EFFECTS OF LOW-PRESSURE COLD PLASMA AND POLYETHYLENIMINE TREATMENTS ON SLOW PYROLYSIS-DERIVED BIOCHAR

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ABSTRACT

The increasing emission of carbon dioxide (CO_2) caused by industrial activities and fossil fuel combustion has encouraged the development of effective and sustainable carbon capture technologies. This study utilized coffee husk biochar as an adsorbent modified with polyethyleneimine (PEI) and Low Pressure Cold Plasma (LPCP) to improve CO_2 adsorption and desorption performance. The adsorbent samples consisted of BC, BCP, BCP5, BCP10, and BCP20 with plasma power variations of 5–20 watts. Experiments were conducted at 25°C with CO_2 concentrations ranging from 10,000 to 16,000 ppm. The results showed that PEI addition and LPCP treatment significantly enhanced CO_2 adsorption capacity compared to unmodified biochar, with the highest adsorption capacity achieved by BCP20 at 9.71 mmol/g under 16,000 ppm CO_2 concentration. Isotherm analysis indicated that the Freundlich model provided the best fit with R^2 values of 0.88–0.98, while the pseudo second order (PSO) kinetic model showed R^2 values of 0.9401–0.9942, indicating the dominance of chemisorption mechanisms in the CO_2 adsorption process.

Keywords: biochar; polyethyleneimine; Low Pressure Cold Plasma