Plasma chemical oxidation of phthalic anhydride: Application to the treatment of Tunisian landfill leachate

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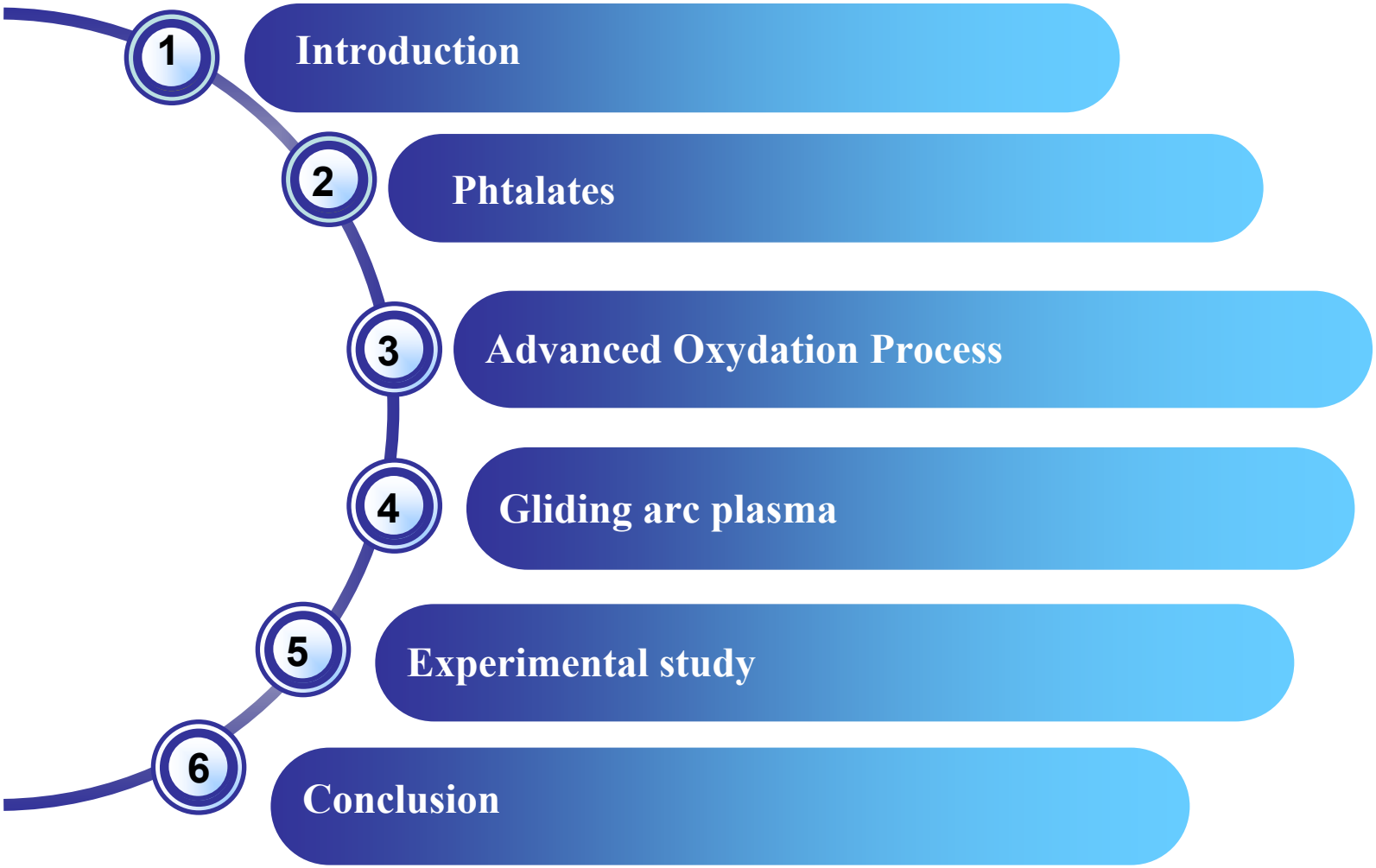
Plan


1
Introduction
2
Phtalates
3
Advanced Oxydation Process
4
Gliding arc plasma
5
Experimental study
6
Conclusion

The increase of industrial and agricultural activities in developing countries → The use of high varieties of synthetic chemicals

