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Using sorbent waste materials to enhance treatment of micro-point source effluents by constructed wetlands

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Sorbent materials are widely used in environmental settings as a means of enhancing pollution remediation. A key area of environmental concern is that of water pollution, including the need to treat micro-point sources of wastewater pollution, such as from caravan sites or visitor centres. Constructed wetlands (CWs) represent one means for effective treatment of wastewater from small wastewater producers, in part because they are believed to be economically viable and environmentally sustainable. Constructed wetlands have the potential to remove a range of pollutants found in wastewater, including nitrogen (N), phosphorus (P), biochemical oxygen demand (BOD) and carbon (C), whilst also reducing the total suspended solids (TSS) concentration in effluents. However, there remain particular challenges for P and N removal from wastewater in CWs, as well as the sometimes limited BOD removal within these treatment systems, particularly for micro-point sources of wastewater. It has been hypothesised that the amendment of CWs with sorbent materials can enhance their potential to treat wastewater, particularly through enhancing the removal of N and P.

This paper focuses on data from batch and mesocosm studies that were conducted to identify and assess sorbent materials suitable for use within CWs. The aim in using sorbent material was to enhance the combined removal of phosphate (PO_4-P) and ammonium (NH_4-N). The key selection criteria for the sorbent materials were that they possess effective PO_4-P, NH_4-N or combined pollutant removal, come from low cost and sustainable sources, have potential for reuse, for example as a fertiliser or soil conditioner, and show limited potential for re-release of adsorbed nutrients. The sorbent materials selected for testing were alum sludge from water treatment works, ochre derived from minewater treatment, biochar derived from various feedstocks, plasterboard and zeolite. The performance of the individual sorbents was assessed through preliminary desorption studies, isotherm and kinetic adsorption studies, as well as through final desorption studies. Batch studies demonstrated that alum sludge and ochre effectively removed PO_4-P from solution (maximum sorption capacity up to 45 mg/g), whilst biochar from both bamboo and rice feedstocks demonstrated effective removal of NH_4-N from solution. The potential benefit of using combined reactive media in conjunction with wastewater recirculation to enhance N, P and C treatment was examined using mesocosm studies, and we report initial data from these mesocosm studies.