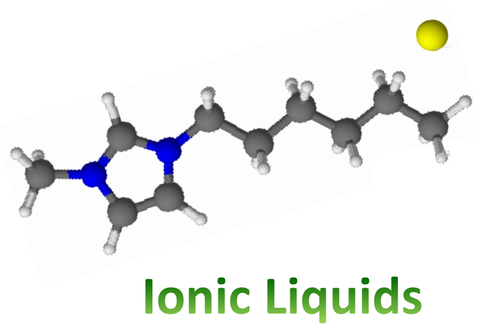
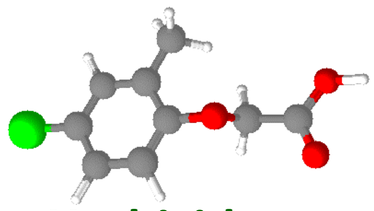
Removal of pollutants in aqueous phase through catalytic processes and biological treatments

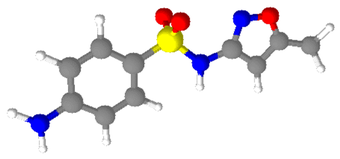
POLLUTANTS



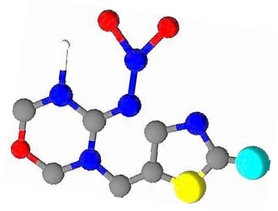
Ionic Liquids



Herbicides



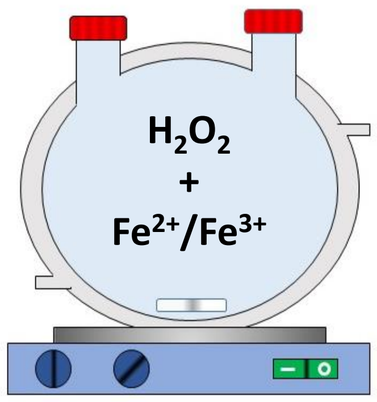
Drugs



Insecticides

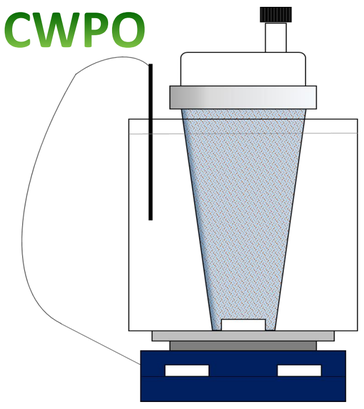
ADVANCED OXIDATION PROCESSES

FENTON



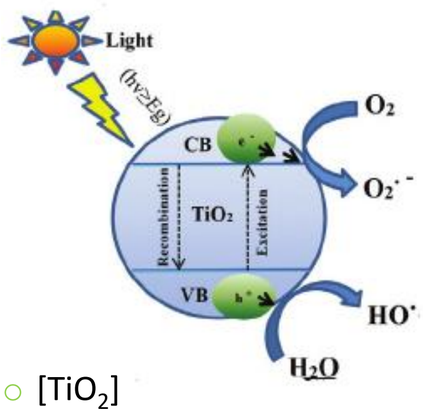
- Temperature
- pH
- H_2O_2/Fe ratio

CWPO



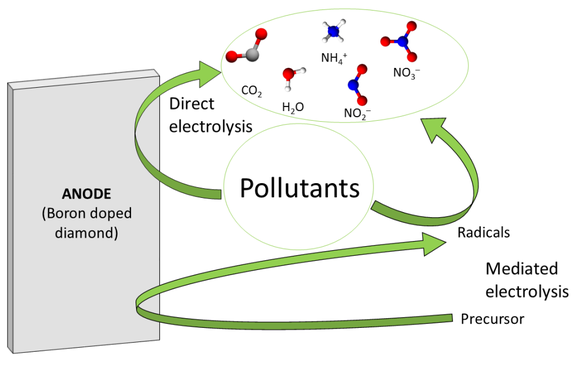
- Temperature
- pH
- H_2O_2 dose
- Catalyst concentration

PHOTOCATALYSIS



- [TiO_2]
- Solar lamp intensity
- Pollutant concentration

ELECTRO-OXIDATION



- Temperature
- Current density
- Electrolyte

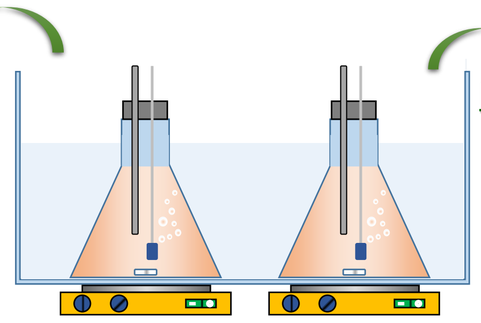
Table 1. Results and operating conditions for different AOPs

