

Supplementary information

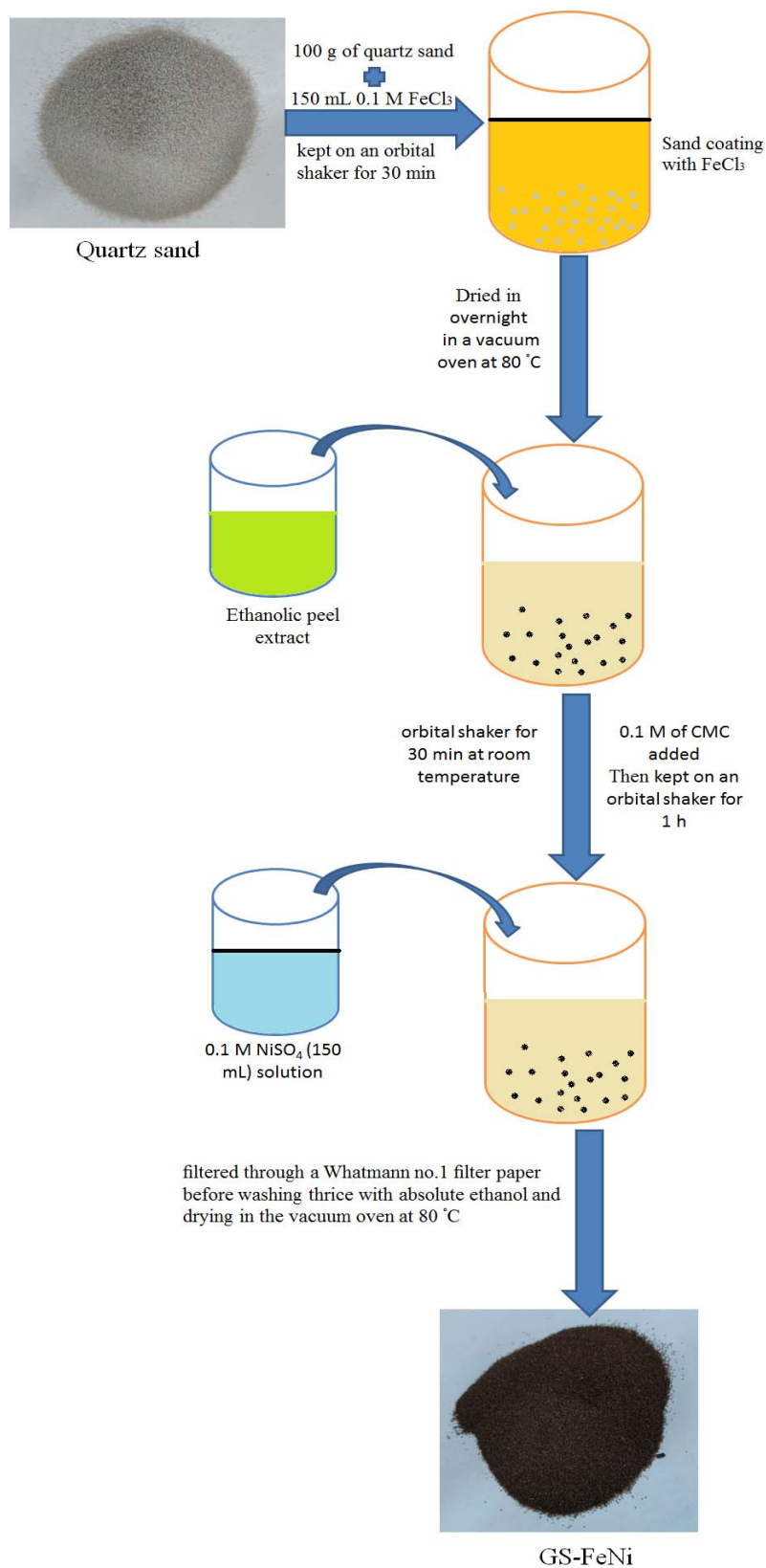


Fig. S1. Green synthesis process of Fe-Ni coated on sand

