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Supplementary material: Electrooxidation treatment of simulated wastewater using mixed-metal oxide anodes for bacterial decontamination

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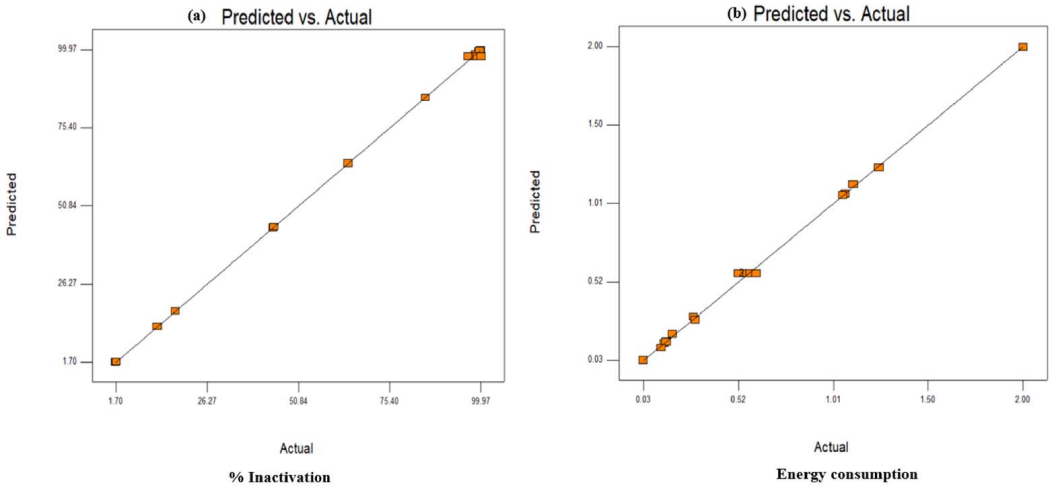
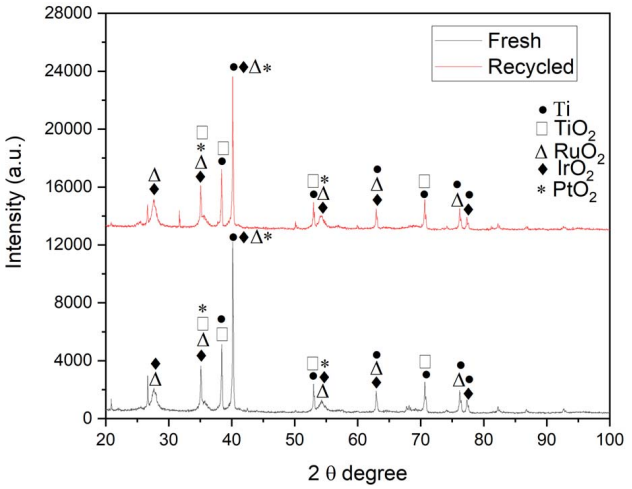
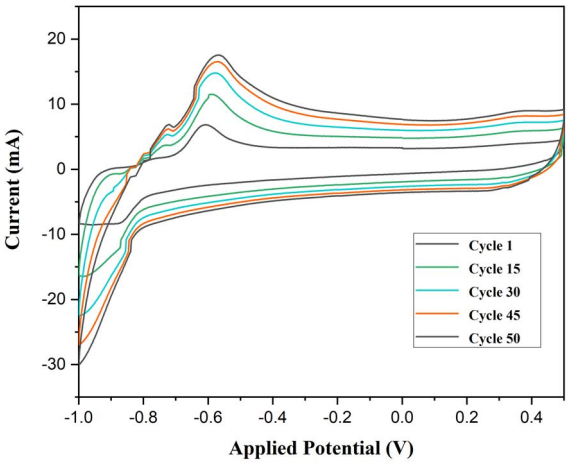


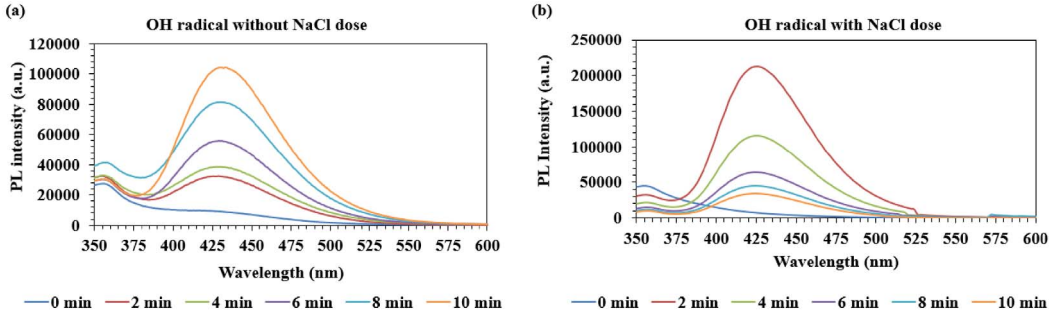
Supplementary Figure S1. The graphs show the regression plot of predicted vs actual for (a) % Inactivation and (b) Eenergy consumption indicating that the actual experimental values are in close proximity with the predicted values.



