Journal of Hazardous Materials 353 (2018) 190–203

Contents lists available at ScienceDirect

Journal of Hazardous Materials

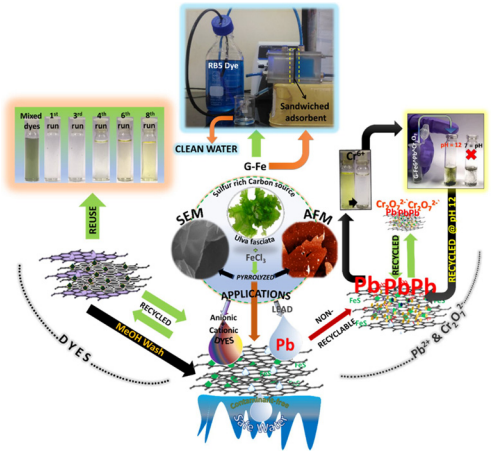
journal homepage: www.elsevier.com/locate/jhazmat

Solvent-free production of nano-FeS anchored graphene from *Ulva fasciata*: A scalable synthesis of super-adsorbent for lead, chromium and dyes

Ashesh Mahto[a,b], Anshu Kumar[a,c,1], Jai Prakash Chaudhary[a,d], Madhuri Bhatt[a,c], Atul Kumar Sharma[e], Parimal Paul[a,c], Sanna Kotrappanavar Nataraj[b,*], Ramavatar Meena[a,e]

[a] Academy of Scientific and Innovative Research (AcSIR)-Central Salt & Marine Chemicals Research Institute, G. B Marg, Bhavnagar, 364002, India
[b] Centre for Nano and Material Sciences, Jain University, Jain Global Campus, Kanakapura, Ramanagaram, Bangalore, 562112, India
[c] Analytical Division and Centralized Instrument Facility, CSIR-Central Salt and Marine Chemicals Research Institute, G. B. Marg, Bhavnagar, 364 002, India
[d] Department of Chemical Engineering, Indian Institute of Technology, Gandhinagar, Gujarat, 382355, India
[e] Natural Products & Green Chemistry Discipline, CSIR- Central Salt and Marine Chemicals Research Institute, G. B. Marg, Bhavnagar, 364002, India

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Graphene composite
Seaweed biomass
Dyes
Heavy metal
Wastewater

ABSTRACT

Here we demonstrate, a simple and solvent-free synthetic route for the production of FeS/Fe(0) functionalized graphene nanocomposite (G-Fe) via a one-step pyrolysis of seaweed biomass (*Ulva fasciata*). It is proposed that the natural abundance of both inorganic and organic sulfur in the seaweed induces the reduction of exfoliated graphitic sheets at elevated temperatures. $FeCl_3$ was employed both as the iron precursor as well as the templating agent. Iron doping played a dual-faceted role of exfoliating as well as activating agent, producing composite with high adsorption capacity for Pb^{2+} (645 ± 10 mg/g), CR (970 mg/g), CV(909 mg/g), MO (664 mg/g), MB (402 mg/g) dyes and good recyclability (8 cycles). Pb^{2+} adsorption was irreversible even at low pH values and the spent composite (G-Fe-Pb) was utilized for efficient Cr(IV) removal {100 mg/g). The adsorption data followed the pseudo second order kinetics while the equilibrium data fitted perfectly into the Langmuir adsorption equation. Further, a thin layer of composite was deposited on a filter paper by vacuum filtration which was tested under continuous filtration mode for RB5 dye removal. Preliminary results highlight

* Corresponding author at: Academy of Scientific and Innovative Research (AcSIR)-Central Salt and Marine Chemicals Research Institute, G. B Marg, Bhavnagar, 364002, India.
E-mail addresses: sk.nataraj@jainuniversity.ac.in (S.K. Nataraj), rmeena@csmcri.res.in (R. Meena).
[1] Department of Chemistry, School of Sciences, Gujarat University, Navarangpura, Ahmedabad, 380009, India.

https://doi.org/10.1016/j.jhazmat.2018.03.054
Received 4 December 2017; Received in revised form 19 March 2018; Accepted 27 March 2018
Available online 28 March 2018
0304-3894/