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Synthtic chemicals are considered toxic when they are present in aquatic environment

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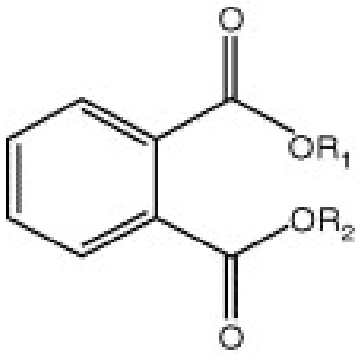
80% of the diseases are directly associated with polluted water.

1,2-dicarboxylic benzene acids + Alcohol ↔ Phtalates + water



- They are essentially used as plasticizers to increase the flexibility and durability of polyvinyl chloride

- Several industrial plants produce large amounts of wastewater containing high concentration of phthalates (COT = 6400,88 mg L^{-1}) .

The need to develop an effective, ecological and economical treatment processes becomes obvious

Removal of Phthalates → Biological Process

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Insuffisent ← Advanced Oxidation Process (AOP)

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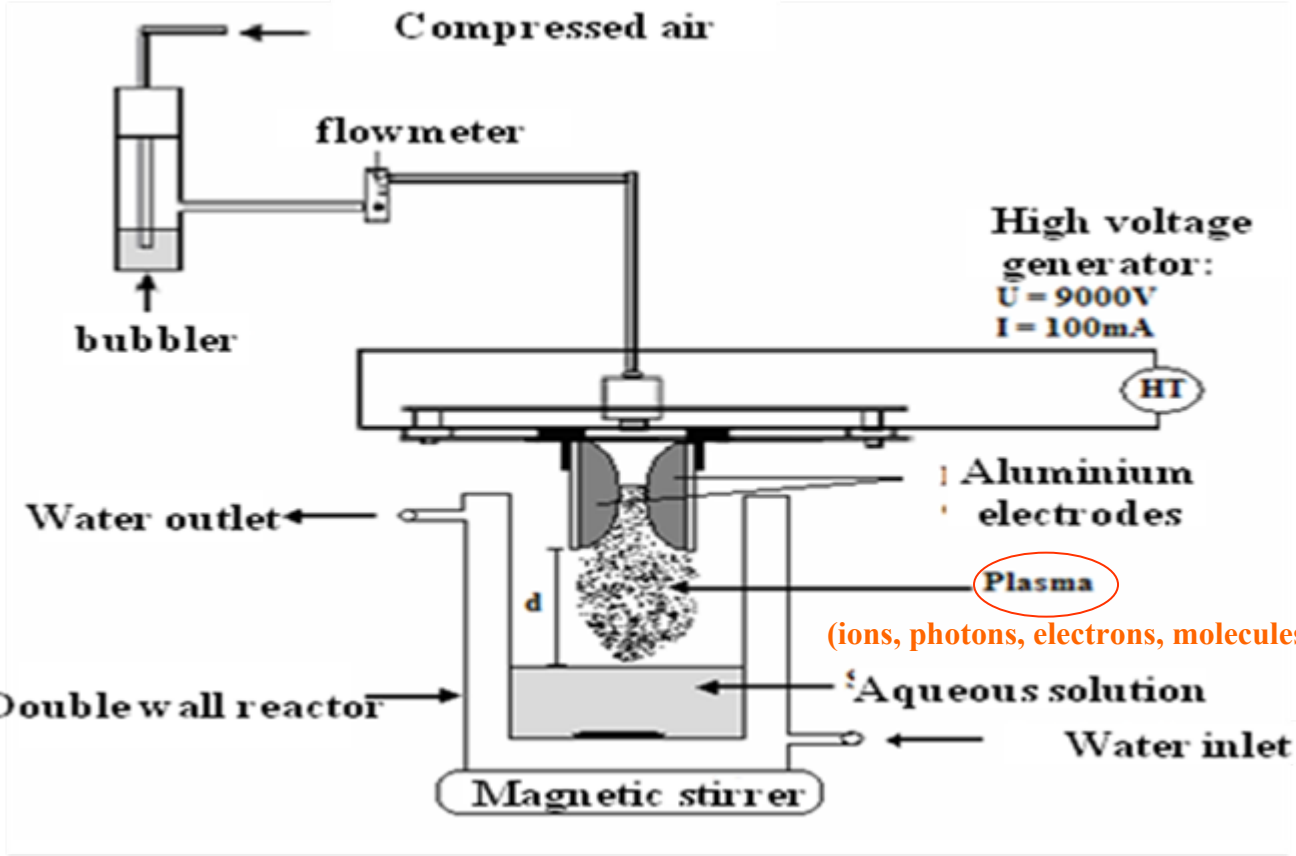
In situ generation of hydroxyl radical : $\cdot$**OH** **($E°_{OH\cdot/H_2O}$=2,8 V/ENH)**

