Supporting Information

Synergistic effect of soil organic matter and nanoscale zero-valent iron on the biodechlorination

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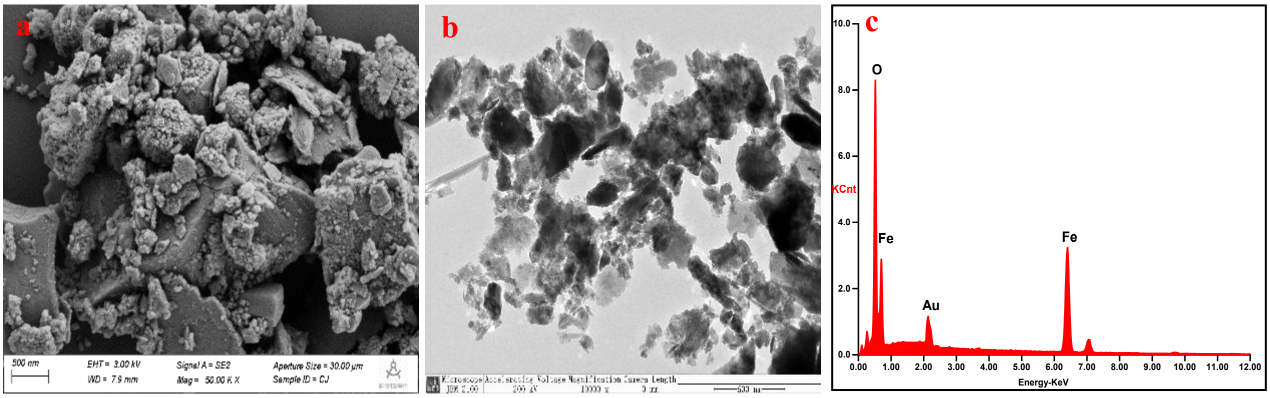
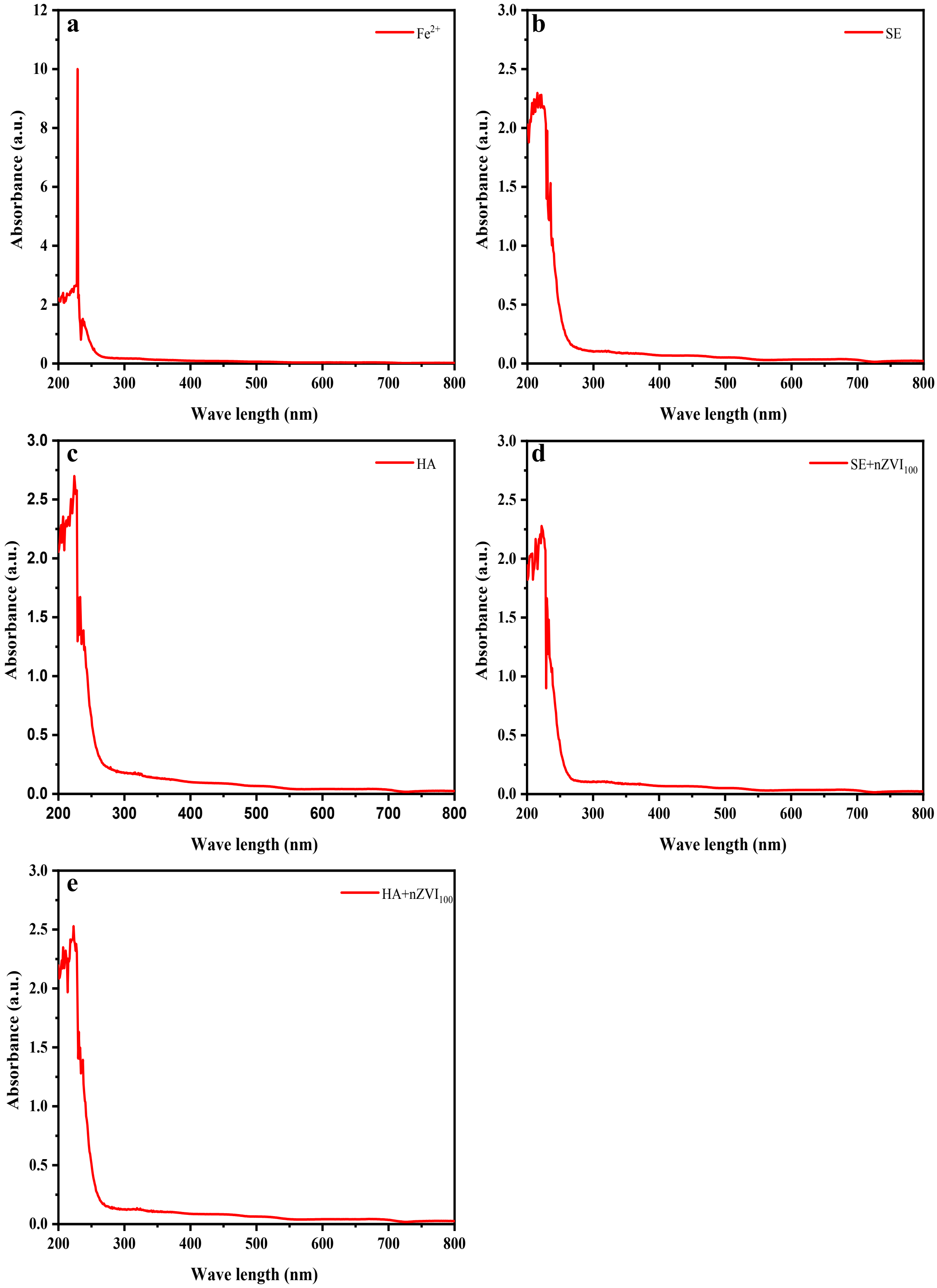


Fig. S1. (a) SEM, (b) TEM, and (c) EDS analysis results of iZVI.



