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PRELIMINARY EXPERIMENTS ON CIPROFLOXACIN DEGRADATION VIA TiO_2 ASSISTED PHOTO CATALYSE

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Introduction

Ciprofloxacin (CIP) is an intensively used antibiotic, which led to the development of bacterial resistance in water. Therefore, both ciprofloxacin and ciprofloxacin resistant bacteria are emerging concerns that can threaten human health.

CIP photo catalyse was studied in the last period for various newly synthesized catalysts and experimental results proved that CIP photocatalytic degradation represents a promising method for CIP removal from aqueous systems.

The results on role of various active species for photocatalytic degradation of CIP are contradictory. Some researchers are stating that hydroxyl radicals and holes play the major role and others are attributing the major role to superoxide radicals formed by electrons and oxygen.

Research

In order to establish optimum photo catalyst dose, degradation experiments were performed using a solution with initial CIP concentration $[CIP]_0$ = 22.13 mg/L = 6.68 x 10^{-5} M and TiO_2 doses varying within the domain 100-400 mg/L.

As it was expected, the increase of initial photocatalyst dose up to amount of 400 mg/L led to the improvement of CIP degradation efficiency due to the increased number of active sites.

A further increase above this concentration is not necessary since CIP degradation efficiency is reaching more than 99.9% after 30 minutes of irradiation. Moreover residual target compound concentration is of 0.02 mg/L.

Process efficiency is demonstrated also by organic F mineralization, which reached values of more than 95% in the same operating conditions. Mineralization efficiencies permanently lower than CIP degradation efficiency demonstrated the formation of organic intermediary compounds that contains F.

Results

CIP degradation via UV/TiO_2 system, $[CIP]_0$=22.13 mg/L, irradiation time 30 minutes

TiO_2 mg/L	[CIP] mg/L	[CIP] M	Efficiency CIP %	k_{CIP}, s^{-1}
100	0,87	2,62 x 10^{-6}	96,07%	1,798 x 10^{-3}
200	0,24	7,25 x 10^{-7}	98,92%	2,513 x 10^{-3}
300	0,13	3,93 x 10^{-7}	99,41%	2,854 x 10^{-3}
400	0,02	6,04 x 10^{-8}	99,91%	3,894 x 10^{-3}

Organic F mineralisation via UV/TiO_2 system, $[CIP]_0$=22.13 mg/L, irradiation time 30 minutes

TiO_2 mg/L	F mg/L	Efficiency F %	k_F, s^{-1}
100	1,07	82,66%	0,973 x 10^{-3}
200	1,12	86,59%	1,116 x 10^{-3}
300	1,18	91,32%	1,357 x 10^{-3}
400	1,23	95,25%	1,693 x 10^{-3}

CONCLUSION

CIP degradation via UV/TiO_2 system proved to be a promising method for CIP removal from aqueous systems:

- Initial target compound concentration $[CIP]_0$ = 22.13 mg/L = 6.68 x 10^{-5} M
- Photo catalyst dose $[TiO_2]$ = 400 mg/L
- Irradiation time = 30 minutes
- Degradation rate constant k_{CIP} = 3.894 x 10^{-3} s^{-1}
- CIP degradation efficiency = 99.91%
- Organic F mineralization rate constant k_F = 1.693 x 10^{-3} s^{-1}
- Organic F mineralization efficiency = 95.25%

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