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Comparison of Photocatalytic Treatment of Domestic and Slaughterhouse Wastewater

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Extended Abstract

Despite the fact that the Latin American region has high freshwater resource availability, only 20% of municipal wastewater is treated, and less than 30% of industrial wastewater receives treatment [1]. In the case of Mexico, there is the problem of pollution of water bodies due to the lack of sanitation of the effluents of human activities, such is the case of the Lerma-Santiago basin [2]. In addition to the discharge of wastewater from domestic activities, the mismanagement of effluents from the agri-food sector, such as the slaughterhouses, generate pressure on the water resource in Mexico [3].

Conventional biological treatments have been attractive from a cost standpoint; however the increasingly complex nature of wastewater limit their application. Advanced Oxidation Processes (AOP) are an alternative to treat wastewater of a complex nature. Heterogeneous photocatalysis with the use of TiO_2 as photocatalyst is an AOP that has the peculiarity of its ambient operating pressure and temperature, the use of non-toxic compounds with high photo-activity and large stability to the illumination [4]. However, scientific reports on AOPs indicate that only about 10% correspond to research on actual wastewater treatment, and less than 1% have addressed the impact of the waster matrix [5].

Therefore, this work focuses on the photocatalytic treatment of two real effluents, domestic wastewater (DWW) and slaughterhouse wastewater (SWW) from the Lerma-Santiago region. The DWW was settled, to remove suspended solids, then the photocatalytic treatment was conducted using 0.25, 0.5 and 0.75 g/L TiO_2 P25 for 60 min with a light emitting diode system of 30 W (10.5 w/m^2). On the other hand, a prior sedimentation of the SWW was applied, and due to the high load of organic matter (measured as chemical oxygen demand, COD) and solids of the sample, it was necessary to apply a coagulation-flocculation, using 0.5 g/L $FeCl_3$ as primary treatment by 30 min. Subsequently, the sample was subjected to photocatalytic treatment under the conditions and in the same system described above.

The results suggest that with DWW, with an initial COD of 980 mg/L and 186 NTU of turbidity, the best dose of the catalyst was 0.5 g/L obtaining 82% reduction in turbidity and about 90% COD removal. The initial and final pH of the samples were maintained around 7-8. Raw sample of SWW had a COD of 12000 mg/L, after sedimentation a 50% COD removal was achieved. Applying the coagulation-flocculation an additional 25% COD removal was achieved. This allowed obtaining the best results of the photocatalytic treatment stage with a dose of 0.25 g/L TiO_2, reaching a COD removal of 96%, and 89% of turbidity reduction. The photo-treated samples from the slaughterhouse presented a final pH about 7.0.

Finally, an analysis via Fourier-transform infrared spectroscopy of the remaining photocatalyst from slaughterhouse wastewater treatment (70% of mass recovery of TiO_2) revealed that a broad bands between 880 and 500 cm^{-1} was detected that are related to the stretching vibration of the Ti-O-Ti and Ti-O-C bonds, but with some absorption peaks related to remainder organic matter.

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