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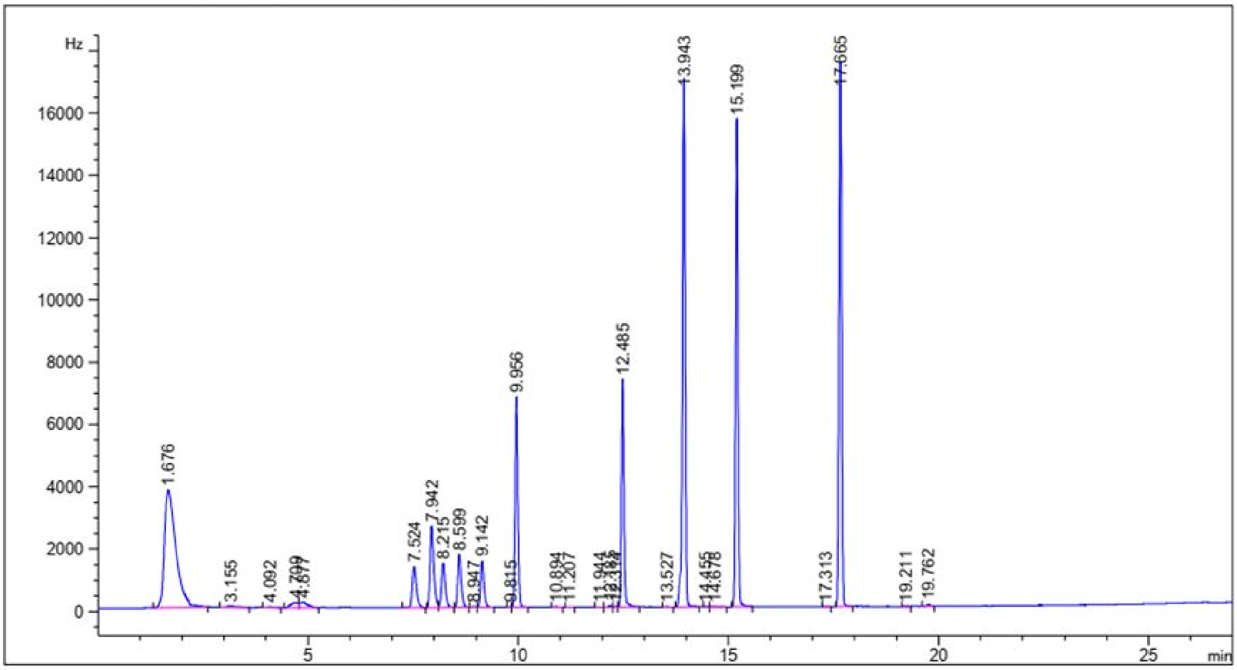


