

3.5.2. Effect of initial phenol concentration

The effect of initial phenol concentration plays a vital role for the photodegradation of phenol. The effect of initial phenol concentration at various levels of 10, 30, 50 and 70 ppm was investigated and the % degradation data are plotted in Fig. 8. Amount of degradation increases with increase in initial phenol concentration (10 ppm to 30 ppm), a maximum value is observed at 50 ppm and then it decreases at 70 ppm. Therefore 50 ppm is the optimal phenol concentration.

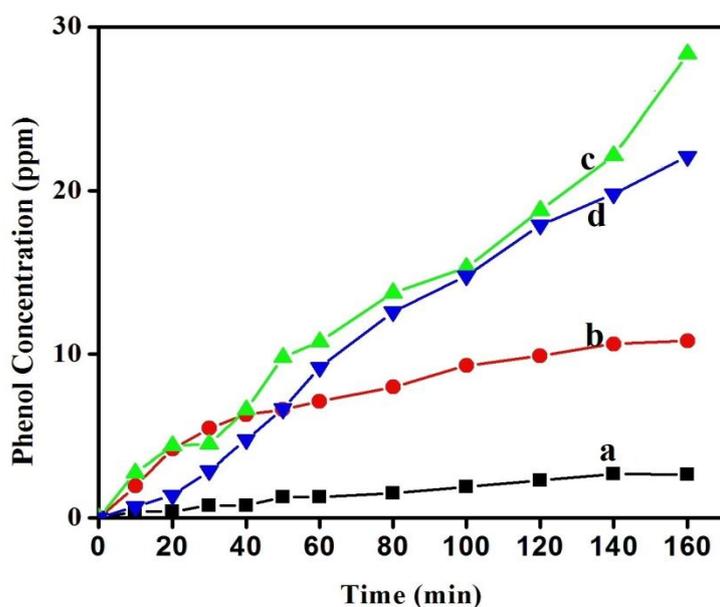


Fig. 8. Effect of initial phenol concentration on degradation (a) 10 ppm (b) 30 ppm (c) 50 ppm and (d) 70 ppm. Condition: pH = 4; Temp = $28 \pm 2^\circ\text{C}$; PANI-PTA-PVP = 0.5 g L⁻¹; H₂O₂ = 2 ml and constant air flow.

3.5.3. Effect of pH

The effect of solution pH on the phenol removal is plotted in Figure 9. 0.1 M HCl and NaOH were used to adjust the solution at various pH values of 2, 4, 6, and 8. After 160 min reaction, the % degradation values obtained are 9.8, 56.7, 20.2 and 10.0 at pH = 2, 4, 6 and 8 respectively. The highest degradation efficiency occurred at pH = 4 and the lowest degradation at pH = 2 and 8.

The point of zero charge, p*H*_{zpc} for PANI-PTA-PVP was determined as 6.91, an almost neutral pH. At highly acidic pH 2.0, the surface charge of the catalyst is positive, since H⁺ can be attached to aniline group. This is an unfavorable situation. While at pH 8.0, the catalyst surface may be negative. Since p*K*_a of phenol is 11, at

higher pHs 6 and 8, the proportion of availability of phenoxide ion will be increasingly higher. Hence there could be electrostatic repulsion between phenoxide and catalyst, which renders phenol adsorption difficult. Altogether pH 4.0 is a conducive condition for maximum adsorption of phenol and is, thus the optimum pH condition. A similar observation has been noted in previous studies [25,26,27]. Thus at moderate pH value (pH = 4), phenol was degraded larger than at other pHs.

