Preparation and Characterization of Biochar-supported nZVI Nanocomposites from Rice Husks for Application on Nitrophenol Wastewater Degradation

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Abstract

The treatment of solid waste and organic wastewater are important environmental issues. Most of the solid waste comes from agricultural waste, and rice husks make almost half of the agricultural waste. Management and effective use of rice husk can reduce the environmental load of solid waste. Organic wastewater mainly comes from agriculture and industry. Nitrophenol (4-NP) has been identified by the US Environmental Protection Agency (USEPA) because its toxicity and threat to the environment. It is among 114 the organic pollutants. 4-NP is difficult to be biodegraded, therefore, the treatment of 4-NP cannot be achieved by the present traditional and low-cost biological treatment technology. Therefore development of effective and low-cost degradation method for 4-NP is of major importance. In this work, rice husk were used prepare biochar (BC) with porous holes. The porous BC combined with nano zero-valent iron (nZVI), with strong reaction power, then used in the treatment of 4-NP. In this study, the thermogravimetric analyzer (TGA) shows that the biochar has the largest thermal weight loss at 350°C; X-ray powder diffractometer (XRD) shows that BC is an amorphous carbon material; specific surface area and porosity analyzer were used (ASAP) pointed out that the increase of BC decomposition temperature will have better specific scale and pore volume, and 700 °C has the best conditions (214 m^2/ g); Fourier Transform Infrared Spectroscopy (FTIR) proves that BC is a carbon material with abundant organic functional groups; X-ray photoelectron spectroscopy (XPS) data indicated that nZVI and nZVI@BC have the highest proportion of O elements on the surface (63% of the former and 47% of the latter), and the surface elements will gradually oxidize from Fe^0 to Fe^{3+} after degradation; extended X-ray absorption fine structure (EXAFS), and X-ray absorption near edge structure (XANES), to identify the structure of the catalyst that the inversion point of the catalyst before and after the reaction is close to 7,112 eV, and the valence is in line with Fe foil (iron standard plate); Ultraviolet-visible spectrometer (UV-Vis) was used to determine the ability of the catalyst to degrade 4-NP. **T**he order of degradation efficiency is nZVI@BC700> nZVI@BC600> nZVI@BC500> nZVI@BC400> nZVI@BC300> nZVI. BC can indeed help nZVI degrade 4-NP more effectively, and the efficiency of nZVI@BC is higher than that of BC. The surface area is proportional to the pores.

Keywords - Rice husks, Biochar, nZVI, nZVI@BC, 4-NP.

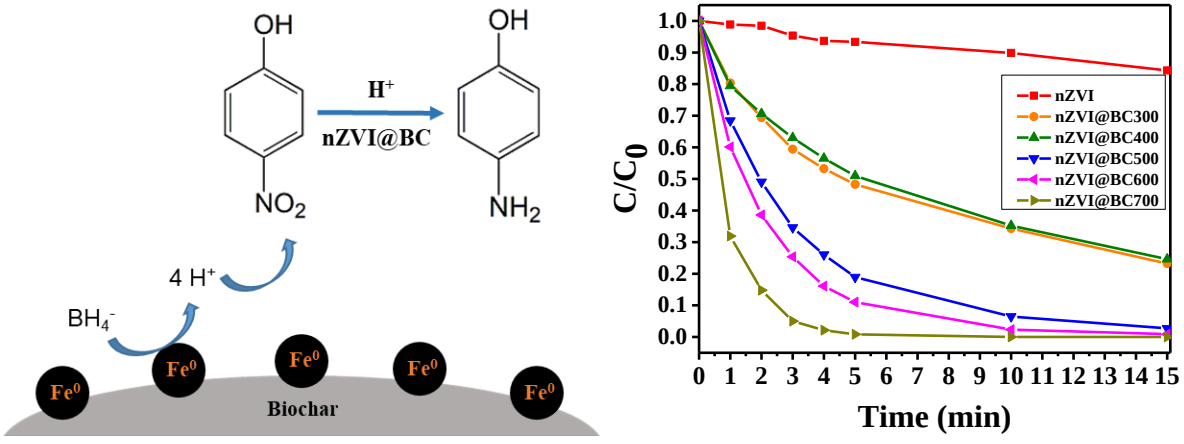

Fig. 1. Degradation mechanism of 4-NP and kinetic data of 4-NP degradation.