Fig. S3. Chromatogram of PCP and its intermediates by GC-ECD

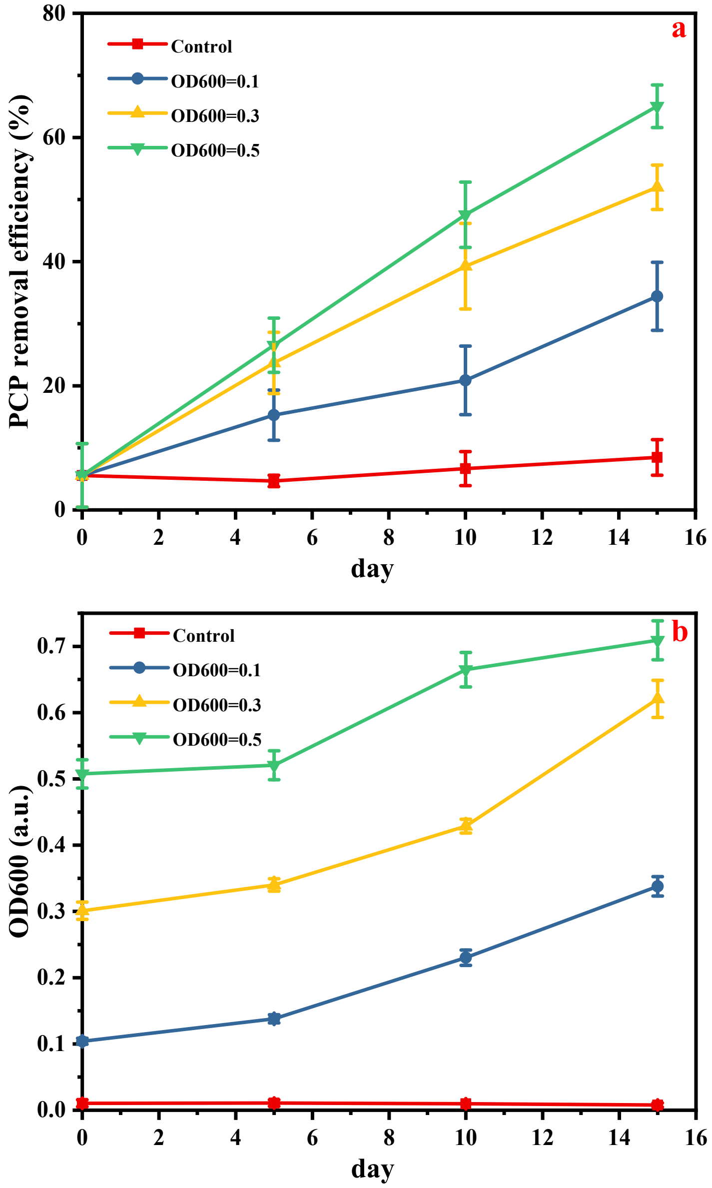
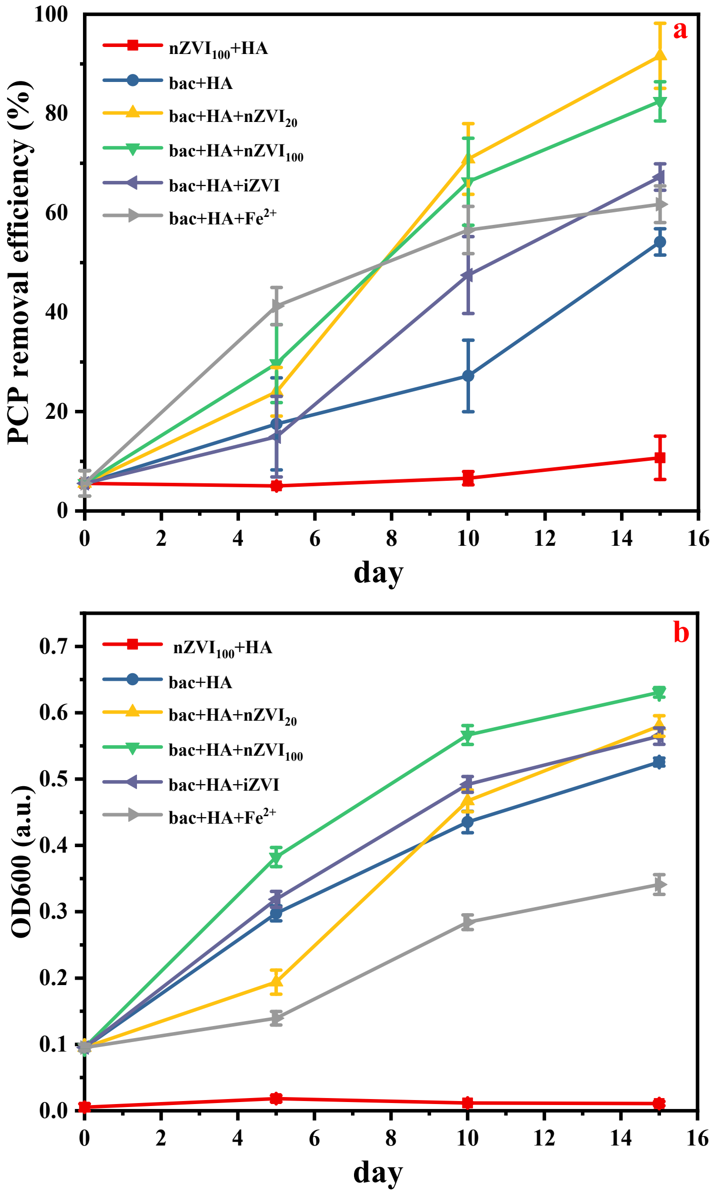


Fig. S4. Changes in (a) PCP removal efficiency and (b) bacterial density of reactors (PCP=10 mg/L) with different initial bacterial densities against incubation time. Error bars represent standard deviations for the corresponding mean values (n=3).