Advanced Oxidtion Process

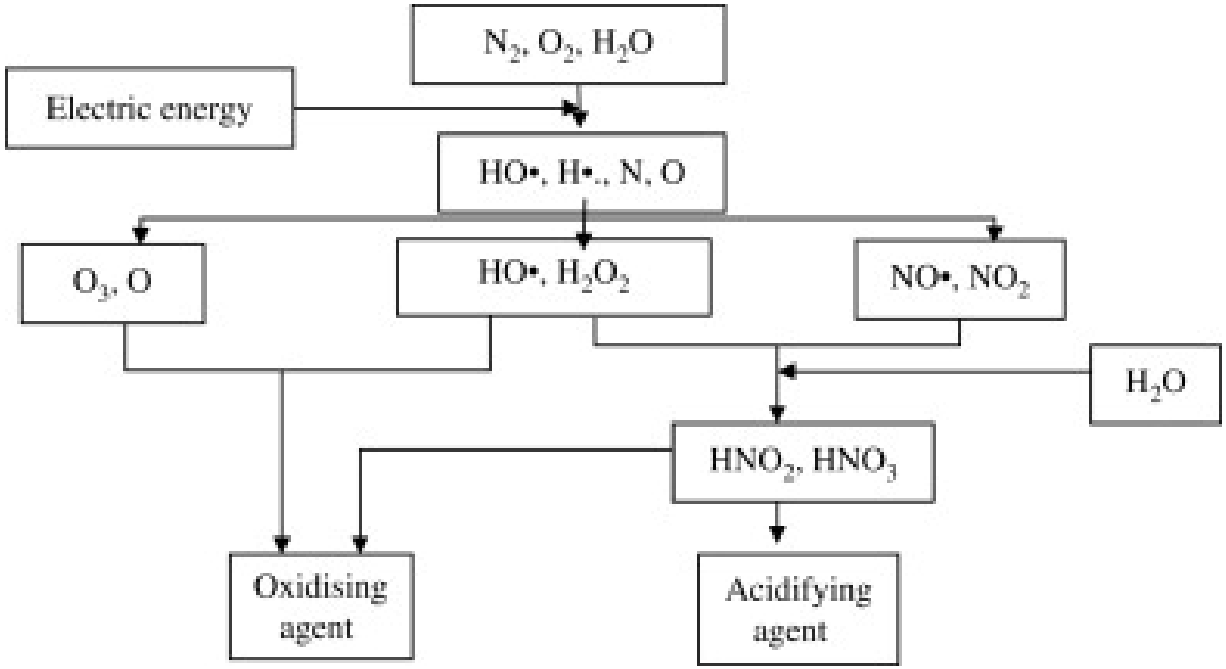
- Chemical
- Photochemical
- Electrochimical

$$\cdot OH + \text{Pollutants} \xrightarrow{\textbf{Minéralization}} CO_2 + H_2O + \text{mineral ions}$$

Gliding arc discharge « Glidarc »