Treatment	Operating conditions	IL removal	X_{TOC} (%)
Fenton	[HmimCl] = 1 g L^{-1}; H_2O_2/Fe^{3+} (ratio 10:1 M/M); 70 ^oC; pH 3; $t_{reaction}$ = 4 h	100% (5 min)	54 %
CWPO	[HmimCl] = 0,20 g L^{-1}; [Fe_2O_3/Al_2O_3] = 1 g L^{-1}; [H_2O_2] = stequiometric dose, 90 ^oC; pH 3; $t_{reaction}$= 4 h	100% (1 h)	42 %
Photocatalysis	[HmimCl] = 0,35 g L^{-1}; [TiO_2] = 0,25 g L^{-1}; Solar lamp 600 W m^{-2}, $t_{reaction}$ = 24 h	100% (14 h)	35 %
Electrolysis	[HmimCl] = 0,20 g L^{-1}; BDD electrodes, 30 mA cm^{-2}; 25 ^oC; pH libre; $t_{reaction}$ = 8 h	96 % (8 h)	70 %

BIOLOGICAL TREATMENT ECOTOXICOLOGY

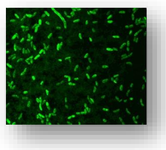
ECOTOXICITY

Activated sludge inhibition test Specific Oxygen Uptake Rate (**SOUR**)



BIODEGRADABILITY

Activated sludge (24-100 h)



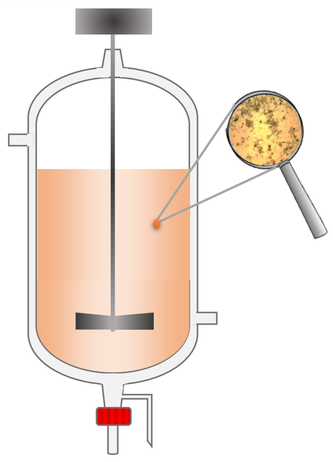
MICROTOX

Vibrio fischeri

BIODEGRADABILITY

Zahn Wellens (28 d)

DBO_5 (5 d)



SBR

Organic load

Cm = 0.15-0.3 kgCOD $kgVSS^{-1}$ d^{-1}

Volatile Suspended Solids

VSS = 1,5-5 g L^{-1}

Anoxic-aerobic cycles

3-4 cycles/d

COMBINED TREATMENTS

AOPs + Biological treatment → **High TOC conversion and COD removal**

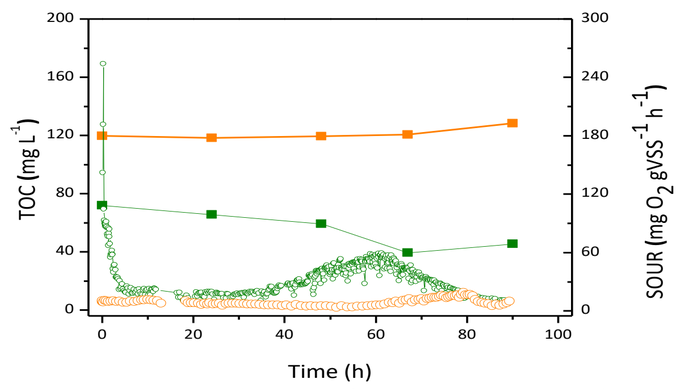


Figure 1. Time-course evolution of SOUR and TOC by respirometric inhibition test using activated sludge

Nitrate

CATALYTIC REDUCTION OF NITRATE

WATER TREATMENT- EFFECT HCO_3^-, Cl^- AND SO_4^{2-}

Real water / Synthetic water + 100 mg L^{-1} NO_3^- → **Bimetallic catalyst** Sn-Pd/Al_2O_3 5-0,5 % wt → Activity and selectivity → Batch reactor

Stability → Fixed bed reactor

Table 2. Nitrate conversion ($X_{NO_3^-}$), selectivity to ammonium ($S_{NH_4^+}$) and nitrogen (S_{N_2}) of real and synthetic waters in batch reactor test

Real water	Concentration (mg L^{-1})			t = 360 min		
	Cl^-	SO_4^{2-}	HCO_3^-	$X_{NO_3^-}$ (%)	$S_{NH_4^+}$ (%)	S_{N_2} (%)
A	7,3	22,6	255,1	10,8	8,3	91,7
B	nd	2,6	8,9	87,0	4,2	95,8
C	8,4	6,1	162,6	22,3	8,0	92,0
D	1,9	40,4	370,0	29,9	6,0	94,0
E	16,3	379,7	128,8	43,3	6,4	93,6
F	169,8	39,1	244,0	46,6	6,7	93,3
G	7,1	8,6	13,0	72,0	4,5	95,5
Synthetic water				92,5	4,1	95,9