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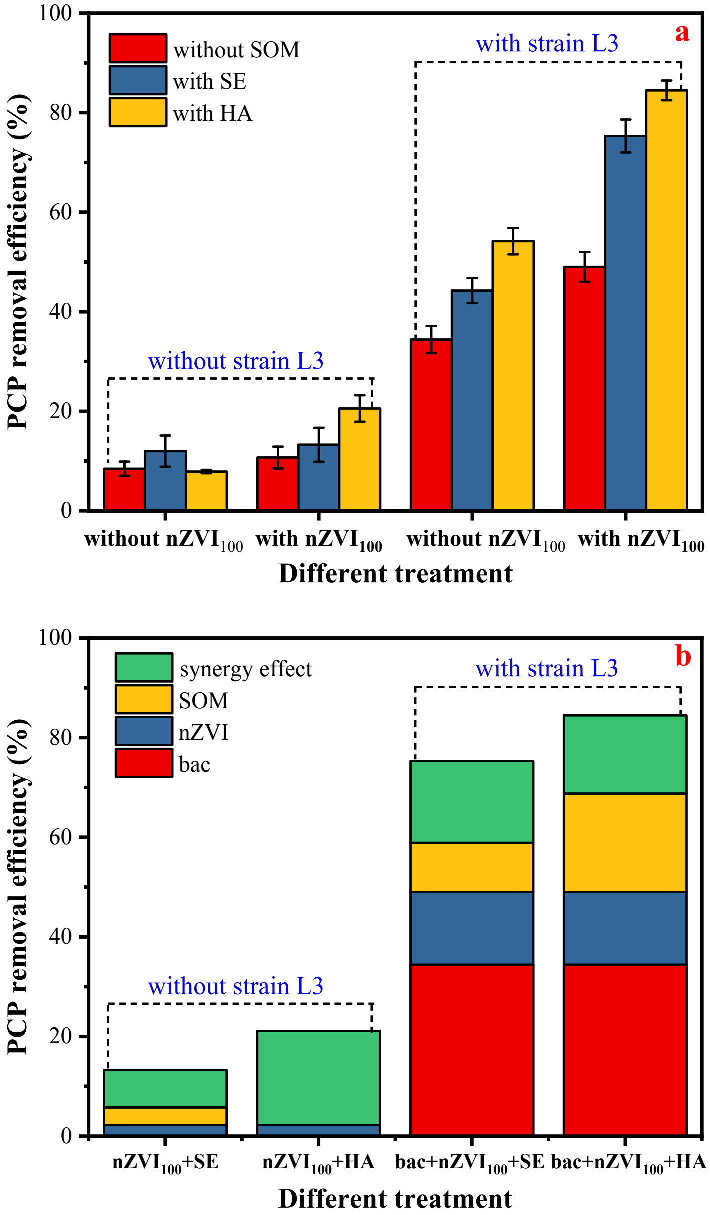
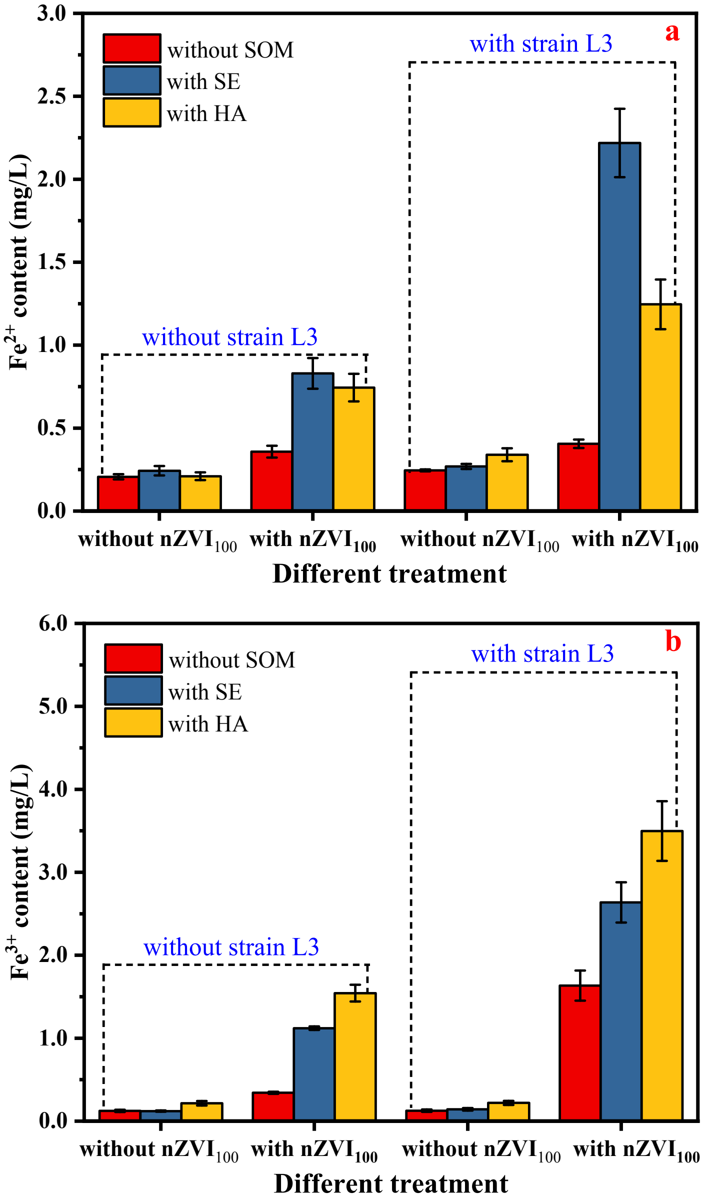


61 **Fig. S6.** (a) PCP removal efficiency and (b) contributions of bac, nZVI, and SOMs in different reactors after 15 day incubation. Error bars represent standard deviations for the corresponding mean values (n=3).



64 **Fig. S7.** Contents of (a) Fe^{2+} and (b) Fe^{3+} in sterilized and L3 strain reactors (PCP=10 mg/L) after 15

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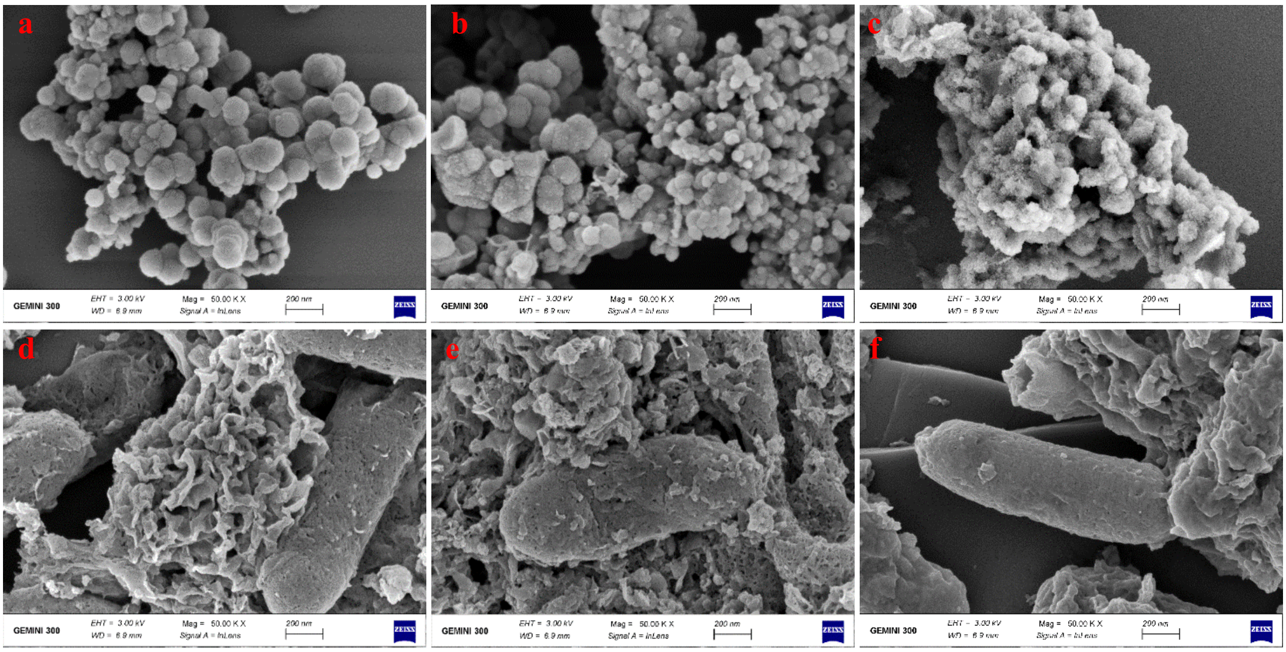

