LABORATOIRE DE CHIMIE DES EAUX

(Laboratory of water Chemistry)

Photocatalytic discoloration of Methyl Orange on TiO_2 (P25) deposited on conducting substrates: Effect of H_2O_2 and $S_2O_8^{2-}$

Tomkouani KODOM, Gbandi DJANEYE-BOUNDJOU, Moctar Limam BAWA

Laboratoire de Chimie des Eaux, Faculté Des Sciences, Université de Lomé –Togo, BP : 1515 Lomé-Togo, tchakodotom@yahoo.fr

INTRODUCTION

Dyes are a large group of organic compounds used in different fields such as food, textile, cosmetic and chemical processes. Much waste water is produced during these processes. A sizable fraction of synthetic or natural organic dyes is lost during the dying process and is released in the effluent water streams from the above industries or laboratories **(Rajeshwar et al., 2008)**. In the field of water treatment, efforts have been devoted to the study of photochemical processes in heterogeneous or homogeneous systems. Of particular interest are the processes on inorganic oxide surfaces since semiconductor, like TiO_2, can provide a convenient way of treating undesirable chemicals.

EXPERIMENTAL SECTION

TiO_2 P-25 was deposited by electrophoresis on two conducting supports such as stainless steel 304L and conducting glass from Solems France. Photocatalysis experiments were performed in a flow loop reactor open to air, provided by a 240 cm^2 surface of thin photocatalyst layer, volume of treatment 0.9 L solution. A UV-A Black light Blue Lamp, (15 W, 365 nm) was used as light source under continuous flow conditions (**Fig 1**).

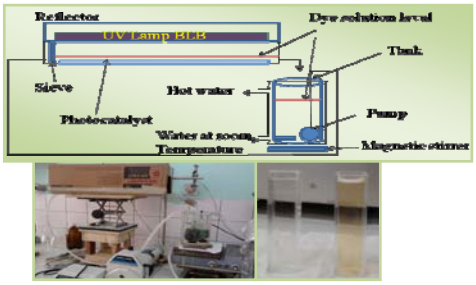

Fig 1:Diagram and Photography of flow loop

RESULTS AND DISCUSSION

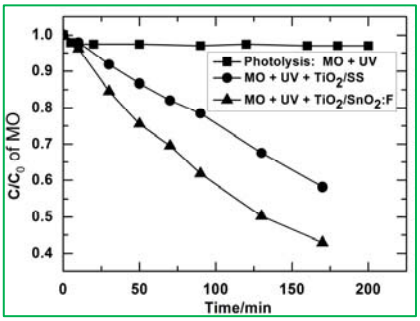

Fig2: Kinetics of the disappearance of Methyl Orange (MO, 1 mM)

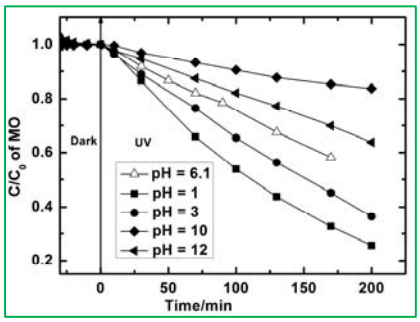

Fig3: Effect of the pH on MO degradation

The rate of degradation is enhanced about 1.6 times with conducting glass than stainless steel. Annealing the conducting glass at 450 °C did not affect its stability while for stainless steel the annealing causes the diffusion of iron (Fe) leading to the formation of iron oxides which affect the photoactivity of TiO_2 **(Kodom, 2011)**.

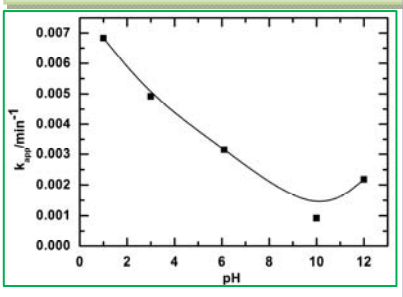

Fig 4: pH effect on apparent first order kinetic constant (k_{app})

pH is an important parameter influencing the rate of degradation of some organic compounds in photocatalytic processes. Analyzing our result, the rate of degradation of Methyl Orange is high in acid medium **(Fig 3).** The result shows that high apparent first order was obtained at pH 1 probably because of the adsorption which was also high at this pH **(Fig 4).**

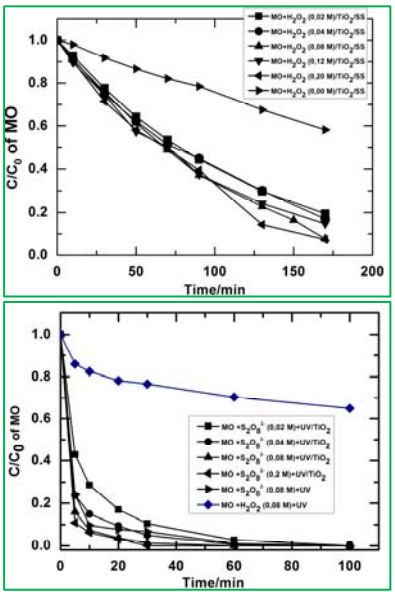

Fig5: Effect of H_2O_2 and $S_2O_8^{2-}$ on MO degradation

The discoloration rate increased significantly in the presence of **H_2O_2 *or* $S_2O_8^{2-}$.** This might be because **H_2O_2 or $S_2O_8^{2-}$** was reduced by photo-electrons in the conduction band of TiO_2 resulting in the formation hydroxyl radicals (HO°) that enhance the oxidation of MO (**Fatimah et al., 2009).** Also H_2O_2 can be activated by UV light, however, the positive effect of **$S_2O_8^{2-}$ is more pronounced**

CONCLUSION

The results of our study have shown that the degradation of Methyl Orange dye was successfully carried out using coated TiO_2 on stainless steel. pH, H_2O_2 and $S_2O_8^{2-}$ have a strong effect on the rate of MO degradation.

REFERENCES

Rajeshwar K, Osugi ME, Chanmanee W, Chenthamarakshan CR, Zanoni MVB, Kajitvichyanukul P, Krishnan-Ayer R. 2008, Journal of Photochemistry and Photobiology 9 171–192.

Kodom T. 2011, phD. Of Chemistry - University of Lomé-University of Poitiers

Fatimah I, Shukla PR, Kooli F. 2009, Journal of Applied Sciences 9: 3715-3722.

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