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Supplementary Material

Soil decontamination by natural minerals: a comparison study of chalcopyrite and pyrite

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Table S1. The components of the soil sample.

Components	Content (%)
Na_2O	1.872
MgO	2.295
Al_2O_3	16.094
SiO_2	63.976
P_2O_5	0.205
SO_3	0.102
Cl	0.055
K_2O	2.490
CaO	6.605
TiO_2	0.839
Cr_2O_3	0.015
MnO	0.082
Fe_2O_3	4.993
NiO	0.012
CuO	0.008
ZnO	0.009
SrO	0.019
ZrO_2	0.022
Bi_2O_3	0.009

Table S2. The primary chemical existence elements of NCP.

Components	Content (%)
Mg	0.789
Al	0.320
Si	5.330
P	0.012
S	25.837
Cl	0.068
K	0.024
Ca	3.938
Cr	0.033
Mn	0.048
Fe	32.604
Co	0.090
Cu	30.011
Zn	0.600
As	0.035
Se	0.010
Sr	0.015
Rh	0.029
Sb	0.109
Pb	0.096

Table S3. The primary chemical existence elements of NP.

Components	Content (%)
Na	0.315
Mg	0.116
Al	0.670
Si	1.338
P	0.025
S	40.997
Cl	0.076
K	0.170
Ca	0.248
Ti	0.157
Cr	0.044
Mn	0.09
Fe	55.517
Cu	0.077
Zn	0.013
As	0.025
Sb	0.143

Table S4. The TOC values of TCH and PHE in heterogeneous PMS/H_2O_2 activation systems.

Reaction system	Reaction time (h)	TOC (g/L)	Sample volume
Blank (TCH)	0	10.05	300.0 μL
NCP/PMS/H_2O_2/TCH	4	3.15	300.0 μL
NP/PMS/H_2O_2/TCH	4	3.54	300.0 μL
Blank (PHE)	0	72.22	300.0 μL
NCP/PMS/H_2O_2/PHE	24	5.03	300.0 μL
NP/PMS/H_2O_2/PHE	24	39.17	300.0 μL

Table S5. Kinetic parameters obtained from first-order models at different conditions.

Reaction system	Stage-I	Stage-II	
	k_1	k_2	R^2
NCP/PMS/H_2O_2/TCH	0.10095	0.00866	0.98951
NCP/PMS/TCH	0.07681	0.00581	0.96684
PMS/H_2O_2/TCH	0.01440	0.00496	0.93384
PMS/TCH	0.00546	0.00435	0.99184
NCP/H_2O_2/TCH	0.00558	0.00115	0.98581
H_2O_2/TCH	0.0009646	0.0009051	0.92716
NCP/PMS/H_2O_2/PHE	0.71539	0.07845	0.87110
NCP/PMS/PHE	0.60148	0.06975	0.98388
PMS/H_2O_2/PHE	0.05572	0.05025	0.97128
PMS/PHE	0.25786	0.02793	0.94009
NCP/H_2O_2/PHE	0.09784	0.03213	0.99001
H_2O_2/PHE	0.05456	0.02991	0.97315
NP/PMS/H_2O_2/TCH	0.06777	0.00832	0.99251
NP/PMS/TCH	0.05980	0.00366	0.99258
PMS/H_2O_2/TCH	0.01440	0.00496	0.93384
PMS/TCH	0.00546	0.00435	0.99184
NP/H_2O_2/TCH	0.00201	0.00284	0.97745
H_2O_2/TCH	0.0009646	0.0009051	0.92716
NP/PMS/H_2O_2/PHE	0.12704	0.03651	0.94192
NP/PMS/PHE	0.07602	0.03447	0.97479
PMS/H_2O_2/PHE	0.05572	0.05025	0.97128
PMS/PHE	0.25786	0.02793	0.94009
NP/H_2O_2/PHE	0.10325	0.02771	0.96986
H_2O_2/PHE	0.05456	0.02991	0.97315

Table S6. The related parameters of lake water and river water.