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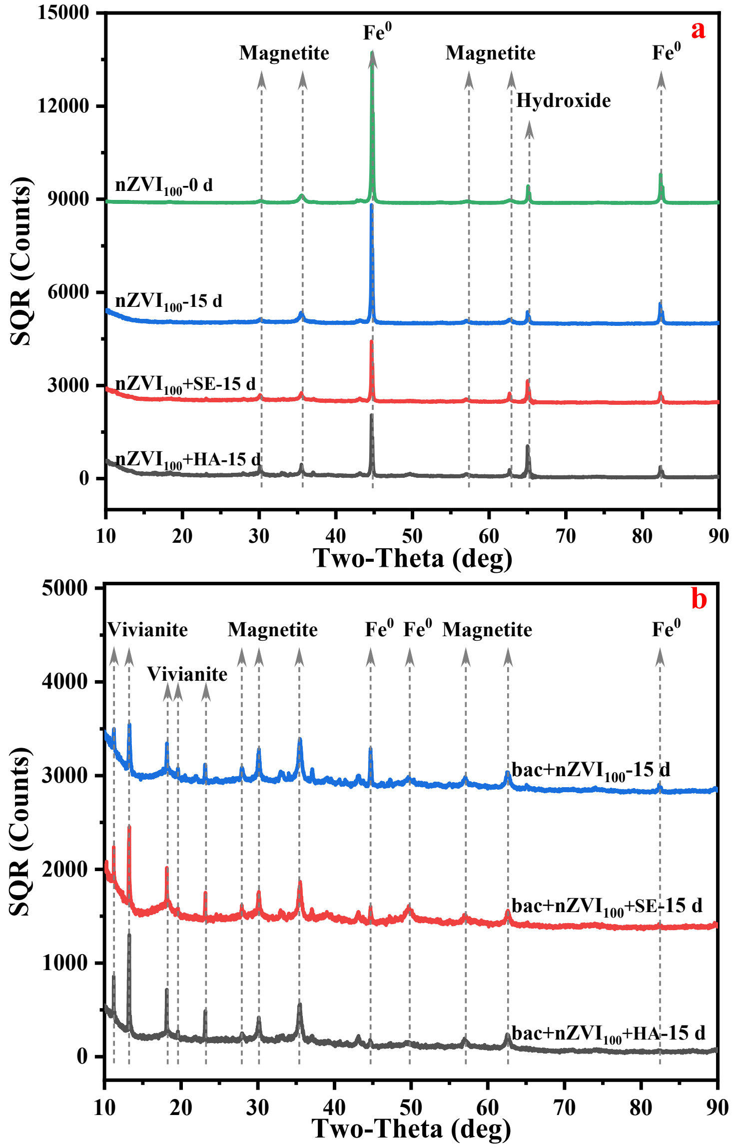

