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Biochar characteristics produced from food-processing products and their sorptive capacity for mercury and phenanthrene

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Various organic-rich wastes including wood chips, animal manure, and crop residues have been used for biochar production. Biochar is used as an additive to soils to sequester carbon and improve soil fertility but its use as a sorbent for environmental remediation processes is gaining increased attention. Surface properties such as point of zero charge, surface area and pore volume, surface topography, surface functional groups and acid-base behavior are important factors, which affect sorption efficiency. Understanding the surface alteration of biochars increases our understanding of the pollutant-sorbent interaction. The scope of the present work was to evaluate the effect of key characteristics of biochars on their sorptive properties. Raw materials for biochar production were evaluated including byproducts from brewering, coffee, wine, and olive oil industry. The charring process was performed at different temperatures under limited-oxygen conditions using specialized containers. The surface area, the pore volume, and the average pore size of the biochars were determined. Open surface area and micropore volume were determined using t-plot method and Harkins & Jura equation. Raw food-processing waste demonstrates low surface area that increases by 1 order of magnitude by thermal treatment up to 750oC. At temperatures from 750 up to 900oC, pyrolysis results to biochars with surface areas 210-700 m2/g. For the same temperature range, a high percentage (46 to73%) of the pore volume of the biochars is due to micropores. Positive results were obtained when high surface area biochars were tested for their ability to remove organic (i.e. phenanthrene) and inorganic (i.e. mercury) compounds from aqueous solutions. All these properties point to new materials that can effectively be used for environmental remediation.