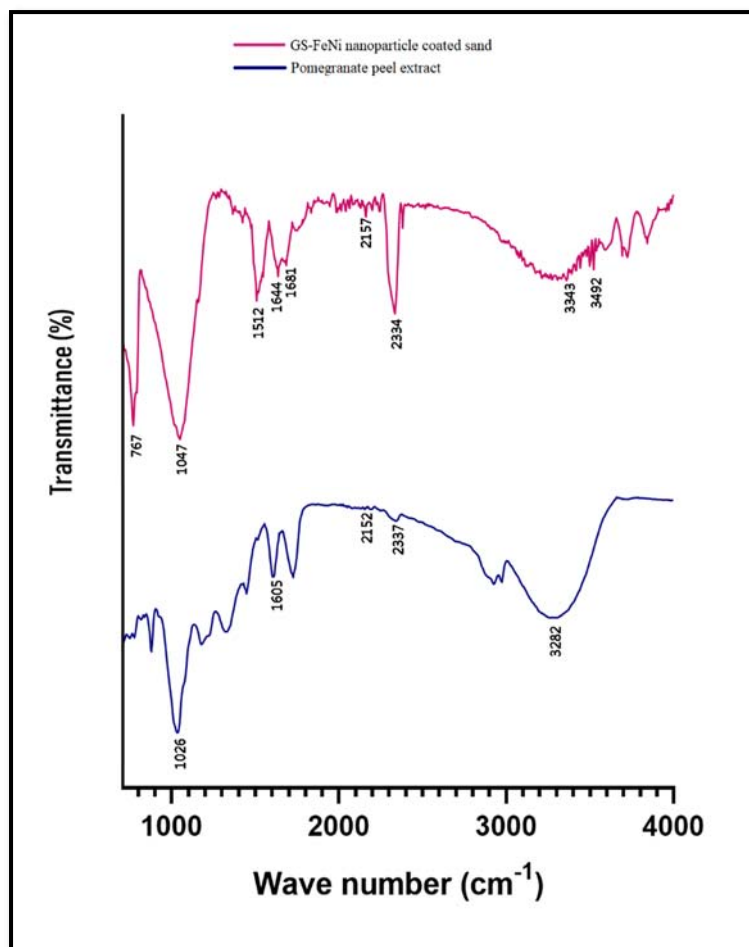


Fig. S2. FT-IR spectra of GS-FeNi

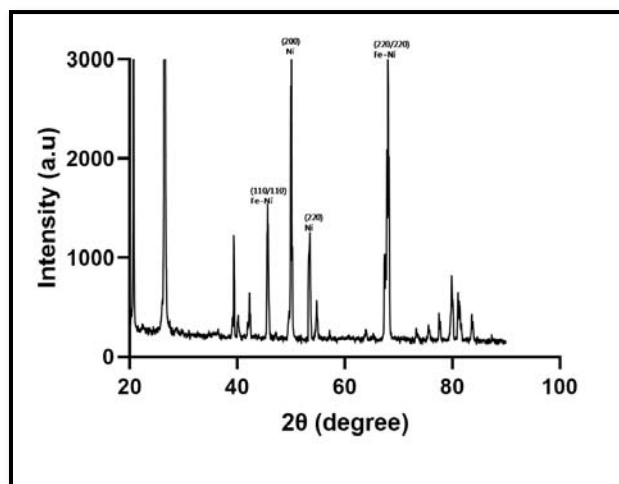


Fig. S3. XRD spectra of GS-FeNi