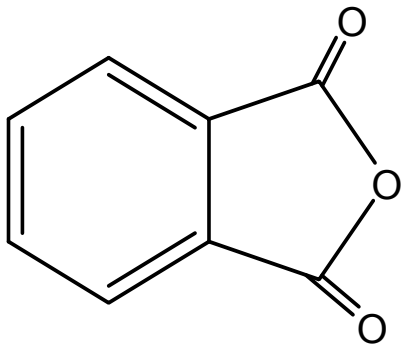


Chemical properties of Glidarc



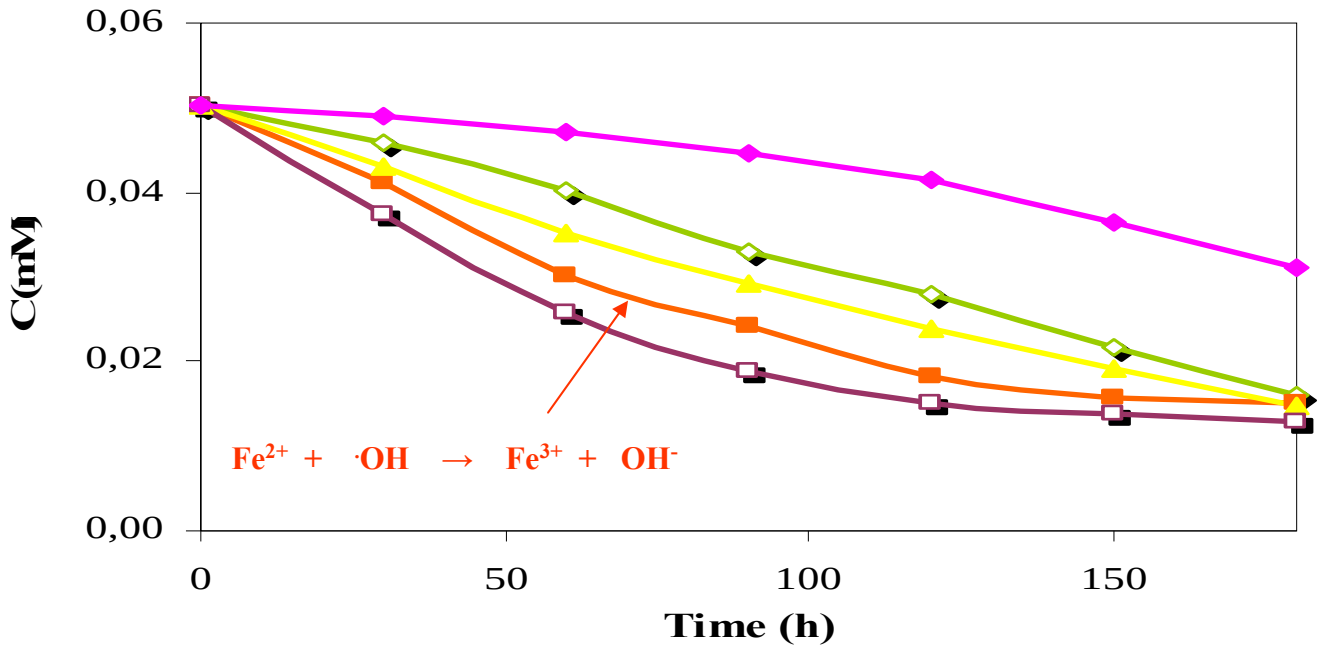
The Gliding arc plasma depends on several factors

