Enhancing heavy metal immobilization in SuDS

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Introduction

Diffuse water pollution from urban runoff has the potential to carry a variety of heavy metals and other pollutants throughout the environment. Sustainable urban drainage systems (SuDS) are increasingly being used as a first defence for stormwater-borne pollutant removal. One example of a SuDS system is a filter drain; a trench filled with gravel filter material intended to filter pollutants from road runoff and act as storage during high rainfall events.

Since a major component of stormwater runoff can include heavy metals such as Cd, Cu, Pb and Zn, the aim of this study is to increase the heavy metal immobilization of gravel filter media within filter drains. Chemical amendments (iron-oxide coatings) were made to typical filter drain gravel with the aim of increasing affinity for metals. These amendments have already been shown to enhance metal immobilization by finer media such as sand [1, 2] and polyethelyne beads [3].

Experimentation and Results

A process adapted from Liu *et al*. [3] was used to coat 10mm gravel with iron oxide. Initial batch experiments showed that heavy metal removal was pH dependent due to the coating method altering the pH buffering capacity of the gravel. Different coating proceedures generated gravels which buffered batch reaction solutions between pH 3 and 10, (despite repeated washing). Perfecting of the coating method is ongoing, as well as further amendments to gravel which include manganese oxide and clay.

In order to verify geochemical processes, the PHREEQC modelling program was used to determine metal speciation and saturation indices of the solutions. When increased metal removal is observed at higher pH, the solutions are shown to be supersaturated. This is corroborated in batch experiments which show that the immobilization process is non-reversible, and thus likely precipitation dominated.

[1] Edwards *et al*. (1989) *Res J Water Pollut C* **61**, 1523–1533. [2] Lo *et al*. (1997) *Water Sci Technol* **35**, 63–70. [3] Liu *et al*. (2001) *J Environ Eng-Asce* **127**, 868–878.

Usefulness of stable isotopes in small catchment studies: Overview of results from the stressed ecosystems of Central Europe

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Over the past 20 years, a number of stable isotopes (C, N, S, O, Pb and Zn) have been used in Central European catchments as diagnostic tools in biogeochemical studies or tracers of dispersion pathways of pollutants. Here we summarize the main isotope success stories in a hydrochemical monitoring network of 13 headwater catchments in the Czech Republic. The network, known as GEOMON, has been supplying monthly hydrochemical input-output data since 1994. The monitoring has coincided with a major decrease in industrial emissions, that had peaked in the 1980s, and are now lower. We have documented linkages between the behaviour of C, N and S in ecosystems. Assimilation of all three elements by plants is associated with an isotope fractionation. Plant tissues tend to accumulate lighter isotopes. In soils, both in upland and wetland locations, degradation of organic molecules is associated with preferential release of the lighter isotopes of C, N and S. The residual vertical soil profiles exhibit isotopically heavier C, N and S with an increasing depth. In retrospective studies, comparing isotope data from emanating greenhouse gases and from organic soils can provide an insight into terminal C, N and S mineralization. Vertical stratification of S isotopes in soils has been used to calculate the proportion of organically cycled anthropogenic S in stream discharge. It appears that most acidifying S was stored in the topmost organic soil horizon and is now flushed out of the ecosystem. Soil solutions, taken by lysimeters, contain newly formed nitrate and sulfate, isotopically different from that in rainfall/canopy throughfall. Sulfate oxygen isotopes systematically show that throughfall sulfate was mainly formed by heterogeneous oxidation of SO_2, wherese sulfate deposited in open areas was mainly formed by homogeneous oxidation of SO_2. Lead isotopes in tree rings and peat profiles are useful as archives of past pollution rates and for apportionment of pollution sources (coal burning, traffic, ore smelting). Zinc isotope ratios, recently determined in ice accretions and snow, fingerprint pollution sources that are rarely situated upwind from the receptor sites.