Regeneration of exhausted activated carbon in a fluidized electrochemical reactor

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Activated carbon is widely used as adsorbent for the removal of organics in water and wastewater treatment. The economics of the adsorption process greatly depend on the reuse of activated carbon. Various regeneration techniques such as thermal regeneration[1], chemical regeneration[2] and wet air oxidation[3] have been attempted. Though thermal regeneration process is regarded as the most widely used one, it needs to keep temperature as high as 800 °C, which leads to high energy consumption. Regeneration of activated carbon by wet air oxidation would work under temperature of 130 – 250 °C, while require high pressure, usually 0.1 – 1.0 MPa oxygen partial pressure, which limits the application of the process. Though chemical regeneration was performed at room temperature and ambient conditions, the regeneration efficiency is not very high.

Recently, the electrochemical method for spent activated carbon regeneration was investigated[4,5]. The advantages for this process are including: (1) performance at mild conditions, *e.g.*, room temperature; (2) no additional treatment of the regeneration solution; (3) removal of a broad spectrum of organic compounds. However, the process was almost operated at fixed electrochemical reactor, the mass transfer limitation is significant[4].

Thus in this work, activated carbon regeneration was carried out in a fluidized electrochemical reactor to avoid the problem above. Further, the electrochemical reactor was integrated in a fluidized bed for organic compound adsorption. Therefore, the exhausted activated carbon could be regenerated in-situ after adsorption, which save the regeneration devices.

p-Nitrophenol (PNP), one of the priority toxic pollutants by U.S. EPA, was selected as the model pollutant for adsorption due to its wide presence in many wastewaters such as pesticides and dyes. The operating parameters such as regeneration place (anode or cathode), supporting electrolyte type and their concentration, liquid flowrate, regeneration time and current intensity were systematically investigated on regeneration efficiency and PNP removal rate. The regeneration efficiency of activated carbon was found promoted with the increase of current intensity, regeneration time and electrolyte concentration. In the optimized conditions, the regeneration efficiency can reach over 85%. The regeneration cycle was attempted to discover the lifetime of the regenerated activated carbon. This method showed promising potential for environmental application.

References

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