- **The nature of catalyst**
- **The catalyst initial concentration**



Phthalic anhydride

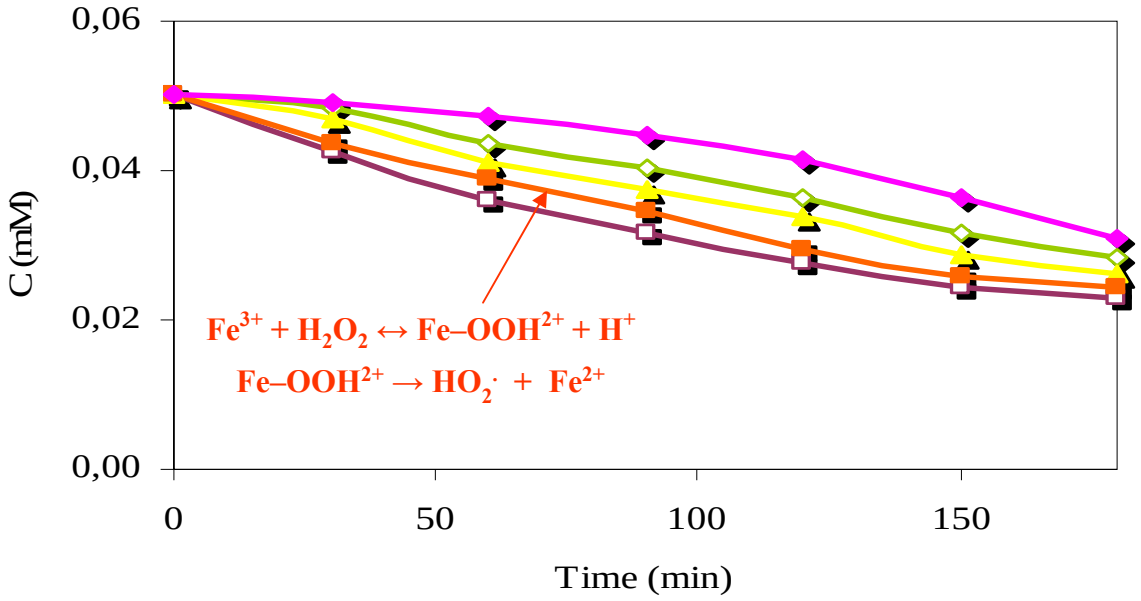
Effect of the Fe^{2+} initial concentration



$[Fe^{3+}]_0$: 0 mM (♦); 0,1 mM (◊); 0,2 mM (▲), 0.5 mM (□), 1 mM (■)

[phthalic anhydride]0 = 0,05 mM, V = 200 mL, Φ = 650 L h^{-1}, d = 2,5 cm.

Effect of the Fe^{3+} initial concentration



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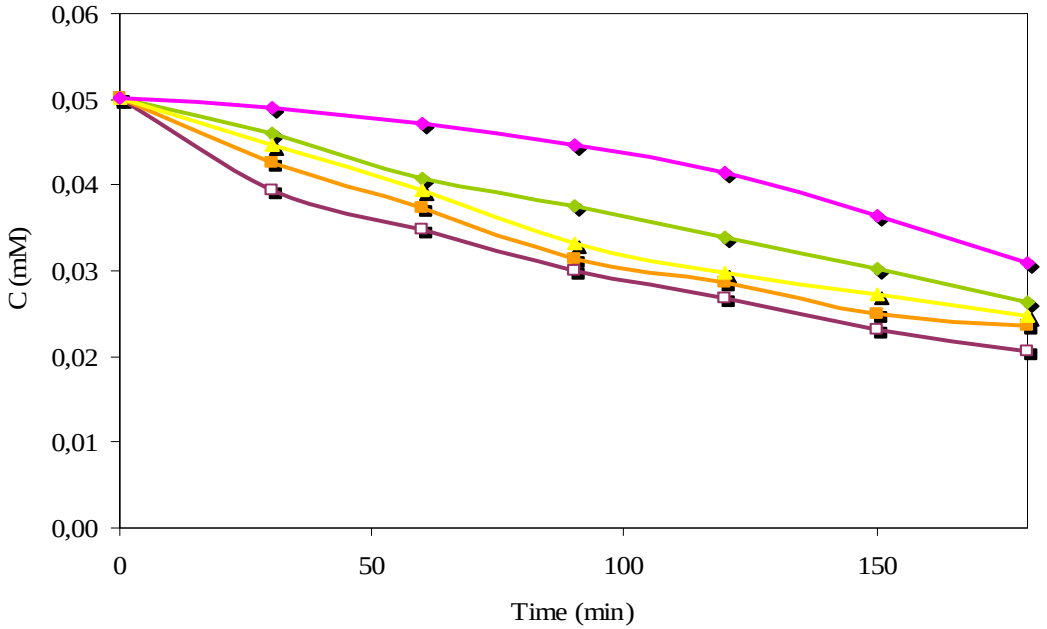
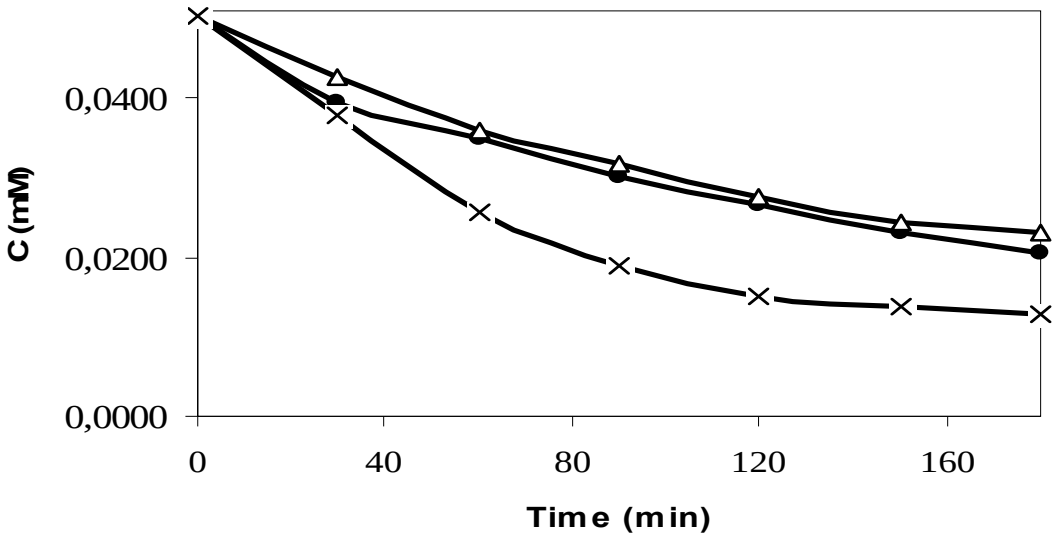
Plasmachemical treatment with TiO_2