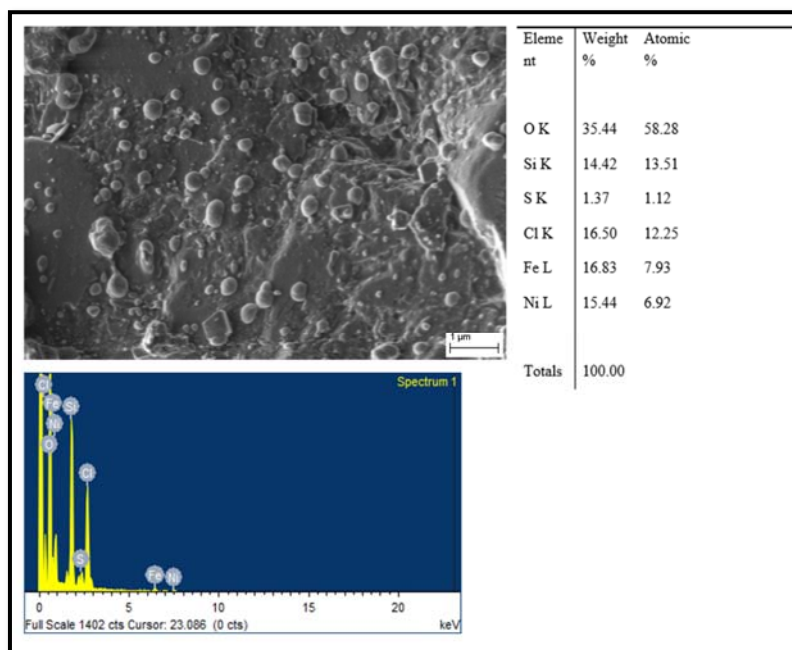


Fig. S4. SEM image and EDX results of GS-FeNi

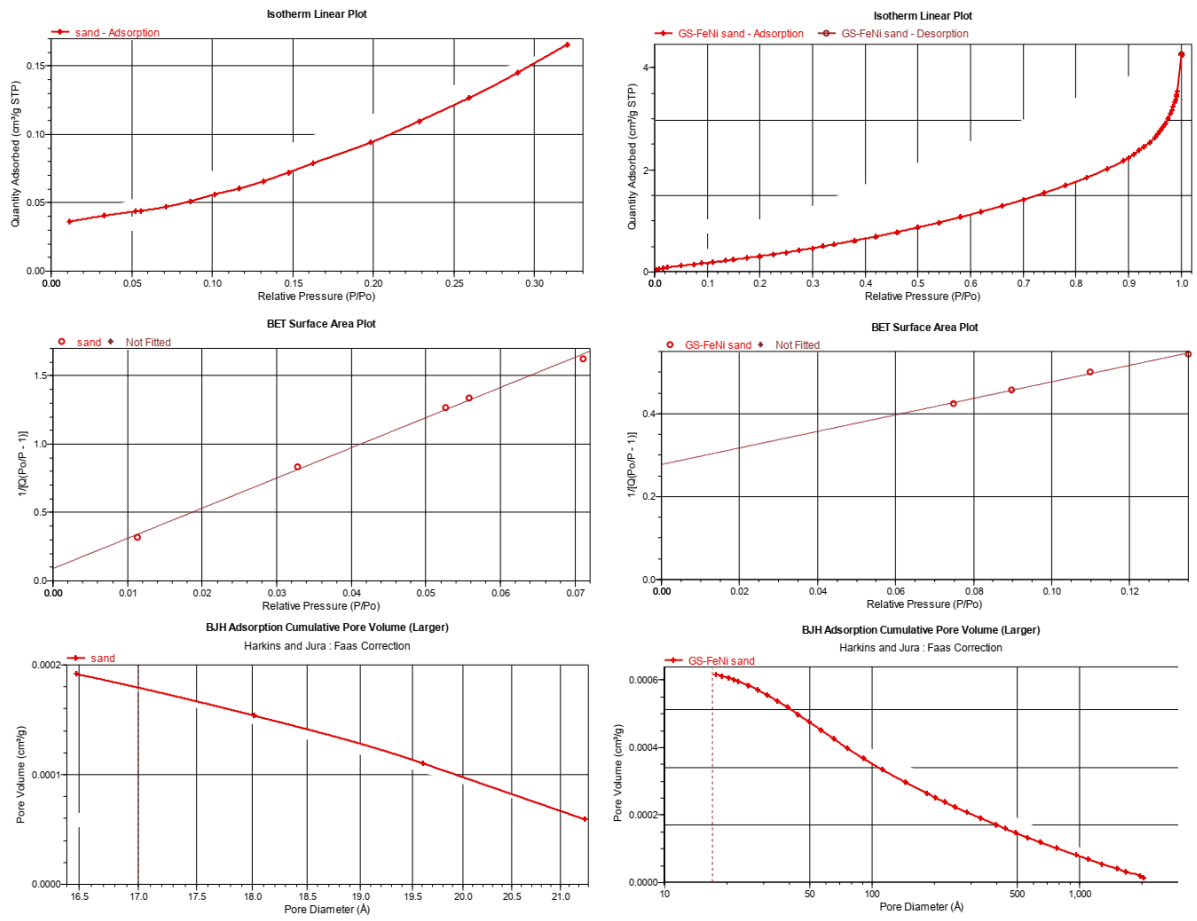


