14 September 2017
Issue 495

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Source: Fowdar, H.S., Hatt, B.E., Cresswell, T., Harrison, J.J., Cook, P.L.M., Deletic, A. (2017). Phosphorus Fate and Dynamics in Greywater Biofiltration Systems. *Environmental Science & Technology*, 51:2280–2287. DOI: 10.1021/acs.est.6b04181.

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To cite this article/service: "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol.

European Commission

Science for Environment Policy

Tall sedge in biofiltration systems removes the majority of dissolved phosphorus from greywater

The pathways for removal of dissolved phosphorus within biofiltration systems have been examined in a new study. Over 95% of phosphorus was removed over the study period, with the majority of phosphorus stored within plants. The researchers say the findings demonstrate the value of using suitable plant species within biofiltration systems to treat polluted water.

Excess phosphorus from agricultural, industrial or urban sources is an environmental pollutant, which can cause euthrophication, oxygen depletion and biodiversity loss in waterways. A biofiltration system — a technology that uses sand or planted soil to filter pollutants — is used to remove phosphorus and other nutrients from water before it is released into rivers or other waterways. Originally used to treat stormwater run-off, biofiltration systems are increasingly used to treat polluted water such as greywater (i.e. non-sewage waste water from baths, sinks, washing and other domestic sources) and partially treated waste water from urban areas. However, the fate of dissolved phosphorus within biofilters is not well known. For example, it may be taken up by plants or deposited within the sand; more accurate information may help improve the efficiency of phosphorus removal within biofiltration systems.

This study examined the separation of dissolved phosphorus within a biofilter using a phosphorus radiotracer to see where dissolved phosphorus was stored. A radiotracer is a chemical compound with the addition of a radioisotope, which can be used to map where a compound travels within a living system. A biofilter was set up in a laboratory using sand as a filter substrate and planted with the sedge species *Carex appressa*, which is commonly used in biofiltration systems in Australia and Israel. The use of local species in biofiltration systems is usually recommended[1]. Unplanted filters were also set up as a comparison. Greywater was applied to the filters over a 15-week period as along with the phosphorus. A radiotracer was added towards the end of the study period. To track where phosphorus ended up within the system, samples of the filter substrate and the entire sedge (roots and shoots) were taken for analysis.

The system removed over 95% of phosphorus from the water, with the majority (average of 64%) stored within the plants. Planted filters maintained this 95% removal capacity over the 15-week period. Unplanted filters removed over 95% of the phosphorus within the first four weeks but showed a decline to around 30% by the end of the 15 weeks, as the capacity of the sand to hold phosphorus decreased.

The radiotracer indicated that the majority of dissolved phosphorus (up to 57%) first attaches to the substrate and is most likely assimilated into the plants later. The majority of the phosphorus recovered within plants was stored in the sedge shoots, making up 50% of the phosphorus added to the system. Harvesting the sedge shoots is, therefore, a means of sustainably removing a large proportion of the pollutant phosphorus from the system. Following removal, the sedge shoots could be used as compost.

Biofiltration systems have the advantage of efficient pollution removal, flexible design and amenity value, which means they can be incorporated into urban areas[2]. The researchers recommend biofilters use plant species such as tall sedge, which can efficiently extract nutrients such as phosphorus.

1. In other countries, locally available species that display similar characteristics to *Carex appressa* (e.g. native species, drought-tolerant, fine root system, capable of luxury uptake of nutrients) would be used.

2. Uses of biofiltration systems which do not include sewage waste water are specified in the second paragraph of this article.