IMPACT OF WATER QUALITY ON REMOVAL OF CARBAMAZEPINE IN NATURAL WATERS BY N-DOPED TiO_2 PHOTO-CATALYTIC THIN FILM SURFACES

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Introduction: Contamination of natural water resources by pharmaceutical residues is increasingly rigorous * To meet the water quality standards, advanced treatment technologies for water and wastewater treatment developed * In advanced oxidation processes (AOPs), pollutants are chemically oxidized * The following research is addresses the effects of the interaction between water characteristics and the photocatalytic surface on the photodegradation of target organic pollutants * The main objectives of this study were to **(a)** examine the influence of NOM and water contaminants on the photocatalytic efficiency of a sol-gel N-doped TiO2 surface on CBZ, **(b)** characterize the streaming potential and hydrophobicity of the coated surface and their correlation to CBZ removal, and **(c)** determine the photocatalytic degradation of CBZ under various conditions (pH, NOM, alkalinity) and water types (surface, ground and wastewater effluents).

Figure 1

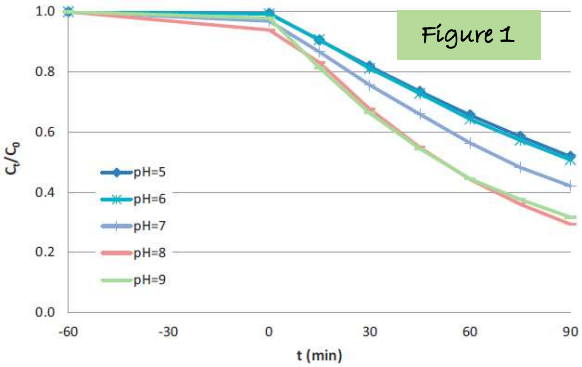
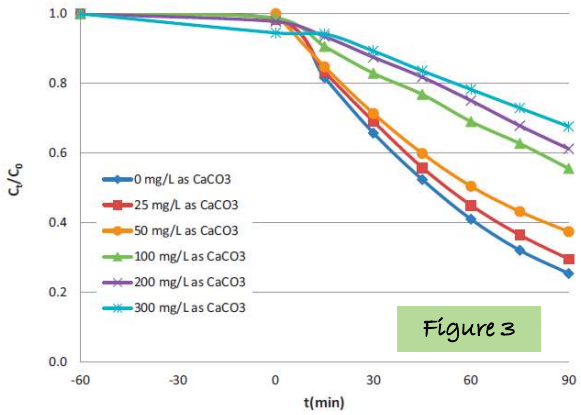


Figure 3



Materials and Methods: N-dopted TiO_2 coatings were prepared and analyzed * The examined solution was stirred for 60 min in the dark prior to its irradiation under a solar simulator for 90 min * Samples of 0.25 mL were taken periodically and analyzed by HPLC to quantify the CBZ concentration * The photocatalytic efficiency was expressed as percent removal: **Removal (%)= $((C_0-C_t)/C_0\times100$.**

Results and Discussion: * CBZ degradation by radical induced reaction is not affected by changing the pH of the solution in the range of 2.0-8.0 (Figure 1) * The generation of OH• is expected to be higher at natural or high pH, due to the presence of more available hydroxyl ions on the catalyst surface which expected to enhance the degradation efficiency * No sorption of CBZ to the catalytic surface was found * Low concentration of DOC (2 mg/L), resulted only a negligible effect on CBZ removal, with approximate 20% reduction in CBZ removal at 5 mg/L DOC (Figure 2 & Table 1) * It is shown that the C component that increase after treatment with NOM and irradiation, may influence the efficiency of the photo catalytic degradation of CBZ * At low alkalinity concentration (25 mg/L $CaCO_3$) showed a negligible effect on CBZ removal in contrast to drastic decrease in CBZ removal at high alkalinity of 100 mg/L (Figure 3 & Table 2) * Photocatalytic degradation of CBZ decreased drastically for all types od water from 70% in buffered water to approximately 35%, 21% and negligible removal with surface water, groundwater and either secondary or tertiary effluent respectively (figure 4 & table 3).