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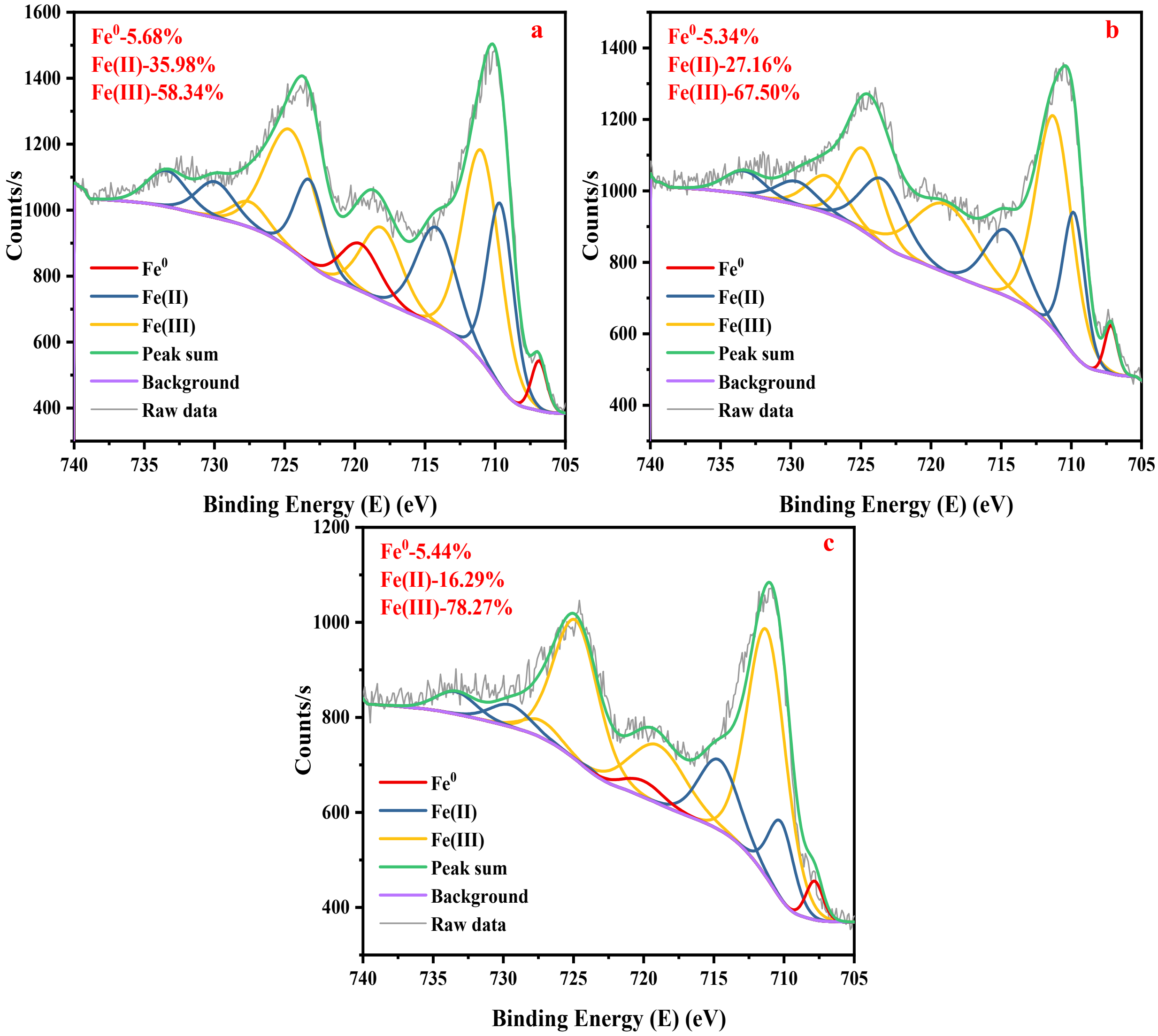

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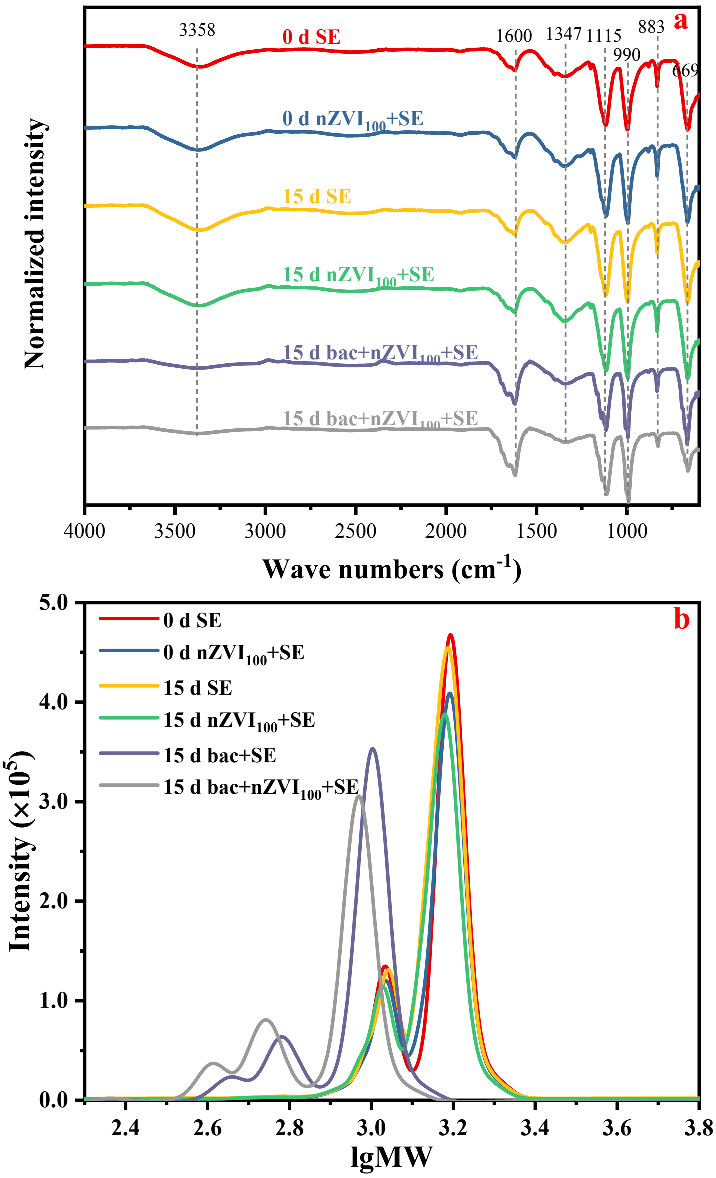


74 **Fig. S11.** (a) FTIR spectra and (b) molecular weight distributions of SE solutions.

