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Biochar in purification of runoff water from clear-cut forest area

Marjo Palviainen (1), Ari Laurén (2), Taija Saarela (3), and Jukka Pumpanen (3)

(1) University of Helsinki, Department of Forest Sciences, Helsinki, Finland (marjo.palviainen@helsinki.fi), (2) University of Eastern Finland, Faculty of Science and Forestry, Joensuu, Finland (ari.lauren@uef.fi), (3) University of Eastern Finland, Department of Environmental and Biological Sciences, Kuopio, Finland (taija.saarela@uef.fi, jukka.pumpanen@uef.fi))

Biochar is formed in a pyrolysis process in which organic material is heated under low oxygen concentration. Biochar has porous structure, large specific surface area and high cation exchange capacity, and it is thus capable of adsorbing nutrients and other dissolved compounds from water. However in forest areas, biochar has so far mainly been used as a soil amendment, but as a good adsorbent, it may provide an innovative, cheap, renewable and 100% recyclable material for active water purification and nutrient recycling in forestry.

For a laboratory experiment, we collected runoff water from boreal peatland forest site which has been recently clear-cut. In these kind of fertile spruce fens, the risk of high nutrient export is particularly severe after final cutting. We conducted an adsorption experiment where biochar and runoff water were stirred at constant temperature (20°C) for 10 days. We quantified adsorption rate and adsorption isotherm (maximum adsorption) for total N, NH4-N, NO_3-N, total P, H+ and dissolved organic carbon (DOC). We tested two different wood biochars (Picea abies and Betula pendula) and two particle sizes (2-4 mm and > 4 mm). During the experiment, the concentrations of elements and pH were measured from the filtered solution at regular time intervals.

Biochar adsorbed effectively H+, N and DOC. Thus, biochar has a good potential for use in the removal of nutrients and DOC, and decreasing the acidity of runoff waters. The study will continue with meso-scale column experiments, where runoff water is directed through biochar-filled columns, and water quality is monitored in inlet and outlet of the columns. Based on these results we will construct a simulation model describing the water purification process, and the model will be applied in the design of a biochar reactor which finally will be tested in field conditions.