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Impact of Sodium Chloride and Sodium Carbonate on Photocatalalytic Degradation of Azure B dye.

Dr. David Swami*

***Department of Chemistry, S.B.N. Govt. P.G. College, Barwani (M.P.) INDIA**

Abstract - Azure B is a Phenothiazine class of dye in which an atom of sulphur replacing oxygen in heterocyclic ring. They have color range from green to blue and have been used for coloring paper, tannin mordant cotton, silk and leather. The decoloration and mineralization of the Azure B dye under condition of visible light and TiO_2 photocatalyst was studied. The textile waste-water from dyeing process normally contains considerable amount of chloride and carbonate ions. These chemicals are often used in textile processing operations for adjusting the P^H of the dye bath It is a important to study the effect of chloride and carbonates on the treatment efficiency. This study confirms that the presence of Na Cl and Na_2CO_3 led to inhibition of the degradation process.

Introduction - Synthetic dyes have quickly replaced the traditional natural dyes. They have offered a vast range of colors, impact better properties upon the dyed materials and cost less. (1) Synthetic dyes are prepared from aromatic compounds. Dyes pollutants from the textile industry are an important source of environment contamination . They enter the equatic ecosystem and can create various environmental hazards (2) Advanced exidation process oxidize and mineralize the pollutants into their simple forms, which are easily biodegradable and so it facilitating their treatments in conventional process(3). Waste water contains not only organic contaminants but inorganic anions such as chloride and carbonate anions are also present in industrial wastewater.(4) The presence of NaCl and Na_2CO_3 led to inhibition of photodegradation process.

Experimental: Azure B was obtained from Loba Chemie. Photo catalyst TiO_2 was obtained from the S.D. Fine Company. All Solutions were prepared in doubly distilled water. Photo catalytic experiments were carried out with 50 ml of dye solution ($3.8x10^{-5}$ mol dm^{-3}) using 300mg of TiO_2 photo catalytic under exposure to visible irradiation in specially designed double-walled slurry type batch reactor vessel made up of Pyrex glass (7.5 cm height, 6 cm diameter) surrounded by thermostatic water circulation arrangement to keep the temperature in the range of 30 ± 0.3^0c. Irradiation was carried out using 500 w halogen lamp surrounded by aluminum reflector to avoid irradiation loss. During photo catalytic experiments after stirring for 10 min slurry composed of dye solution and catalyst was placed in dark for ½ h in order to establish equilibrium between adsorption and desorption phenomenon of dye molecule on photo catalyst surface. Then slurry containing aqueous dye solution and TiO_2 was stirred magnetically to ensure complete suspension of catalyst particle while exposing to visible light. At specific time intervals aliquot (3ml) was withdrawn and centrifuges for 2 min at 3500 rpm to remove TiO_2 particle from aliquot to assess extent of decolourisation photo metrically. Changes in absorption spectra were recorded at 480 nm on double beam UV-Vis, spectrophotometer (Systronic Model No. 166) Intensity of visible radiation was measured by a digital luxmeter (Lutron LX 101). pH of solution was measured using a digital pH meter

Results and Discussion:

Effect of NaCl and Na_2CO_3: The textile wastewater from dyeing process normally contains considerable amount of CO_3^{2-} and Cl^- ions. These chemicals are often used in textile processing operations for adjusting the pH of the dye bath(5). As can be seen from Table 3.5 and Fig. 3.7, an increase in concentration of Cl^- from 2.0×10^{-6} mol dm^{-3} to 14.0×10^{-6} mol dm^{-3}, resulted in reduction of rate constant from 3.91×10^{-4} s^{-1} to 1.84×10^{-4} s^{-1}, which with same CO_3^{2-} ion concentration variation, the rate constant decreased from 3.64×10^{-4} s^{-1} to 2.87×10^{-4} s^{-1}. The cause of inhibition was due to the ability of these ions to act as hydroxyl radical (OH) scavengers. These ions might also block the active sites on the TiO_2 surface thus deactivating the TiO_2 towards the dye and intermediate molecules (6).

$$TiO_2 \rightarrow TiO_2 (h^+_{VB}, e^-_{cb}) \quad (1)$$

$$Cl^- + {}^{\bullet}OH \rightarrow Cl^{\bullet} + OH^- \quad (2)$$

$$Cl^- + h^+_{VB} \rightarrow Cl^{\bullet} \quad (3)$$

$$Cl^{\bullet} + Cl^- \rightarrow Cl_2^{-\bullet} \quad (4)$$

$${}^{\bullet}OH + CO_3^{2-} \rightarrow OH > + CO_3^{\bullet-} \quad (5)$$

$${}^{\bullet}OH + HCO_3^- \rightarrow H_2O + CO_3^{\bullet-} \quad (6)$$

Table: Effect of NaCl and Na_2CO_3: [AB] = 3.0 × 10^{-5}mol dm^{-3}, TiO_2 = 200 mg/100 mL, pH = 9.0, Light intensity = 25 × 10^3 lux, Temperature = 30 ± 0.3 ºC.

