Simultaneous Production of Synthetic Gas and Metal-Biochar through Co-Pyrolysis of Zirconia and Coffee Waste

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The CO_2 pyrolysis of CW presented the high level of CO production (14.3 mole%) during two stages of non-isothermal (280 to 700 °C) and isothermal pyrolysis (kept at 700 °C). At the same condition, the incorporation of ZrO_2 improved the CO generation up to about twice that of CW (29.5 mole%) by possibly inducing more conversion of pyrolytic oil into gas. The characterization results exhibited that (ZrB) possessed the distinctive surface morphology that highly graphitic- and porous carbon layers were covered by ZrO_2 nanoparticle clusters. In a series of adsorption experiments, ZrB composite showed pH-dependent As(V) adsorption and pH neutralization ability. The adsorption proceeded relatively rapid with 95% removal during 120 min in the early stage, followed by 5% removal in the remaining 240 min. The maximum adsorption capacity was found to be 25.2 mg g^{-1} at final pH 8. The reusability and stability of ZrB were demonstrated in the 6 consecutive cycles of adsorption/desorption. As a result, ZrO_2-assisted CO_2 pyrolysis can potentially produce fuel gas with high CO fraction and composite adsorbent suitable for As(V) removal in acidic wastewater.