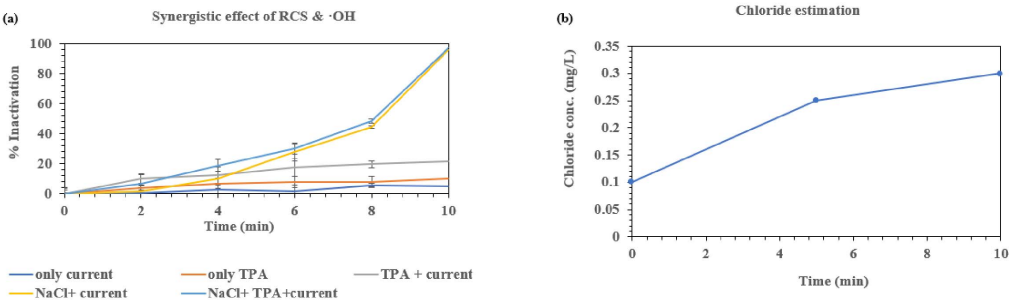
Supplementary Figure S2. XRD graph of fresh and recycled MMO anode after 50 experimental runs.



Supplementary Figure S3. I–V curve of MMO anode at a scanning rate of 500 mV/s for 50 cycles.



Supplementary Figure S4. PL spectra of OH radical at 425 nm under optimized condition of (current density = 6.34 mA/cm^2, NaCl dose = 1.77 g, time = 10 min). (a) The graph shows the PL spectra of OH radical at an acidic pH of 3.8 when no NaCl dose was applied. (b) The graph shows the PL spectra of OH radical with NaCl dose of 1.77 g.



Supplementary Figure S5. (a) The graph depicts the synergistic effect of RCS and •OH of simulated wastewater containing bacterial consortium under optimized conditions of (current density = 6.34 mA/cm^2, NaCl dose = 1.77 g). (b) The graph dipicts the chloride concentration of the sample solution having bacterial consortium.

Supplementary Table S1. Range of actual and coded variables for electrooxidation treatment of simulated wastewater

Factors	Variables	Range of actual and coded variables		
		−1	0	+1
X_1	NaCl dose (g/L)	0.5	1.5	2.5
X_2	Current density (mA/cm^2)	2.38	7.14	11.90
X_3	Treatment time (min)	2	9	16

Supplementary Table S2. Constraints of process variables for optimization

Variables	Goal	Lower limit	Upper limit
j	Is in range	2.38	11.904
n	Is in range	0.5	2.5
t	Is in range	2	16
% Inactivation	Maximize	1.7	99.97
Energy consumption	Minimize	0.033	1.995

Supplementary Table S3. Individual and multiresponse optimization for desirability calculations

Response	Current density (mA/cm^2)	NaCl dose (g/L)	Time (min)	Desirability
Individual response optimization				
% Inactivation, (Q_1) = 100.00%	10.35	1.05	8.01	1.000
Energy consumption, (Q_2) = 0.022 kWh/m^3	2.40	0.82	2.01	1.000
Simultaneous optimization of responses				
% Inactivation, (Q_1) = 99.96%	6.34	1.77	10	0.884
Energy consumption, (Q_2) = 0.58 kWh/m^3				

Supplementary Table S4. Comparison between predicted and actual experimental values at optimized conditions

Responses	Predicted	Actual experimental values
% Inactivation	99.96%	99.2%
Energy consumption (kWh/m^3)	0.58	0.42

Supplementary Table S5. Evaluation of tentative operating cost of EO process

Electrical energy consumed for treating bacteria with MMO = 0.413 kWh/m^3
Price of electricity in Punjab = 0.070 $/kWh
Price of electricity consumption = 0.070 × 0.413 = 0.028 $/m^3
Price of one MMO anode used = 9.43 $
Total price of MMO anode = 9.43 + 0.028 = 9.458 $
Total cost of MMO for removal of bacteria = 9.43 + 0.028 = 9.458 $/m^3
Total runs = 50
Cost of one run = 9.458/50 = 0.189 $/m^3
Total operating cost for per run of bacterial inactivation = 0.189 $/m^3