Supplementary data:

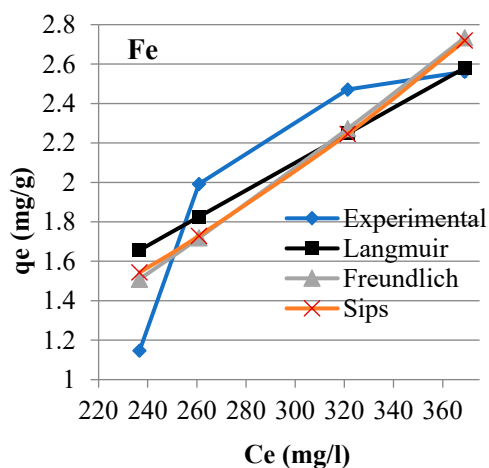**Table S1:** Equations used in analyzing adsorption data

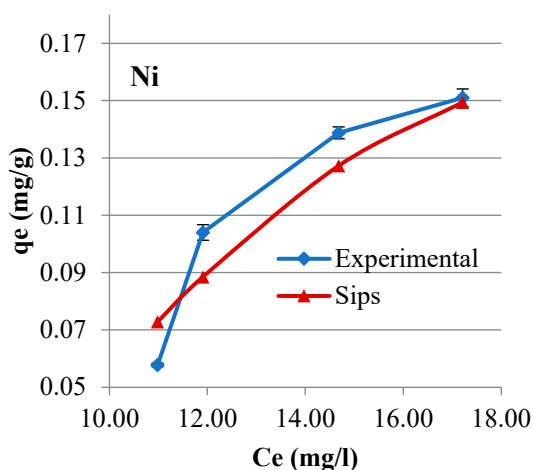| Expression name	Non-linear version	Constants	Key attributes	References
Langmuir isotherm	$q_e = \dfrac{q_m K_L C_e}{1 + K_L C_e}$	K_L, q_m	Normally describes mono layer adsorption for dilute systems. Most suited isotherm for desulfurisation.	(Muzic et al., 2010)
Freundlich isotherm	$q_e = K_F C_e^{1/n}$	K_F, n	Non ideal irreversible and multilayer adsorption concepts.	(Proctor & Toro-Vazquez, 1996)
Sips isotherm	$q_e = \dfrac{K_s C_e^{\beta s}}{1 + \alpha_s C_e^{\beta s}}$	$K_s, \beta s, \alpha s$	Combines Freundlich and Langmuir behaviour to describe heterogeneous systems	(Sips, 1948)
PFO kinetics	$q_t = q_e(1 - e^{-k_1 t})$	k_1	Based on pseudo first order reaction equations.	(Azizian, 2004)
PSO kinetics	$q_t = \dfrac{q_e^2 k_2 t}{1 + k_2 q_e t}$	k_2	Successfully modelled metal removals from wastewater in previous studies	(Ho, 2014)
Exponential decay	$A = A_0 e^{-kt}$	k	Models decreasing order values with time	(Westrich & Berner, 1984)

q_e: solid phase equilibrium concentration of adsorbate on adsorbent (mg/g)
q_m: maximum adsorption capacity of the adsorbent (mg/g)
q_t: adsorbate concentration on adsorbent after duration t during adsorption (mg/g)
C_e: equilibrium concentration of adsorbate in the solvent/liquid phase (mg/L)
K_L: Langmuir constant
R_L: separation factor
K_F: Freundlich constant
n: Freundlich heterogeneity parameter to be determined
K_S, β_S, α_S: Sips constants
k_1, k_2 and k_3:   rate constants
A, A$_o$:   Any variable
k: exponential decay constant

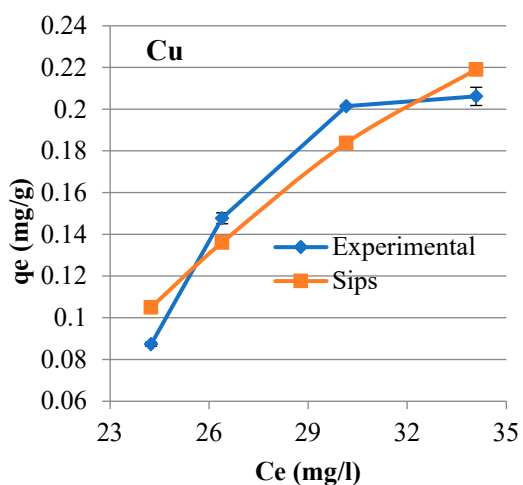**Table S2:** Exponential decay parameters for modelling metal ion concentration during bioremediation

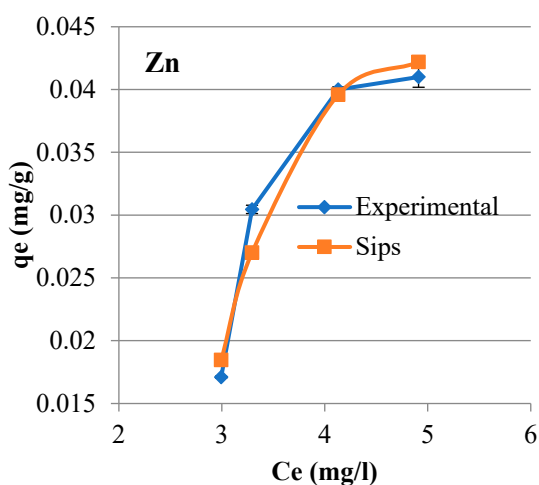| Exponential Model	Metal/ Variable	Fe(5)	Fe(4)	Ni	Cu	Zn
Decay constants	C	21.5	9.0	0.5	9.8	0
	k_1	0.100	0.096	0.104	0.113	0.063
Coefficient of determination	R^2	0.97	0.99	0.99	0.97	0.95

(a)

(b)

(c)

(d)

Figure S1: Adsorption isotherms for **(a)** Fe **(b)** Ni **(c)** Cu and **(d)** Zn on 80 g/L tobacco waste

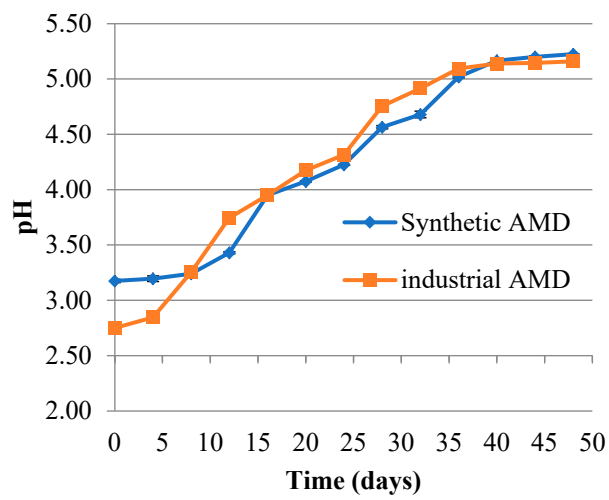**Figure S2:** Adsorption kinetics for **(a)** Fe (5) and **(b)** Fe (4) **(c)** Ni **(d)** Cu **(e)** Zn on tobacco waste

Figure S3: Variation of pH during AMD bioremediation