Parameter	Lake water	River water
pH	7.32	7.62
TOC (mg/L)	9.05	14.38
Ca (mg/L)	36.18	92.68
Mg (mg/L)	19.28	19.07
Fe (mg/L)	0.0211	0.0134

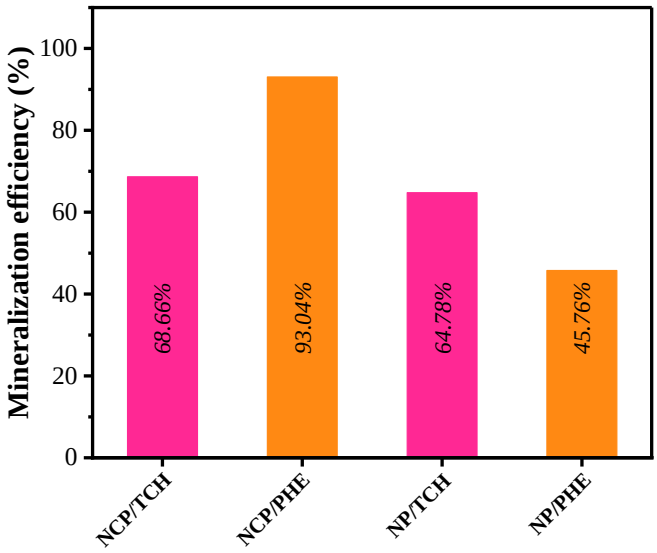


Figure S1. The mineralization efficiencies of TCH and PHE via PMS/H_2O_2 activation by natural minerals. Experimental conditions: $[catalyst]_0$ = 0.75 g/L, $[PMS]_0$ = $[H_2O_2]_0$ = 1.23 mM, $[TCH]_0$ = 500 mg/kg, $[PHE]_0$ = 50 mg/kg, T = 22 °C, pH (unadjusted), reaction time of 4 h with TCH and 24 h with PHE.

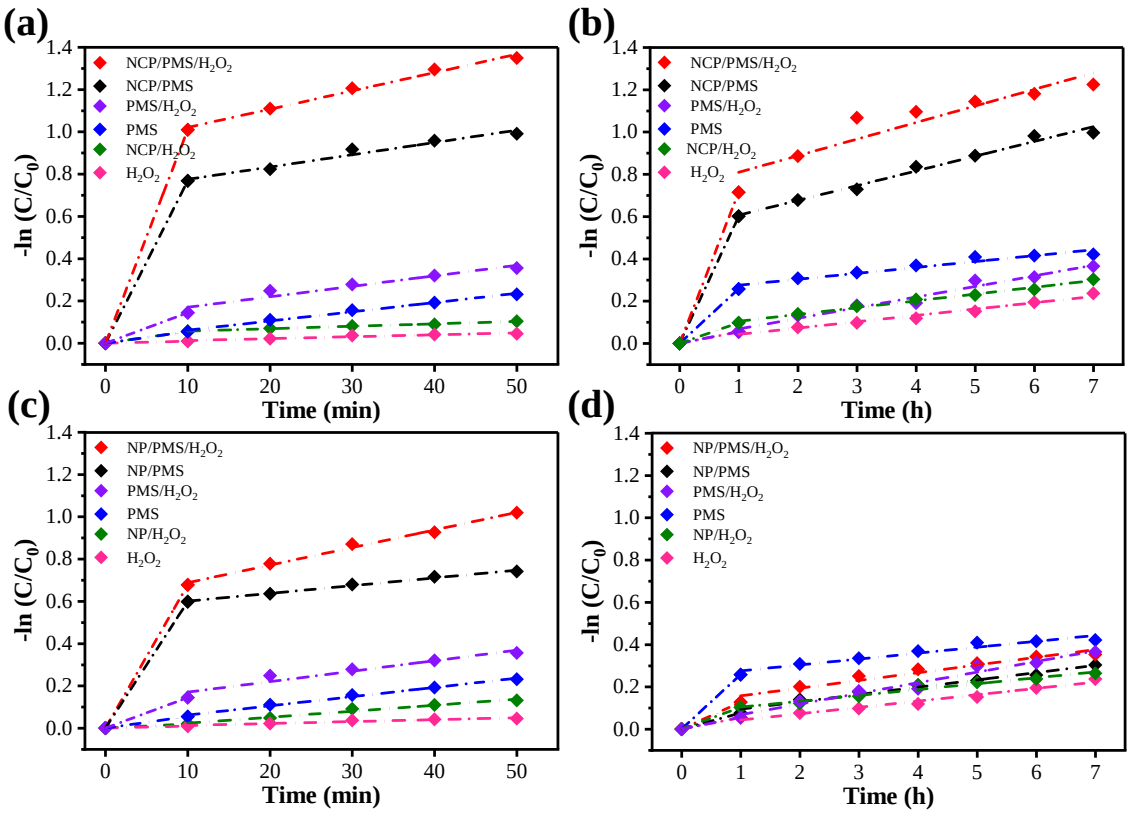


Figure S2. Linear transform -ln(C/C_0) of kinetic curves of NCP heterogeneous systems for (a) TCH and (b) PHE degradation; NP heterogeneous systems for (c)TCH and (d) PHE degradation. Experimental conditions: $[catalyst]_0$ = 0.75 g/L, $[PMS]_0$ = $[H_2O_2]_0$ = 1.23 mM, $[TCH]_0$ = 500 mg/kg, $[PHE]_0$ = 50 mg/kg, T = 22 °C, pH (unadjusted).

