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Effect of degassing temperature on specific surface area and pore volume measurements of biochar

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Specific surface area, pore volume, and pore size distribution are key biochar properties that have been related to water and nutrient cycling, microbial activity as well as sorption potential for organic compounds. Specific surface area and pore volume are commonly determined by measurement of physisorption of N_2 and/or CO_2. The measurement requires prior degassing of the samples, which may change the structure of the materials. Information on degassing temperature is rarely reported in literature, and recommendations differ considerably between existing guidelines for biochar characterization. Therefore, the influence of degassing temperature on N_2 and CO_2physisorption measurements was investigated by systematically degassing a range of materials, including four biochars, Al_2O_3 and carbon nanotubes at different temperatures (105 ˚C, 150 ˚C, 200 ˚C, 250 ˚C and 300 ˚C for $\geq$ 14 h each).

Measured specific surface area and pore volume increased with increasing degassing temperature for all biochars. Additional surface area and pore volume may have become available as components in biochars volatilized during the degassing phase. The results of our study showed that (i) degassing conditions change material properties, and influence physisorption measurements for biochar (ii) comparison between parameters derived from different degassing protocols may not be appropriate, and (iii) degassing protocols should be harmonized in the biochar community [1].

[1] Sigmund, et al. (2016), “Biochar total surface area and total pore volume determined by N_2 and CO_2 physisorption are strongly influenced by degassing temperature”, STOTEN, doi: http://dx.doi.org/10.1016/j.scitotenv.2016.12.023.