Fig. S5. BET surface analysis plots of sand and GS-FeNi sand

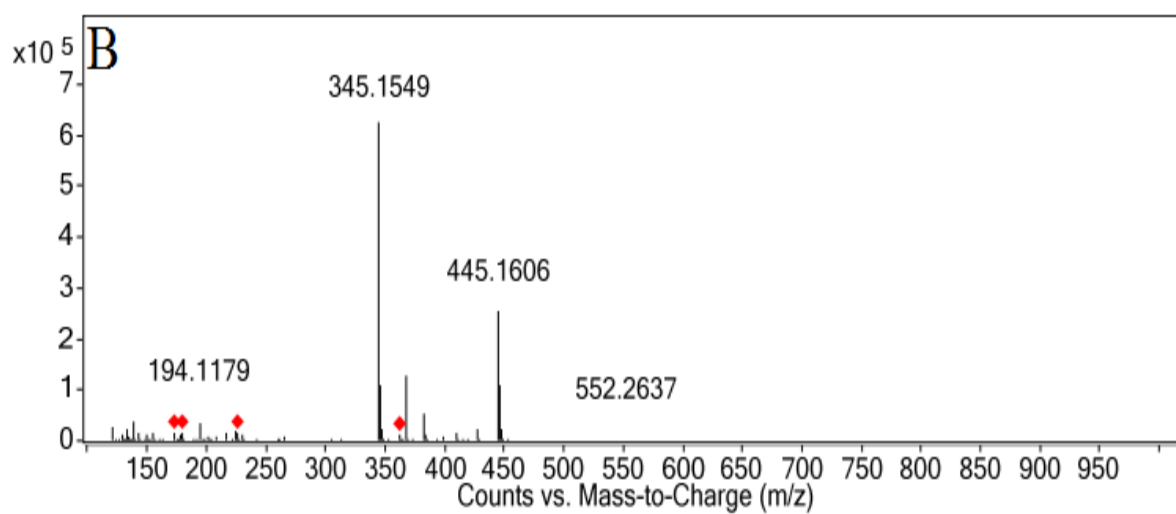
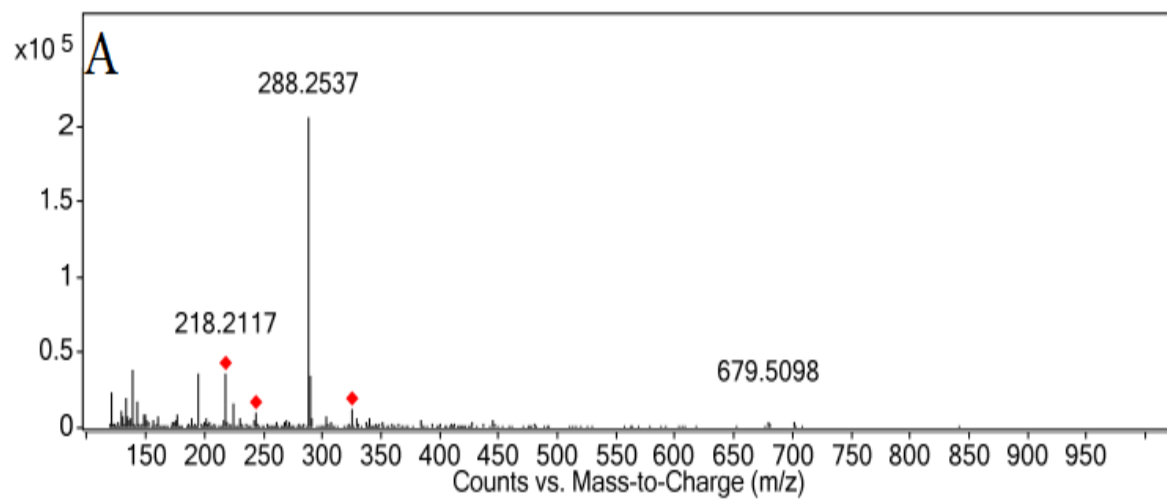