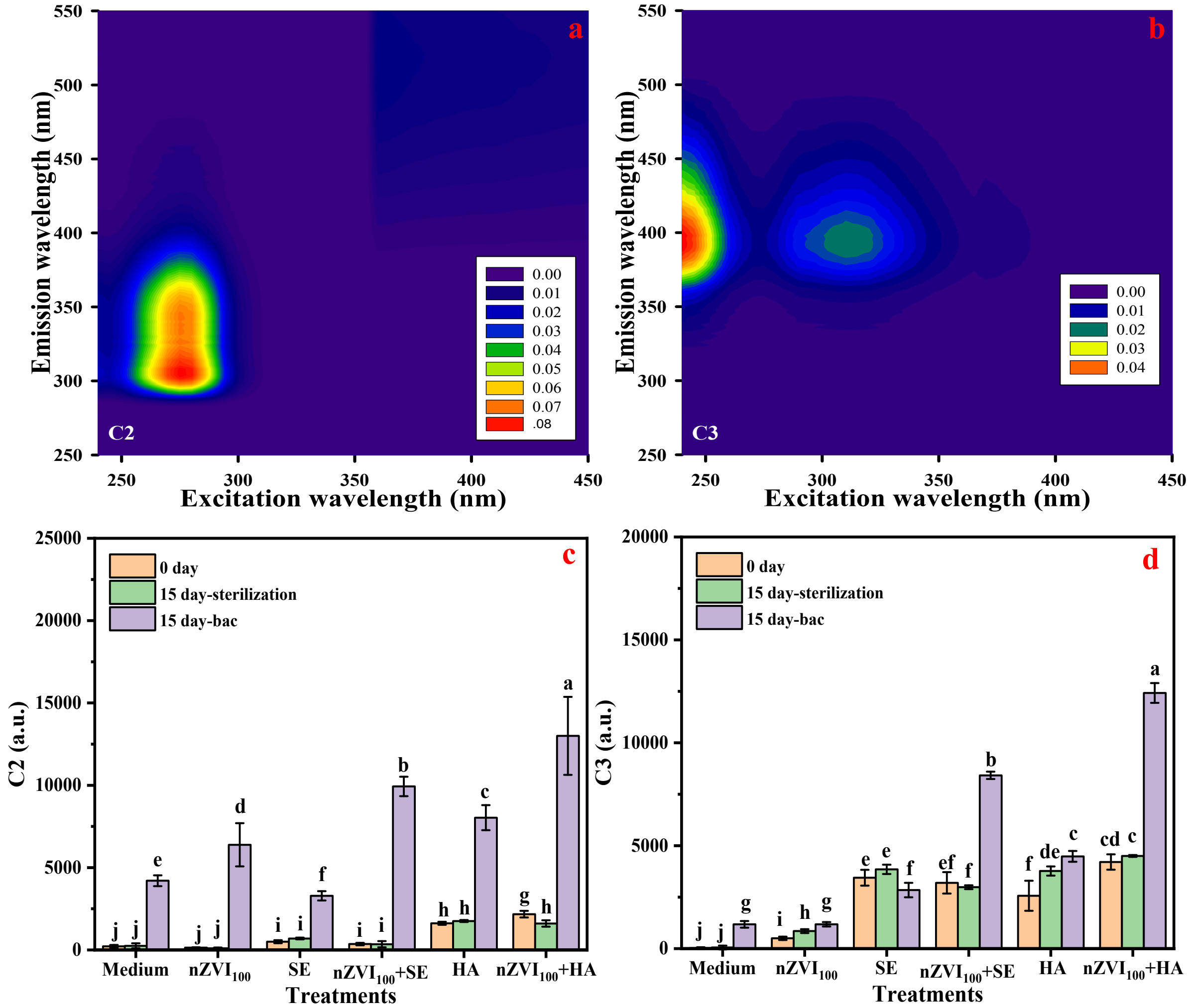


Fig. S12. Spectral characteristics of (a) C2 and (b) C3 fractions, and relative fluorescence intensities of (c) C2 and (d) C3 fractions identified by PARAFAC-EEMs for all SOM treatments with and without $nZVI_{100}$ before and after 15 day cultivation under sterilization or unsterilization. Error bars in panels c and d represent standard deviations for the corresponding mean values (n=3). Different letters for a group of data in panels c and d indicate differences of statistical significance (p< 0.05).

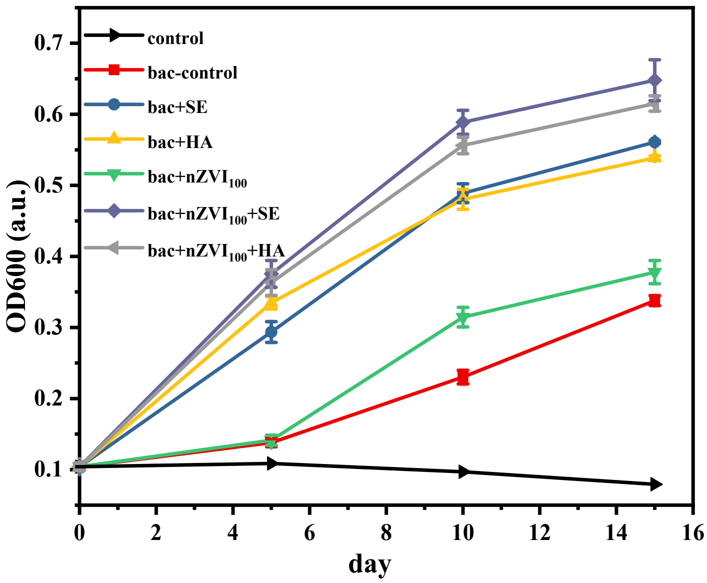
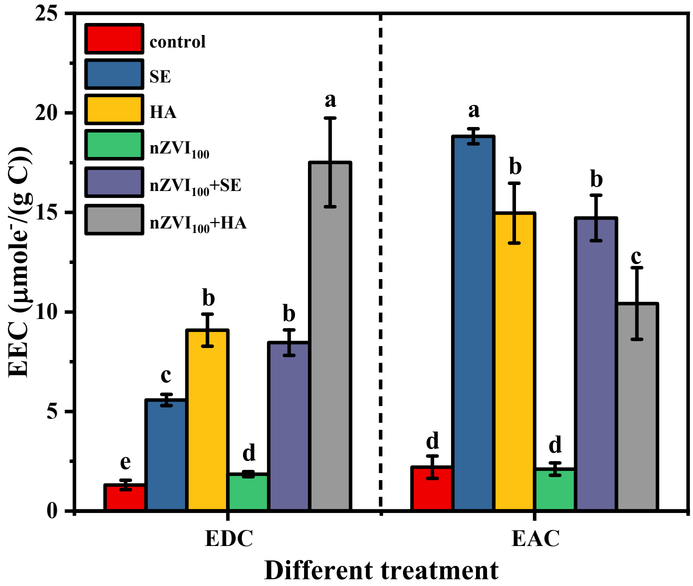


