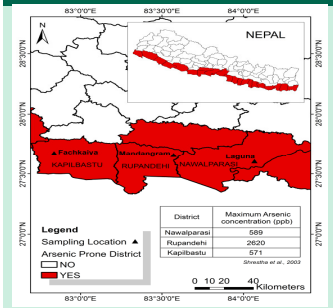
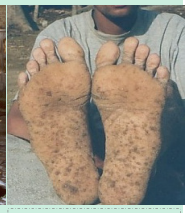
The Problems/ Issues?)



Map of Arsenic contaminated regions in Nepal showing the locations from which groundwater samples were collected

Tube well water is contaminated by arsenic and pathogens

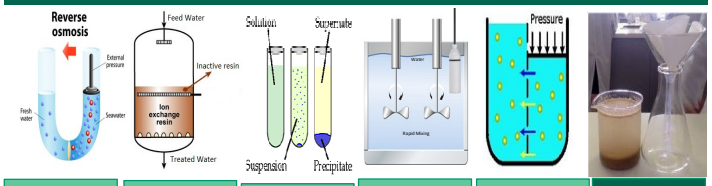


Person suffers from skin diseases due to arsenic poisoning

Unsafe Drinking Water

- In Nepal, arsenic (As) contamination is a major environmental health management issues especially in the plain region, i.e., in the Terai districts.
- 90% of the population in the rural Terai depends on groundwater for drinking water.
- More than 20% of the Terai tube well water is contaminated with arsenic, causing arsenicosis, vascular diseases, and cancer of the lungs, bladder, and kidney.

INTRODUCTION



Reverse Osmosis | Ion Exchange | Chemical Precipitation | Coagulation | Ultra Filtration | Adsorption

Adsorption

Merits

- Effective Removal
- Low treatment cost
- Ease in treatment handling
- Simple & Stable operation

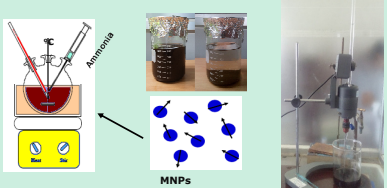
eg. silicon dioxide, cerium oxide, Iron oxide

Objectives

- To develop a reliable adsorption method using magnetic nanoparticles as adsorbent for arsenic removal.
- To develop a green chemical approach of modification of nanoparticles using supercritical carbon dioxide (Sc CO2)
- Optimization of Batch experiment parameters.
- Study and determine optimum adsorption isotherm.
- Arsenic removal study with real samples.

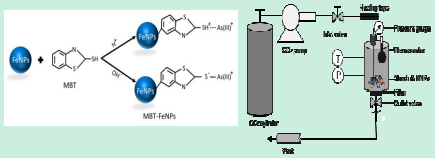
Methodology

Supercritical Synthesis of starch-MNPs



Feng, L. *et al.*, (2012)

In-situ reinforcement of FeNPs into polymer



Bisht, G.,& Zaidi, M. G. H., (2015)

Batch Study

- Effect of contact time
- Effect of pH
- Effect of Adsorbent dosage
- Effect of Initial concentration
- Effect of temperature
- Regeneration & Reusability study
- Arsenic quantification was carried through blue molybdenum.

Kinetics Study

- Pseudo First order
- Pseudo second order

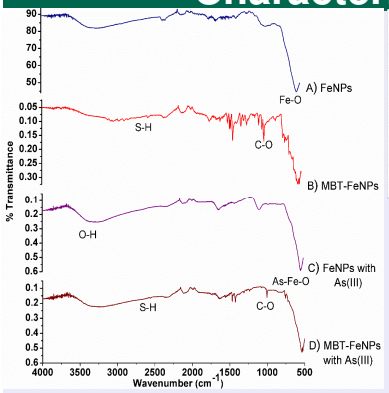
Adsorption Isotherm

- Langmuir Isotherm
- Freundlich Isotherm
- Temkin Isotherm

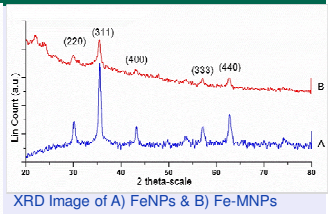
Field Study

- Sample Collection &
- AAS analysis of samples

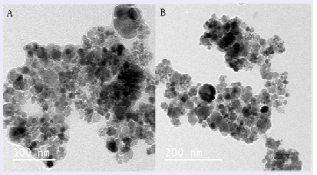
Characterization



FT-IR Spectral Analysis

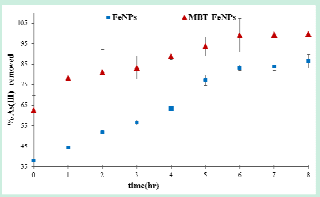


XRD Image of A) FeNPs & B) Fe-MNPs

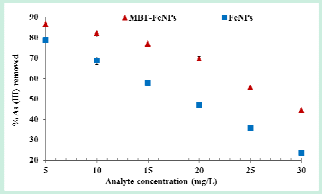


TEM Images of FeNPs

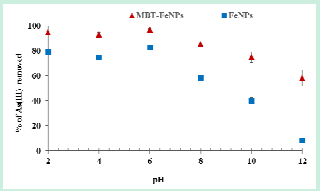
Batch Adsorption Study



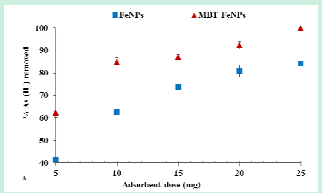
Effect of contact time



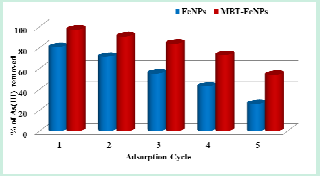
Effect of Initial analyte concentration



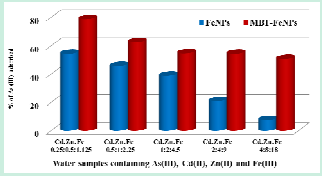
Effect of pH



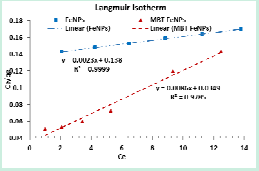
Effect of Adsorbent dose



As (III) removal behaviour up to 5 cycles



Effect of co-ions (Cd^{2+}, Zn^{2+} and Fe^{3+})



Adsorbent Isotherm

Arsenic content in groundwater samples

Groundwater Samples	Laguna, Nawalparasi	Fachkaiya, Kapilbastu	Mandangram , Rupandehi
Total arsenic concentration obtained (µg/L)			
Untreated Sample	90	80	60
FeNPs treated Sample	10	10	9
MBT-FeNPs treated sample	ND (<5)	ND (<5)	ND (<5)

Conclusion

- New method for modification *via* SC-CO_2, a green chemical technology was developed.
- High removal percentage 99.7 % with Starch-MNPs for As(III) solution of 10 ppm.
- Excellent adsorption capacity (qe in mg/g)140.8 with Starch-MNPs and 108.7 with FeNPs
- Retention of 50% of their initial As (III) removal capacity after being regenerated for five cycles.

References

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