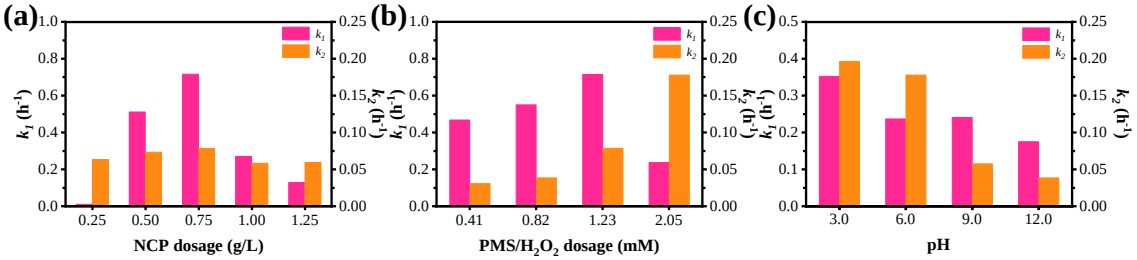
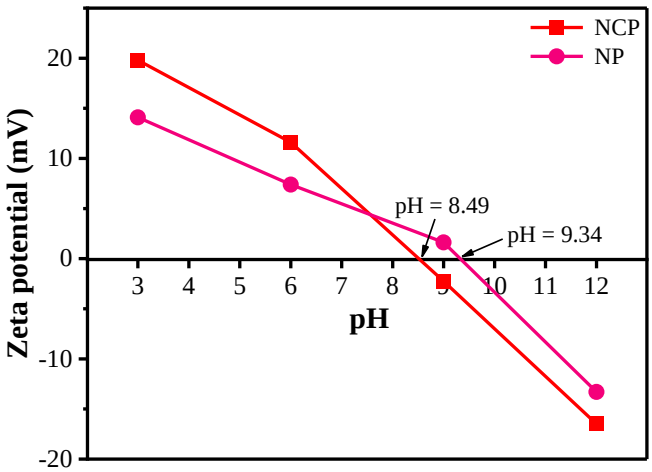


Figure S3. Kinetic constants of different (a) NCP dosage, (b) oxidants dosage, (c) initial pH value for PHE degradation. Experimental conditions: (a) $[PMS]_0$ = $[H_2O_2]_0$ = 1.23 mM, pH (unadjusted), $[PHE]_0$ = 50 mg/kg, T = 22 °C; (b) $[catalyst]_0$ = 0.75 g/L, pH (unadjusted), $[PHE]_0$ = 50 mg/kg, T = 22 °C; (c) $[catalyst]_0$ = 0.75 g/L, $[PMS]_0$ = $[H_2O_2]_0$ = 2.05 mM, $[PHE]_0$ = 50 mg/kg, T = 22 °C.