Fig. S6. BET surface analysis plots of T interacted GS-FeNi sand

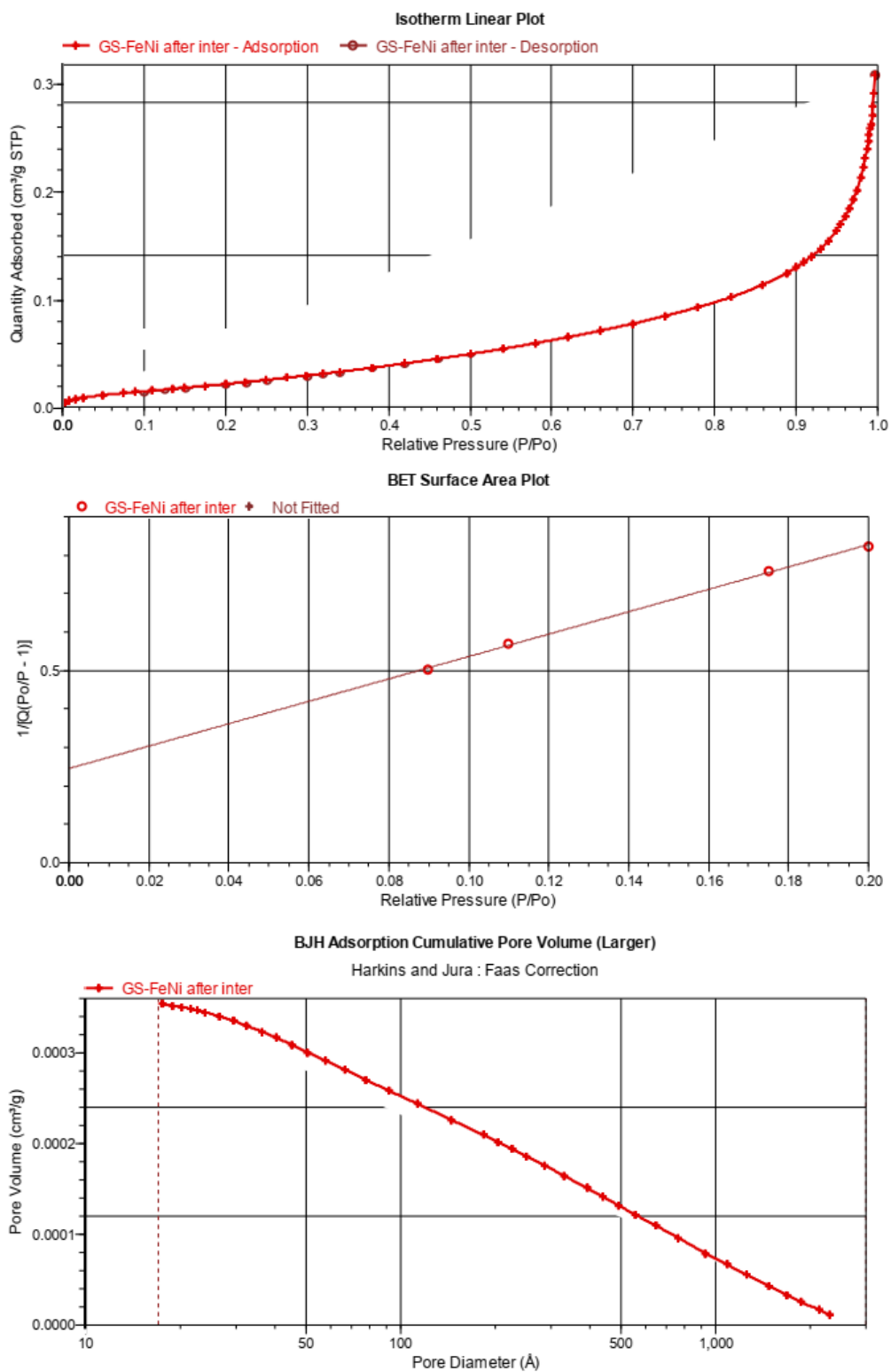


Fig. S7. LC-MS results of TC removal in column study A) 1 h and B) 170 h

Table S1. Comparison of TC removal using nanoparticles as reported with current study