[Salt] × 10^6 mol^{-1}dm^3	NaCl		Na_2CO_3	
	k×10^{-4}s^{-1}	$t_{1/2}$×10^3s^{-1}	k×10^{-4}s^{-1}	$t_{1/2}$×10^3s^{-1}
0.0	4.10	1.69	4.10	1.69
2.0	3.91	1.77	3.64	1.90
4.0	3.33	2.08	3.53	1.96
6.0	3.21	2.15	3.49	1.98
8.0	2.91	2.38	3.41	2.03
10.0	2.80	2.47	3.22	2.15
12.0	2.61	2.65	3.00	2.31
14.0	1.84	3.76	2.87	2.41

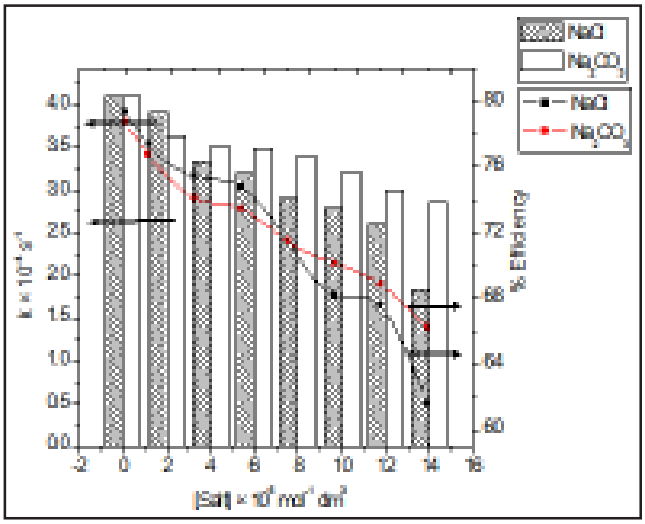

Fig: Effect of Salt NaCl and Na_2CO_3

$^{\bullet}OH + HCO_3^- \rightarrow H_2O + CO_3^{\bullet-}$

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[Salt] × 10^6 mol^{-1}dm^3	NaCl		Na_2CO_3	
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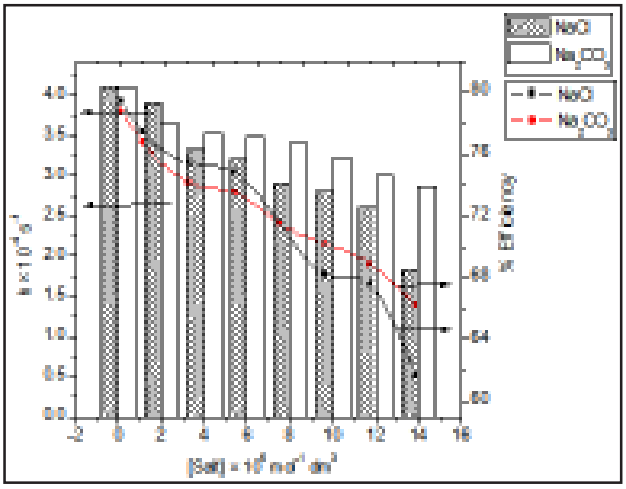

Fig: Effect of Salt NaCl and Na_2CO_3

Conclusion: This study confirms that photo assisted mineralization of Azure B dye can be effectively carried out utilizing TiO_2 with visible light. The presence of inorganic salts such as NaCl and Na_2CO_3 hinders the photocatalytic degradation of Azure B dye.

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References:-

1. Gulrajani M. L., *Introduction to Natural Dyes, Indian Institute of Technology, New Delhi,* (**1992**).
2. Lodha S., Vaya D., Ameta Rakshit and Panjabi P. B., *J. of the Serbian Chem.Soc.* 73 **(2008)** 631.
3. Alinsafi A., Evenou F., Abdulakarim E. M., Zahraa M. N. P., Benhammou A., Nejrreddire and Yaacoubi A., *Dyes and Pigments A*, 22 **(2007)** 439.
4. Goswami Y., *Advan. in Solar Energy,* 10 **(1995)** 735.
5. Mohammoodi N. M., Arami M., Limall N. and Tabrizi N. S., *J. Chem. Eng.,* 112 **(2002)** 191.
6. Sokmen M. and Ozkan K., *J. Photochem. Photobiol., A: Chem.,* 147 **(2002)** 77.

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