CHAPTER V

CONCLUSION

5.1 Choosing the better titanium dioxide

This research used two TiO_2 photocatalysts, T1 and N1, to decompose phenol using the shaker-type photoreactor for investigating the photocatalytic activity and initial reaction rate of each titania. Adsorption and decomposition efficiency, depletion in TOC and initial decomposition rate of TiO_2 nanoparticles in degrading phenol were necessary for the rotary drum filtering reactor design. The better TiO_2 was chosen to degrade the phenol solution in the rotary drum filtering reactor system. In this study, 2 mg of TiO_2 powder and 20 cm^3 of 10 ppm phenol solution were used in the experiment. The better TiO_2 was T1 because it could provide the highest adsorption efficiency after equilibrium time (10 min) of 4.21 % and the highest decomposition efficiency and TOC depletion efficiency after 60 min of 19.72 and 14.86 %, respectively. The initial reaction rate of T1 in degrading phenol could be approximated as first-order reaction.

5.2 Phenol removal using rotary drum filtering photoreactor

A novel rotary drum filtering reactor for photocatalytic decomposition of phenol using T1 as photocatalyst was developed to eliminate the problem of catalyst loss during elutriation with the exhaust stream. In this study, the calculated thickness of TiO_2 cake was 200 μm, the initial concentration of phenol was 25 ppm, and the volume of treated water was 25 dm^3. The rotating speed of the drum was 5, 10, 20, or 30 rpm and the filtration velocity was 0.52, 0.73, or 0.84 cm min^{-1}. An increase in the rotating speed decreased the phenol removal and the optimal rotating speed was observed at 5 rpm. In the case of filtration velocity, the phenol removal was lower if filtration velocity increased or decreased from 0.73 cm min^{-1}. The best condition for phenol removal in this experimental condition was the rotating speed of 5 rpm and filtration velocity of 0.73 cm min^{-1}, whereas the initial decomposition rate and the initial rate of TOC depletion were 0.097 and 0.039 mg dm^{-3} min^{-1}, or 0.08 and 0.03 mg g^{-1} min^{-1}, respectively. From sections 4.2.2 and 4.2.3, the rotating speed of 5 rpm and filtration velocity of 0.73 cm min^{-1} were chosen as the best conditions for investigating the effect of direct photolysis on phenol removal and the dark adsorption of phenol on the TiO_2 cake. The photolysis efficiency of phenol after 360 min was 4.96 % while the decomposition efficiency of phenol by TiO_2 cake was about 21.47 %. The adsorption efficiency of phenol on TiO_2 cake for 30 min was only 0.95 %. Compared with a traditional rotating-drum reactor (Zhang *et al.*, 2000), the initial decomposition rate of phenol and initial rate of TOC depletion by our rotary drum filtering reactor was 36.71 mg phenol m^{-2} min^{-1} and 14.76 mg TOC m^{-2} min^{-1}, respectively. Zhang *et al.*, (2000) reported the initial decomposition rate of phenol and initial rate of TOC depletion by their rotating-drum reactor was 4.88 mg phenol m^{-2} min^{-1} and 0.662 mg TOC m^{-2} min^{-1}, respectively. Obviously, the present system has significantly higher decomposition rate than that of Zhang *et al.*, (2000) in terms of specific surface area of the drum but much lower rate in terms of specific mass of catalyst.

5.3 Recommendation for future work

In this work, it was illustrated that the rotary drum filtering reactor using TiO_2 as photocatalyst could treat the wastewater to a significant extent. The present reactor was a very good alternative photoreactor for photocatalytic reaction in a wastewater treatment system because it could prevent the problem of catalyst loss due to elutriation with the exhaust stream while it could simultaneously recover TiO_2 powder from the slurry. However, there are many important factors in this reactor system, which need to be further investigated such as the TiO_2 cake thickness, initial concentration of the pollutant (phenol), and kinds of pollutant. In addition, the observed pin holes on the surface of the HEPA filter after 96 hours should be eliminated for application in real situation. Its cause was suspected to be the photocatalytic decomposition of HEPA filter which directly contacted the TiO_2 nanoparticles while receiving the UV light for a long period. It is postulated that the glass fibers of the HEPA filter were bounded into a rigid frame using a polyurethane compound and the TiO_2 nanoparticles degraded the polyurethane compound to cause pin holes. Moreover, the uniform formation of a thinner cake layer should proportionally enhance the mass-basis degradation efficiency of phenol in this reactor system.

Hence, the surface of HEPA filter will be modified before TiO_2 powder is be coated on the surface of the drum, including the TiO_2 cake thickness, initial concentration of pollutant, and kinds of pollutant will further be studied in degrading the pollutant by this reactor system.