International Journal of Advanced Technology in Engineering and Science
Volume No.05, Issue No. 10, October 2017
www.ijates.com
IJATES
ISSN: 2348-7550

Adsorption Potential of Commercial TiO_2 Nanoparticles using Methylene Blue as a Model pollutant

Mushtaq Ahmad Rather

Assistant Professor, Chemical Engineering Department,
National Institute of Technology Hazratbal Srinagar-06 (India)

ABSTRACT

TiO_2 photocatalysis is now well known technology for removing organic and inorganic pollutants from water. At same time however TiO_2 has been observed to be having poor adsorption properties. The aim of this study was to explore and enhance the adsorption potential of TiO_2 nanoparticles using methylene blue dye as model pollutant .

Keywords: Nanoparticles, TiO_2, Adsorption, Organic pollutants, Dyes

I. INTRODUCTION

Lakshmi et al. showed the adsorption to conform to Langmuir type of isotherm .Monty L Fetterolf et al. studied the adsorption of MB and acid blue 40 dyes on tiania from aqueous solution. They observed Langmuir type of adsorption .Experimental evidence clearly indicated that electrostatic attraction is a reasonable explanation for the observed adsorption process.Photodecomposition and surface adsorption of MB dye on TiO_2 nanofluid prepared by their own technique was studied by Ho Chang et al. Experimental results indicated that TiO_2 nano fluid prepared by them has excellent photocatalytic activity and surface adsorption property for photocatalytic degradation of MB dye .Rajesh J Tayade et al. showed the percentage adsorption of MB dye was only up to about 10-12 percent . Methylene blue (Thermo Fisher India) was chosen as a model pollutant dye whose adsorption upon commercial TiO_2 nano photocatalyst was studied.

II. EXPERIMENTAL

UV-visible spectrum of Methylene blue (MB) showed λmax at 664 nm , therefore this wavelength was used for the analysis during adsorption. The natural pH of the aqueous MB dye solution was found to be 5.5. The pH of the solutions was adjusted using dilute H_2SO_4 or NaOH.

The adsorption experiments were conducted in a specialized 2.5 litre (3.5 inch ID ,1/4 inch thick) perspex made cylindrical reactor fabricated for the purpose.

The original solution of MB to be used for degradation was of 16 ppm concentration. For adsorption studies this was put in the reactor and brought to the required pH and temperature . The agitator speed was 2500 rpm and temperature was at 23 ^{0}C.The study was carried out in dark where whole reactor assembly was housed inside a wooden UV box covered by thick black polyethylene sheet. The Remi India made mechanical stirrer was centrally mounted and placed at distance of five cm above from the rector bottom. The desired amount of TiO_2 catalyst (1.2 gm/lit) was added to the reactor after 15 minutes of sonication. Percent of the adsorbed dye was reported by dividing the difference between initial dye concentration and dye concentration at the given time by the initial dye concentration. The concentration at any time was determined by using Perkin Elmer lambda 25 UV Spectrophotometer by comparing the intensity data of different samples with the calibration curve at λ_{max} of its absorption.

The samples were sucked at the required times from the reactor by means of syringe and centrifuged for 15 minutes at 15000 rpm in case of adsorption experiments with commercial TiO_2.

III. ENHANCEMENT IN ADSORPTION BY VARYING THE PH

It was observed that very little adsorption to the tune of up to 14 % only occurred up to pH 9.5.Adsorption kept increasing with pH, and at pH 11 it showed a quantum jump to 64% which then increased further to 69% at pH 13.The high adsorption at higher pH is attributed to large electrostatic attraction between the NPs and the dye due to the presence of enough negative charge on NPs and positively charged dye molecules. The variation of percent adsorption with pH at different times is graphically shown in Fig.1 at below;

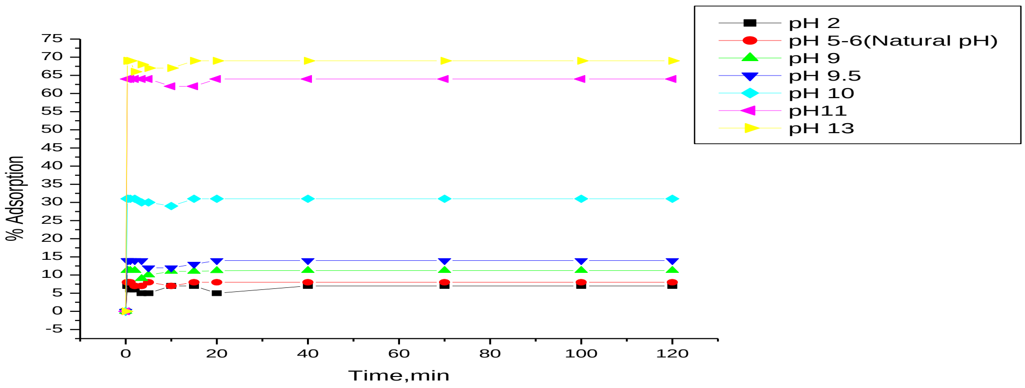

Fig 1: % Adsorption as function of time at different pH.

IV. CONCLUSION

Adsorption of methylene blue dye by commercial TiO_2 nanaparticles enhanced under alkaline pH conditions and increased to 69% at pH 13.Above shows that TiO_2 nanoparticles are potential adsorbents.

REFERENCES

[1.] Rather,M.A., and Bhaskarwar,A.N. "Preparation and Characterization of Magnetic Photoactive Nanoparticles of Iron Oxide-Titanium Dioxide and their Utilization for the Treatment of Methylene Blue as Model Dye" .M.Tech Thesis Department of Chemical Engineering IIT Delhi June-2012.

[2.] Tayade,R., Sivakumar,T., Bajaj, H., Ind. Eng.Chem. Res. 48(2009) 10262-10267.