$[TiO_2]_0$ en $g.L^{-1}$: 0 (♦); 1 (◊); 2 (□); 3 (■); 4 (▲)

$[phthalic\ anhydride]_0$ = 0,05 mM, V = 200 mL, Φ = 650 L h^{-1}, d = 2,5 cm.

Study of the efficiency of catalysts



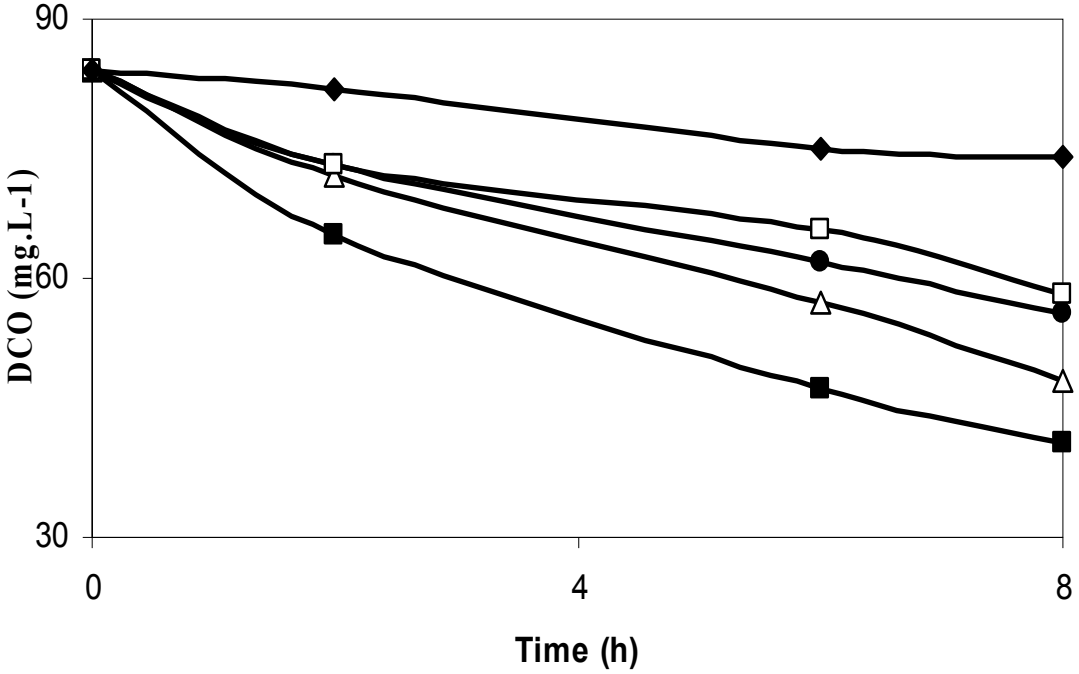
[Fe2+] = 0,5 mM (x); [Fe3+] = 0,5 Mm (Δ); [TiO2] = 2 g.L-1 (●)

$[\text{phthalic anhydride}]_0$ = 0,05 mM, V = 200 mL, Φ = 650 L h^{-1}, d = 2,5 cm.