Figure 2

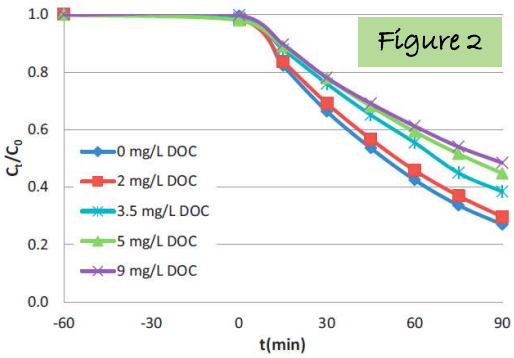
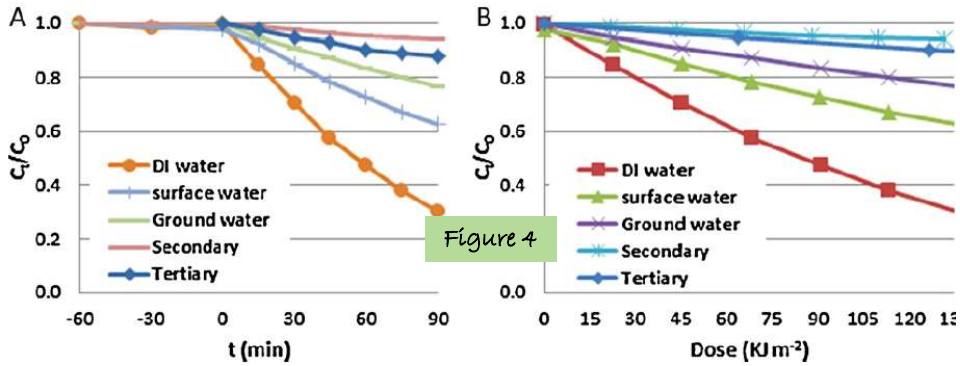


Figure 4



Percent CBZ removal with different DOC concentrations after 90 min of exposure.

Table 1

	DOC conc. (mg/L)				
	0	2	3.5	5	9
% Removal	70	68.3	59.6	53.2	49.5

Percent CBZ removal with different levels of alkalinity ($CaCO_3$ concentrations), after 90 min of irradiation.

Table 2

	Alk conc. (mg/L as $CaCO_3$)					
	0	25	50	100	200	300
% Removal	72.6	68.5	60.6	42.4	36.8	30.3

Table 3

Percent CBZ removal for different water types after 90 min of exposure.

Water type	Groundwater	Surface water	Secondary effluent	Tertiary effluent
% Removal	23.2	37.4	5.8	12.2

Conclusions: * CBZ was stable to photodegradation under direct solar irradiation * No sorption of CBZ to the N-doped TiO_2 catalyst surface was observed * An excess amount of C was detected compared to the control when the catalyst surface was immersed in NOM, indicating some sorption of organics to the surface * CBZ removal improved with increasing medium pH in the range of 5–9 * DOC at a concentration of 5 mg/L resulted in an ~20% reduction in CBZ removal, probably due to competitive inhibition of the photocatalytic degradation of CBZ * An excess amount of C was detected compared to the control when the catalyst surface was immersed in NOM, indicating some sorption of organics to the surface * CBZ removal improved with increasing medium pH in the range of 5–9 * DOC at a concentration of 5 mg/L resulted in an ~20% reduction in CBZ removal, probably due to competitive inhibition of the photocatalytic degradation of CBZ * Alkalinity values of 100 mg/L as $CaCO_3$ resulted in an over 40% decrease in CBZ removal * A 35% reduction in CBZ removal occurred in the presence of surface water compared to complete suppression of the photocatalytic process in wastewater effluent.