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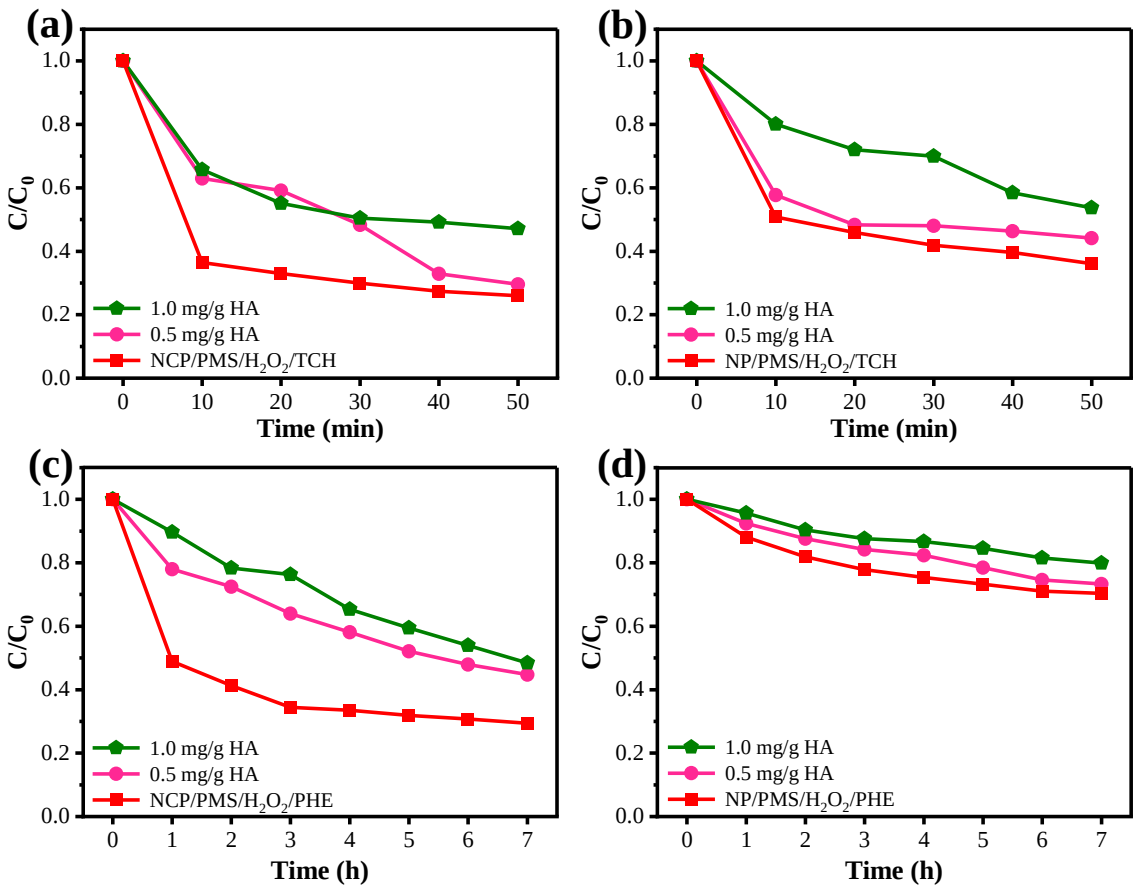

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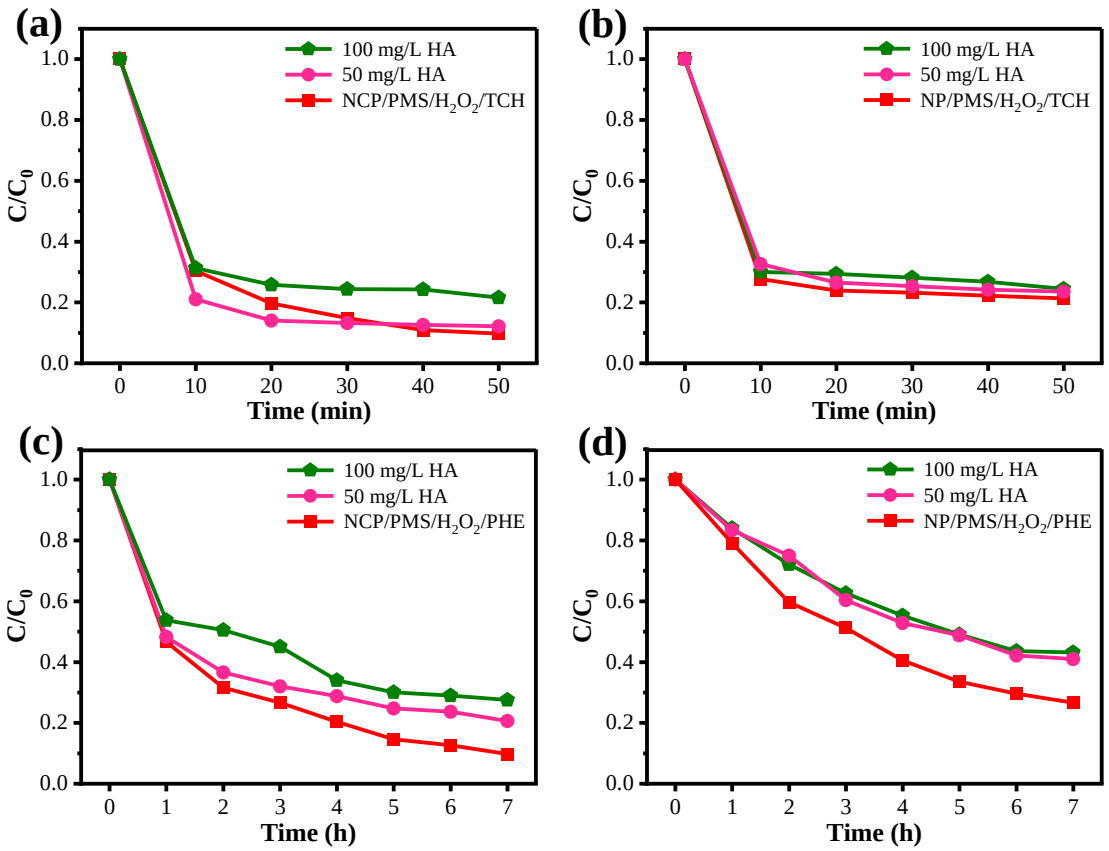
$[H_2O_2]_0$ = 1.23 mM, $[TCH]_0$ = 500 mg/kg, $[PHE]_0$ = 50 mg/kg, T = 22 °C, pH (unadjusted).



