Assessment of biochar for nutrient retention

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PRACTICE ABSTRACT

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Biochar is known to be a potential adsorbent material in treating nutrient-rich or polluted waters. The biochar's ability to retain nutrients such as nitrogen and phosphorous from agricultural waters was assessed by performing sorption experiments in the laboratory by ALCN and VTT. Two distinct biochars were tested. Biochar 1 (B1) is produced by Sonnenerde GmbH from residuals of grain husks, fruit sludge and wood, and is milled down to a grain size of 0-0.2 mm. Biochar 2 (B2) is produced by Charline GmbH from wood and is available at a grain size of 0-2 mm. The biochars were tested in the original, commercially available state and as well activated by water vapor. The biochars were added to separate solutions of ammonium, nitrate and phosphorous. The amount of nutrients that can be absorbed by the char was calculated by measuring the concentration of the solution before and after biochar addition.

Ammonium was well adsorbed by all biochars (20-36 %), the activation did not have a great influence on the adsorption capacity. Overall, the four different biochar types were not efficient in binding phosphorous Only a minor proportion was bound to B1, and activation further increased the adsorption capacity. However, no effect on B2 was noticed.

Nitrate was not adsorbed by original B2 but adsorbed in its activated form. B1 was shown to adsorb nitrate, and activation increases its adsorption capacity to 68%. The main result is that both biochars in their original states can be used to retain ammonium. Depending on the site-specific retention necessity, e.g. a higher amount of nitrate or phosphorous in the run-off, B1 can be used to adsorb moderate amounts with an increase in capacity by activation. Direct benefits of the application are the possibility to apply activated biochar to the field, thus reducing the need for artificial fertilizer, reducing nitrogen leaching and increasing the amount of carbon in the soil and thus the soil structure. Moreover, adsorption capacities for phosphate can be enhanced effectively by chemical modification methods (e.g. doping with iron oxide) to strengthen its surface properties.

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