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Supplementary data

Moving-Bed Biofilm Reactor Combined with a Three-Dimensional Electrochemical Pretreatment (MBBR-3DE) for 2,4-D herbicide treatment: Application for real wastewater and improvement of biodegradability

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Table S1. Data for media biofilm carriers in MBBR process

Gender Media	HDPE (High density poly ethylene)
Type media	2H-BCN 017 KL
Density (g/cm^3)	0.98
Growable special Surface (m^2/m^3)	437
Average weight media (g)	0.89
Mean weight media with biofilm media (g)	2.5

Table S2. Amount of compounds used for synthetic wastewater

Chemical compounds	**Amount**
KI	0.18 g/L
$MnCl_2$. $4H_2O$	0.12 g/L
$FeCl_3$. $6H_2O$	0.15 g/L
$CuSO_4$. $5H_2O$	0.03 g/L
H_3BO_3	0.15 g/L
$CoCl_2$. $6H_2O$	0.15 g/L
$ZnSO_4$. $7H_2O$	0.12 g/L
Na_2MnO_4. 2H2O	0.06 g/L
EDTA	0.10 g/L
$CaCl_2$. H_2O	0.01 g/L
$MgSO_4$. $7H_2O$	0.09 g/L
Trace elements (micronutrients)	0.3 ml/L
COD	500.0 mg/L

Table S3. Routine microbiological biochemical tests performed in the present study

Raw	Test	Purpose	Materials and reagents
1	**Catalase test**	Diagnosis of staphylococcus and micrococcus (positive catalase) from streptococcus (negative catalase), differentiation of clostridium (often negative catalase) from bacilli (positive catalase) and differentiation of Listeria monocytogenes (positive catalase) from beta hemolytic streptococcus	Hydrogen peroxide, 3% (H_2O_2)
2	**Simmons Citrate Agar**	Identification and differentiation of members of the family Enterobacteriaceae	Culture medium of Simmons Citrate Agar
3	**MR-VP**	Differentiation of organisms based on the ability to produce end products due to glucose fermentation	MR-VP culture medium (methyl red reagent, alpha naphthol solution and 40% potash)
4	**TSI**	Identification of gram-negative bacilli, especially members of the Enterobacteriaceae family	Sloping TSI culture medium tube
5	**KIA**	Identification of gram-negative bacilli, especially members of the Enterobacteriaceae family	Sloping KIA culture medium tube
6	**Oxidase**	Isolation of Enterobacteriaceae (which are all negative oxidase) from bacteria such as Vibionaceae, Aeromonas, Pseudomonas (all of which are positive oxidase)	1% solution of tetramethyl-p-phenylenediamine dihydrochloride (TMPD) in sterile distilled water or commercial oxidase ready disk
7	**urease**	Determining the ability of bacteria to produce urease	Culture medium of urease
8	**Gelatinase**	Differentiate gelatinase-producing bacteria (such as Proteus vulgaris) from other bacteria	Culture medium of nutritious gelatin in the tube
9	**Of**	Diagnosis of aerobic or anaerobic bacteria	**-**

Table S4. Data obtained to calculate the kinetic coefficients in the MBBR process

Hydraulic retention time (HRT)	S_i	S_e	**First-order model** □ □□ $\frac{S_i - S_e}{HRT}$	**Second-order (Grau) model** $\frac{S_e \times HRT}{S_e - S}$
0.20	210.0	69.3	0.67	0.31
0.41	210.0	57.54	0.37	0.57
0.62	210.0	45.67	0.26	0.79
0.87	210.0	32.08	0.20	1.03
1.0	210.0	19.13	0.19	1.1