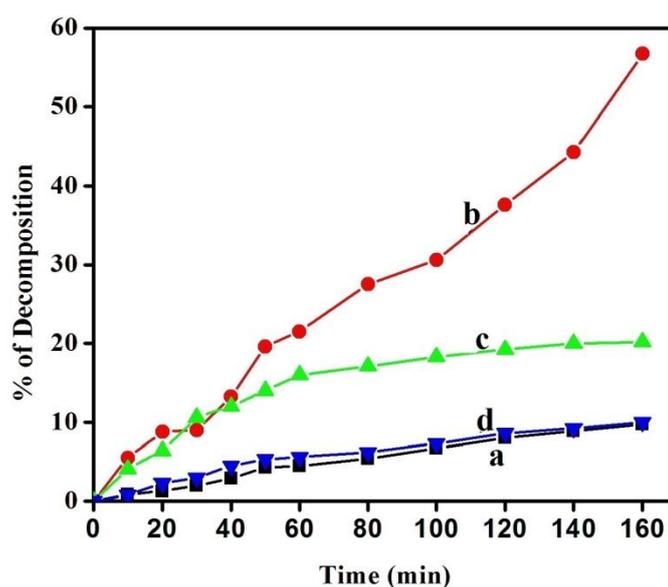


Fig. 9. Effect of pH variation on photodegradation of phenol (a) 2 (b) 4 (c) 6 and (d) 8.

Condition: [phenol] = 50 ppm; Temp = $28 \pm 2^\circ\text{C}$; PANI-PTA-PVP = 0.5 g L^{-1} ; H_2O_2 = 2 ml and constant air flow

3.5.4. Effect of dose of catalyst

The effect of the amount of photocatalyst on the removal of phenol is an important parameter [28] to optimize the catalyst suspension and the results are shown in Fig. 10. As expected, the increase in dose of catalyst from 0.33 to 0.5 g L^{-1} leads to the maximum phenol decomposition of 56.7 %. Beyond 0.5 g L^{-1} catalyst dose, the extent of phenol destruction decreases. This may be because of light scattering and screening effects [29-31]. From our findings, the catalytic loading increases the number of photons absorbed, the available active site and consequently the concentration of phenol adsorbed. At high dose light penetration is compromised because of excessive particle suspension. The trade off between these two opposing phenomena results in an optimum catalyst loading for the photocatalytic degradation.

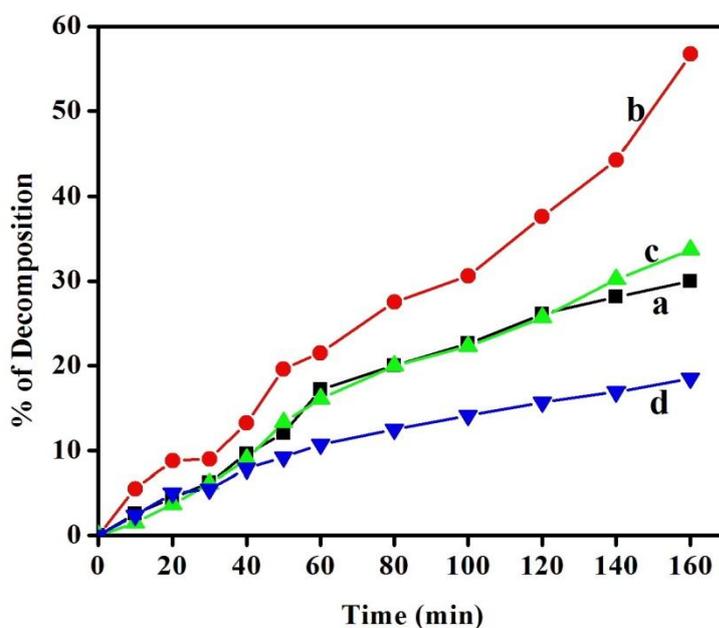


Fig.10. Effect of PANI-PTA-PVP catalyst dosage variation (g L^{-1}) on phenol destruction (a) 0.33, (b) 0.5, (c) 0.67 and (d) 0.83

Condition: $\text{pH} = 4$; $[\text{phenol}] = 50 \text{ ppm}$; $\text{Temp} = 28 \pm 2^\circ\text{C}$; catalyst: PANI-PTA-PVP; $\text{H}_2\text{O}_2 = 2 \text{ ml}$ and constant air flow.