Characteristics of Tunisian landfill leachate

parameters	value
COD_0 (mg/L)	10200
pH	8.15
Conductivity ($mS.cm^{-2}$)	39.7 à 22.8°C
[Fe] (mmol/L)	0.135

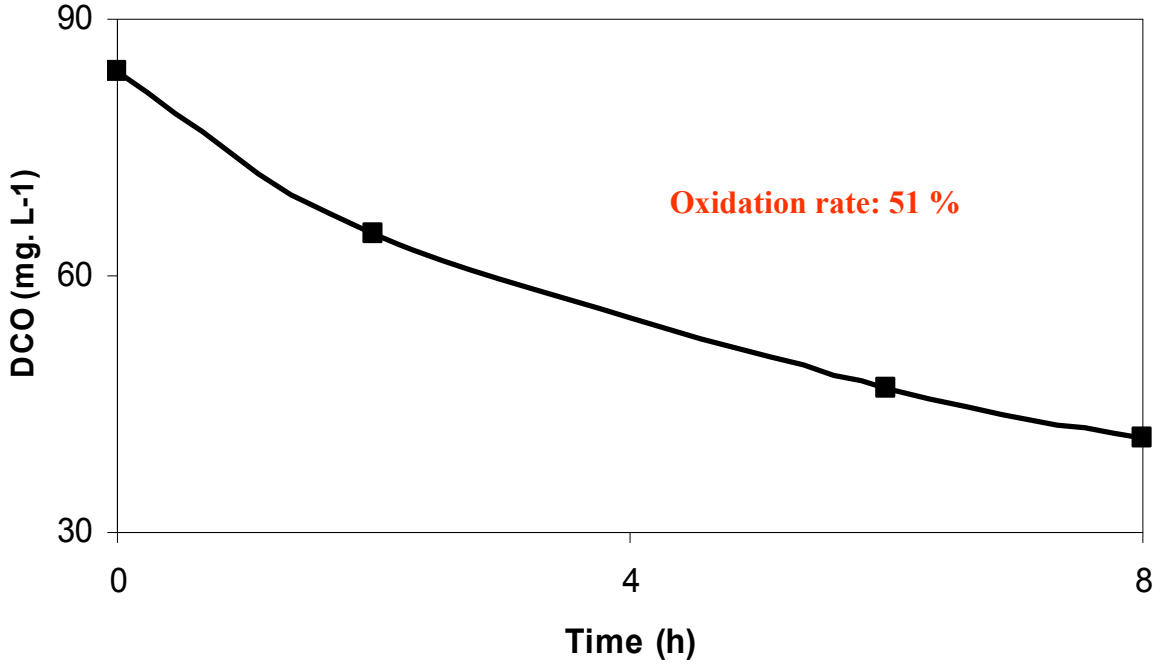
Plasmacatalysis depollution of landfill leachate with TiO_2



[TiO_2] en g L^{-1}: 0 (●); 10 (Δ); 15 (■); 25 (□) and 35 (♦).

[phthalic anhydride]$_0$ = 0,05 mM, V = 200 mL, Φ = 650 $L.h^{-1}$, d = 2,5 cm.

Plasmacatalysis depollution of landfill leachate under optimum conditions



[phthalic anhydride]0 = 0,05 mM, $[TiO_2]_0$ = 15 g.L^{-1}, V = 200 mL,

Φ = 650 L.h^{-1}, d = 2,5 cm.

Gliding arc discharge ⇒ **Oxidation rate = 75 %**

Effeciency of this method in removing phthalates from Tunisian landfill leachate:

Oxidation rate = 51%.

⇒ The disadvantage of this technique is the electrical energy consumed .

Thanks for your attention