Batch study removal								
S.No.	Sorbent	TC conc. mg/L	Sorbent	Time (min)	pH	Removal capacity (mg/g)	Removal (%)	ref
1	Cu ₂ O–TiO ₂ –Pal	30	1 g/L	solar irradiation (240 min) & 60 min dark reaction	8.5	113	88	(Shi et al., 2016)
2	Cu/Fe bimetallic particle	60	1 (g/L)	120	6	133.3	90	(Aslan et al., 2016)
3	Ag/Ag ₃ PO ₄ /BiVO ₄ /RGO	10	0.5 g/L	60	6.7	-	95	(Chen et al., 2017)
4	Fe ₃ O ₄ /MFX	10	0.16 g/L	60	6		82	(Pi et al., 2017)
5	FeNi ₃ /SiO ₂ /CuS	10	0.005 (g/L)	200	9	-	97	(Nasseh et al., 2018)
6	Chitosan modified N, S-doped TiO ₂	10	0.6 g/L	20	8.2	-	91	(Farhadian et al., 2019)
7	MgO-loaded SiO ₂ nanocomposite	10	0.5 g/L	60	6		85	(Yue et al., 2019)
8	calcite/ titania nanocomposites	50	1.5 g/L	Irradiation time = 300 min	7	-	90	(Belhouchet et al., 2019)
9	Fe/Cu-GO nanocomposites	20	0.25 (g/L)	60	6.5	303	100	(Tabrizian et al., 2019)

10	GS- Fe-Ni-NP coated sand	20	1.5 (g): it contains 5.5 mg/L of Fe and 5.2 mg/L of Ni nanoparticles	180	7	96.12	99	Current study
Continuous flow study removal								
S.No.	Sorbent	TC conc. mg/L	Flow rate ml/min	Bed height (m)	Equilibrium time (h)	Removal capacity (mg/g)	Ref	
1	Coffee residue/Fe ₃ O ₄	50	3.3	8	6.6	278.4	(Oladipo et al., 2016)	
2	NiFe coated sand (chemical synthesis)	20	1	10	378	1198	(Ravikumar et al., 2019)	
3	NiFe coated sand (green synthesis)	20	1	10	339	978.24	Current study	

Table S2A. Adsorption kinetic model parameters for TC removal **B** Isotherm data for TC adsorption by GS-FeNi

Kinetic models	Parameters	TC concentration (mg/L)		
		20	60	80
Pseudo–first order	q_e (mg/g)	79.43	141	177
	K_L (L /min)* 10^{-5}	2.13	4.26	4.59
	r^2	0.96	0.97	0.92
Pseudo–second order	K' (g mg ⁻¹ min ⁻¹) * 10^{-2}	3.77	4.83	16.06
	r^2	0.98	0.99	0.99
	q_e (mg/g)	94.33	144.92	163.93
	Experimental: q_e (mg/g)	96.12	126.45	165.32

S2B

Isotherm	Parameters	
Langmuir	q_{max} (mg/g)	123.43
	b (L/mg)	0.162
	r^2	0.99
Freundlich	N	0.52
	K_f (L/mg)	1.03
	r^2	0.92

Table S3. BET results of GS-FeNi before and after interaction with TC

	Surface area (m ² /g)	Pore volume (cm ³ /g)
GS-FeNi	1.35	0.000624
GS-FeNi after interaction with TC	1.19	0.000356

Table S4. A) Concentration of FeNi on the sand B) Fe Ni concentration in the solution during the reaction

A)

Concentration of FeNi on the sand	
Fe	0.51±0.02 mg/g
Ni	0.48±0.03 mg/g
Concentration of FeNi on the sand-After TC interaction	
Fe	0.49±0.01 mg/g
Ni	0.44±0.03 mg/g

B)

	Concentration (ug/L)	
	Fe	Ni
1st cycle	0.033556	6.77
2nd cycle	0.093333	13.91
3rd cycle	0.273333	4.67
4th cycle	0.360778	17.1

Table S5 Metal ions concentration in ground water, lake water and tap water

Sample code	Element symbol and Wavelength (nm)	Concentration
Groundwater	Al 308.215	0.616 mg/L
	Cr 267.716	0.018 mg/L
	Cu 327.393	0.661 mg/L
	Mn 257.610	0.315 mg/L
	Zn 206.200	0.886 mg/L
Tap water	Al 308.215	0.269 mg/L
	Cr 267.716	0.010 mg/L
	Cu 327.393	0.097 mg/L
	Mn 257.610	0.012 mg/L
	Zn 206.200	0.286 mg/L
Lake water	Al 308.215	0.492 mg/L
	Cr 267.716	0.052 mg/L
	Cu 327.393	0.014 mg/L
	Mn 257.610	0.191 mg/L
	Zn 206.200	0.216 mg/L

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