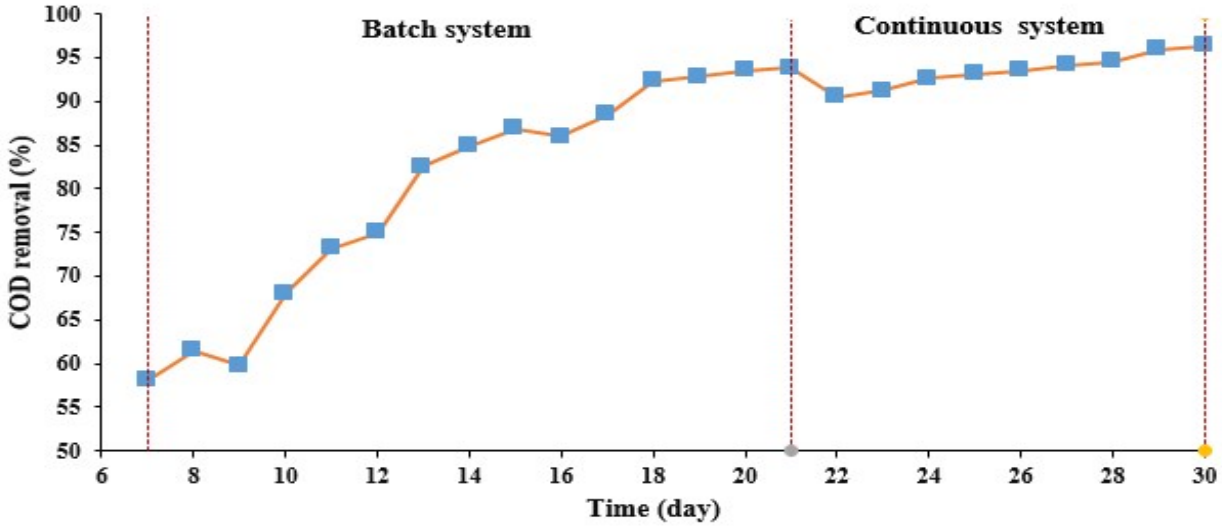

Fig S1. Efficiency of MBBR biological reactor in COD removal during the early stages of reactor adaptation

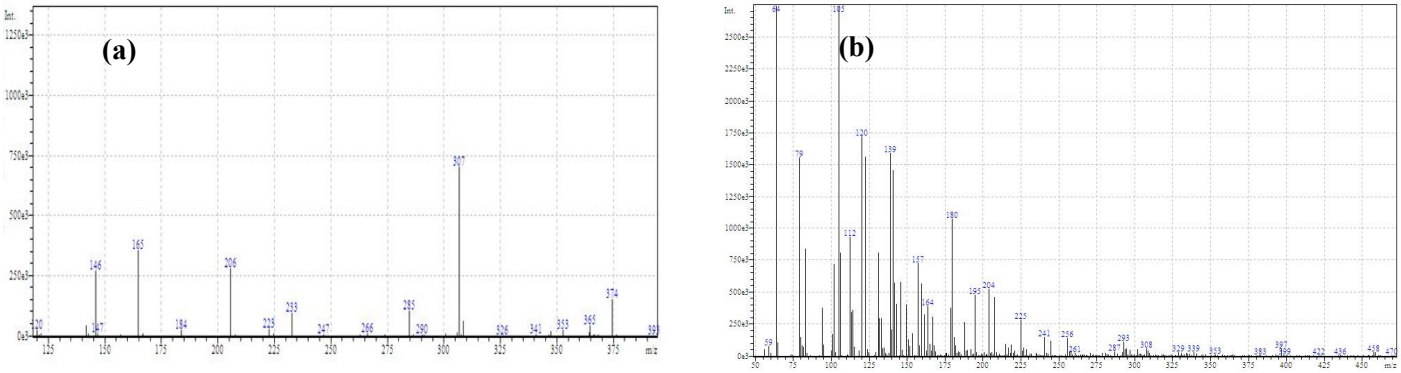

Fig S2. LC/MS chromatograms after a) 3D electrochemical degradation and b) after biodegradation of 2,4-D herbicide under optimal conditions