Fig. S13. Variation of microbial density in the mineral culture medium (PCP=10 mg/L) with $nZVI_{100}$ (100 mg/L) and/or SOM (25 mg C/L) against incubation time. Error bars represent standard deviations for the corresponding mean values (n=3).



83 **Fig. S14.** EAC and EDC of various sterile-reactors by chronoamperometry after three successive cycles of electrochemical reduction at a potential of -0.49 V and oxidation at a potential of +0.61 V. Error bars represent standard deviations for the corresponding mean values (n=3). Different letters indicate differences of statistical significance (p<0.05).

Table S1. Physicochemical properties of PCP

Chlorophenol	Formula	Molecular weight	Water solubility (mg/L 25 ℃)	$\log K_{ow}$
PCP	C_6Cl_5OH	266.3	14.0	5.12

Table S2. Chemical composition of the soil sample. Bars represent standard errors for the corresponding mean values.

Minerals	g/kg	Elements	%
Na_2O	9.87±0.05	N	0.20±0.02
MgO	5.27±0.05	C	1.92±0.25
Al_2O_3	118.13±0.54	S	0.04±0.01
SiO_2	705.10±1.12	H	0.23±0.03
K_2O	28.63±0.26	O	5.46±0.44
CaO	6.10±0.03	-	-
Fe_2O_3	35.53±0.21	-	-

Note: Mineral composition was characterized with an X-ray fluorescence spectrometer. Element contents were determined with an organic element analyzer. Standard deviations represent standard errors for the corresponding mean values (n=3)

Table S3. Composition of the phenols in the mixed standard solution.

Components	CAS	Purity %
4-Chloro-3-methylphenol	59-50-7	99.7
2-Chlorophenol	95-57-8	99.1
2-Cyclohexyl-4,6-Dinitrophenol	131-89-5	100.0
2,4-Dichlorophenol	120-83-2	100.0
2,6-Dichlorophenol	87-65-0	100.0
2,4-Dimethyphenol	105-67-9	100.0
Dinoseb	88-85-7	100.0
2,4-Dinitrophenol	51-28-5	100.0
2-Methyl-4,6-Dinitrophenol	534-52-1	100.0
2-Methyphenol	95-48-7	96.2
3-Methyphenol	108-39-4	99.5
4-Methyphenol	106-44-5	96.6
2-Nitrophenol	88-75-5	100.0
4-Nitrophenol	100-02-7	99.1
Pentachlorophenol	87-86-5	99.0
Phenol	108-95-2	99.0
2,3,4,5-Tetrachlorophenol	4901-51-3	98.0
2,3,4,6-Tetrachlorophenol	58-90-2	100.0
2,3,5,6-Tetrachlorophenol	935-95-5	100.0
2,4,5-Trichlorophenol	95-95-4	100.0
2,4,6-Trichlorophenol	88-06-2	98.0

Table S4. Retention times, recovery rates, and limits of detection (LD) of chlorophenols.

Chlorophenols	Retention time (min)	Recovery rate (%)	LD (mg/kg)
5-Chlorophenol	4.092	87.5±4.6	0.427
3-Chlorophenol	4.709	76.7±5.1	0.525
2,6-DCP	7.524	86.7±4.2	0.125
2,5-DCP	7.942	82.1±3.6	0.162
3,5-DCP	8.215	79.4±4.3	0.198
2,3-DCP	8.599	87.5±5.5	0.141
3,4-DCP	9.142	85.4±5.4	0.147
2,4,6-TCP	9.956	86.2±6.7	0.047
3,4,5-TCP	12.485	87.1±4.6	0.052
2,3,5,6-TeCP	13.895	90.1±3.6	0.024
2,3,4,6-TeCP	13.943	89.3±4.7	0.013
2,3,4,5-TeCP	15.199	92.4±5.0	0.019
PCP	17.665	106.2±8.6	0.011

Note: Standard deviations represent standard errors for the corresponding mean values (n=3).

Table S5. PCP removal efficiencies in different reactors after 15 day incubation.

Without strain L3		**With strain L3**	
groups	removal efficiency (%)	groups	removal efficiency (%)
control group	8.46±1.43	bac-control	34.4±2.74
SE	12.0±3.14	bac+SE	44.3±2.51
HA	7.90±0.34	bac+HA	54.2±2.64
$nZVI_{100}$	10.7±2.18	bac+ $nZVI_{100}$	49.0±3.00
$nZVI_{100}$+SE	13.3±3.40	bac+ $nZVI_{100}$+SE	75.3±3.31
$nZVI_{100}$+HA	20.6±2.66	bac+ $nZVI_{100}$+HA	84.5±1.98