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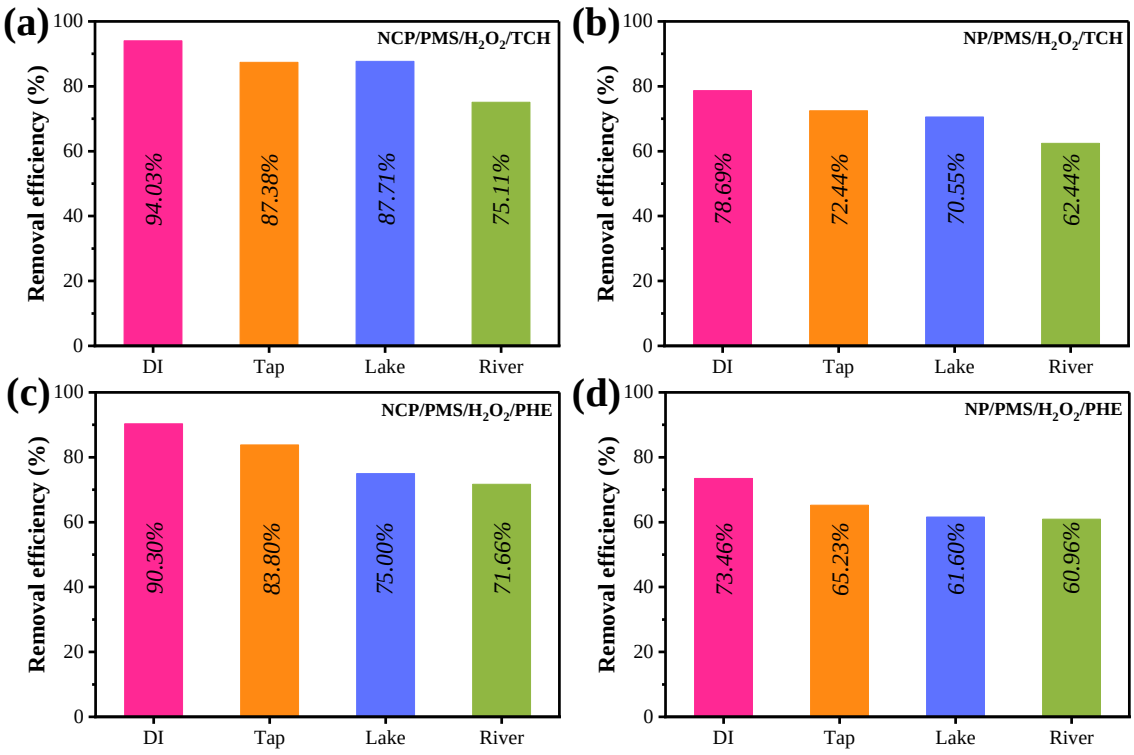

Figure S7. TCH removal efficiencies within 50 min in different real water samples with (a) NCP/PMS/H_2O_2 system and (b) NP/PMS/H_2O_2 system; PHE removal efficiencies within 7 h in different real water samples with (c) NCP/PMS/H_2O_2 system and (d) NP/PMS/H_2O_2 system. Experimental conditions: $[catalyst]_0$ = 0.75 g/L, $[PMS]_0 = [H_2O_2]_0$ = 1.23 mM, $[TCH]_0$ = 50 mg/L, $[PHE]_0$ = 5 mg/L, T = 22 °C, pH (unadjusted).