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Designing of Reusable Amine-Functionalized Zerovalent Bimetallic Magnetic Nanoparticles for Efficient Sequestration of Azo dyes From Water: Kinetics & Thermodynamics Studies

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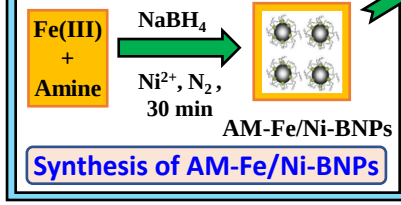
BACKGROUND & OBJECTIVES

Multiple challenges in existing water treatment technologies & toxicity of azo dyes demand their efficient removal from industrial effluents. To meet this, Fe/Ni bimetallic nanoparticles (BNPs) can be a good alternate due to their high surface area, corrosion stability, magnetism, nontoxicity & low cost. The objective of this study is to synthesize, characterize & develop amine-coated Fe/Ni-BNPs (AM-Fe/Ni-BNPs) as efficient, green & economic adsorbent to eliminate azo dyes from water.

EXPERIMENTAL

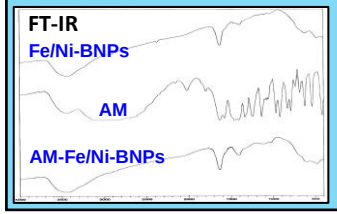


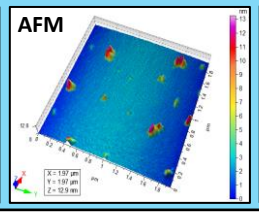
Synthesis of AM-Fe/Ni-BNPs

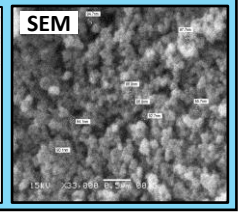
AR27 Removal from Water

RESULTS/DISCUSSION

CHARACTERIZATION OF AM-Fe/Ni-BNPs

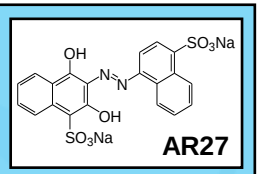




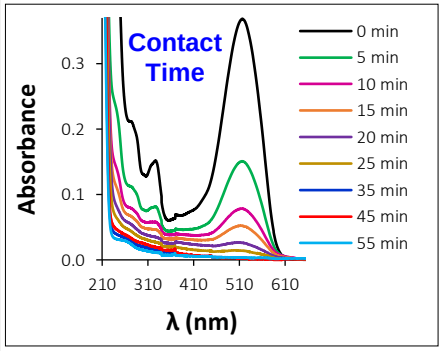


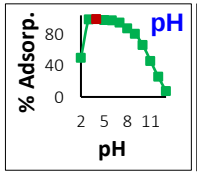
ACID RED 27 (AR27) ADSORPTION STUDIES

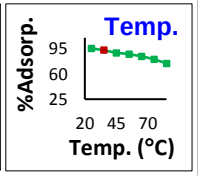
Exp. Conditions: [AR27] = 12 mgL^{-1}, pH = 4, Temp. = 25°C, Adsorbent Dose = 0.5 gL^{-1}

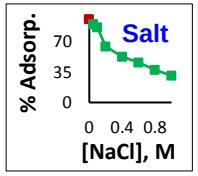


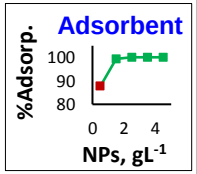
Optimization of AR27 Removal by AM-Fe/Ni-BNPs



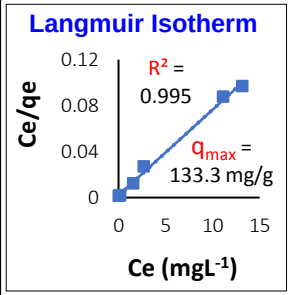


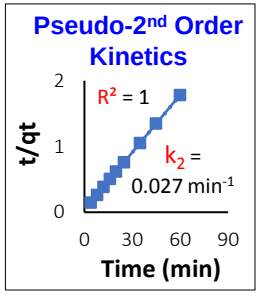


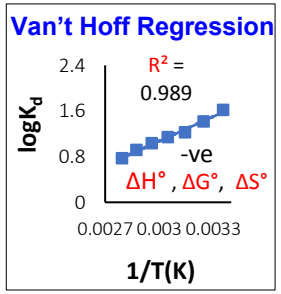




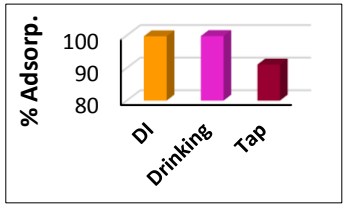
Mechanistic Studies for AR27 Adsorption on AM-Fe/Ni-BNPs



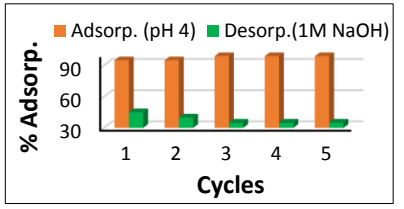




Adsorption from Real Waters



Reusability of AM-Fe/Ni-BNPs



CONCLUSION

This study develops AM-Fe/Ni BNPs as efficient adsorbent of AR27 dye. AM-Fe/Ni BNPs work excellent at pH 4, 25 ^{0}C & low salt presence, providing ≥ 90% AR27 removal from deionized, drinking & tap water within an hour. AR27 removal follows Langmuir isotherm & pseudo-2nd order kinetics. AR27 adsorption by AM-Fe/Ni BNPs is spontaneous & exothermic, involving electrostatic interactions. AM-Fe/Ni-BNPs are reusable. It suggests the future use of AM-Fe/Ni-BNPs in the treatment of textile effluents & advocates further studies in this field.

REFERENCES

Trujillo-Reyes J, Solache-Rios M, Vilchis-Nestor AR, Sanchez V & Colin A. *Water Air Soil Pollut.* 223(2012) 1331–1341.

Liu Y, Zeng G, Tang L, Cai Y, Pang Y, Zhang Y, Yang G, Zhou Y, He X & He Y. *J. Colloid Interface Sci.* 448(2015) 451–459.