3.5.5. UV-Vis spectra during phenol degradation

Uv-vis spectra for photodegradation of phenol by using the catalyst PANI – PTA – PVP are shown in Fig. 11. The conditions for degradation are $[\text{phenol}] = 50 \text{ ppm}$; $\text{Temp}: 28 \pm 2^\circ\text{C}$; $\text{H}_2\text{O}_2 = 2 \text{ ml}$, constant air flow and dose of catalyst of 0.5 g L^{-1} . It shows that absorbance of phenol at 270 nm decreases with time. Higher catalytic activity occurred during the first 100 min of reaction and after that the catalysis occurred at a slower but constant rate and hence the pollutant disappears slowly.

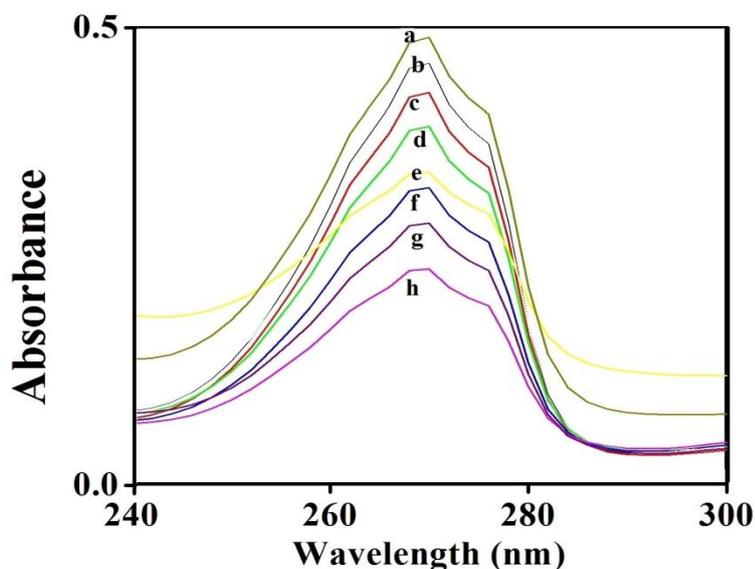


Fig. 11. UV-vis spectra of phenol during its photodegradation with PANI-PTA-PVP at various time intervals of (a) 20 min (b) 40 min (c) 60 min (d) 80 min (e) 100 min (f) 120 min (g) 140 min and (h) 160 min.

Condition: [phenol] = 50 ppm; Temp = $28 \pm 2^\circ\text{C}$; catalyst dose = $0.5 \text{ g L}^{-1} \text{ H}_2\text{O}_2$ (2 ml) and constant air flow

4. CONCLUSION

The PANI catalysts (PANI, PANI – PVP, PANI – PTA and PANI – PTA – PVP) were prepared by chemical polymerization method. UV-vis and FTIR spectra showed the strong interaction of PTA/PVP with PANI. From SEM and XRD it is found that PANI composites are amorphous in nature but have nanostructures. Photocatalysis results showed that the highest degradation efficiency (56.7 %) occurred at pH = 4 for the medium, initial phenol concentration of 50 ppm and 0.5 g L^{-1} of PANI – PTA – PVP, constant air flow and H_2O_2 2 ml, under visible light. The photodegradation study suggested that the light absorption of PANI and catalytic role of PTA can be coupled nicely and thus photocatalysis functionality can be infused in PANI by doping with PTA. The soft template, PVP facilitated the role through small particle formation and active sites number enhancement. At last, it is concluded that PANI – PTA – PVP composite possesses high potential ability for photocatalytic decomposition under visible light. In conclusion, this work opens new possibilities to provide the design of new modified photocatalysts with high activity for the large-scale water treatment and other applications.

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