ABSTRACT

The release of pathogenic and industrial effluents into aqueous environment is being a vital environmental threat for its lethal effects on living beings. Adsorption and photocatalytic degradation are proved to be the most attractive techniques to treat waste water, due to their low cost, easy operation and high efficiency. The synthesis of adsorbents a photocatalysts from industrial solid waste and abundantly available raw materials makes the process more beneficial. In this way, the solid waste disposal problem can also be addressed, while controlling the water pollution problem. Coal fly ash, which is a solid waste generated in thermal power plant, is well known hazard for the environment. Besides, it is composed of considerable amount of alumina and silica, which enable it to be used as the raw material for synthesizing adsorbents and photocatalysts. In this dissertation, we fabricated some adsorbents and photocatalyst from coal fly ash, waste aluminium and ferric chloride. Alumina-silica nano-sorbent was synthesized from coal fly ash and waste aluminiumm foil using sol-gel technique. The waste aluminium foil was used to optimize the alumina silica ratio. The nano-sorbent was characterized thoroughly and proved to be an efficient adsorber for heavy metals and organic dyes. Additionally, silica supported metal organic framework (MIL 53(Al)@SiO_2) was synthesized from coal fly ash and waste aluminium foil by solvothermal process. The beneficial physicochemical properties of synthesized MOF were ensured by in-depth characterization. The novel MIL 53(Al)@SiO_2 was proved to be an efficient adsorbent and satisfactory photocatalyst for treating phenolic waste contaminated water. The photocatalytic activity and the adsorption power of the MIL 53(Al)@SiO_2 were further increased by incorporating iron in the structure of the MOF. The newly synthesized MIL 53(Al-Fe)@SiO_2 offered considerably increased adsorption capacity and photocatalytic activity. The successful incorporation of iron in the MOF structure was proved by the characterization techniques. The MIL 53(Al-Fe)@SiO_2 was successfully used to remove organic dye from waste water. Eventually, another binary MOF (based on iron and copper) was synthesized by one pot solvothermal process. The newly fabricated MIL 53(Fe-Cu) was proved to be an efficient adsorbent and promising photocatalyst, which can be recommended to remove and degrade pharmaceutical wastes from effluents.

Keywords: Adsorption; photocatalytic degradation; alumina-silica nano-sorbent; metal organic framework; coal fly ash; waste aluminium foil

.