# EPHIC

Electrochemically assisted phosphorus and humics recovery via Ion exchange (EPHIC)


## Abstract

Wastewater treatment plants are being redefined. Their role as safeguards of human and environmental health expands to being a supplier of resources such as water and phosphorus. Achieving sufficient phosphorus removal and recovery is chemical-intensive and requires infrastructure that is largely absent today, such as sludge incineration facilities to produce phosphorus-rich ash. The emergence of smaller scale systems to locally enable water recovery also challenges recovery options. Surface waters used for process or drinking water production also exhibit phosphorus levels that are too high at intake, requiring chemical dosing. A new approach is needed.

The EPHIC concept is a revolutionary new approach that
(i) avoids the use of chemicals to remove phosphorus and organics (ii) minimises the need for major infrastructure
(iii) recovers the phosphorus as valuable phosphoric acid, and in parallel humics as valuable organics, both from wastewater and surface water
(iv) can be deployed both at small and large scales.

Our approach builds on a specific ion exchange process that sorbs phosphate to very low levels (<0.1 mg P/L). The resin is regenerated with an alkaline solution, after which the phosphate rich regenerant is treated in an electrochemical system. In this step, the phosphate is extracted as concentrated phosphoric acid while the alkaline solution is recovered for reuse. This enables near complete avoidance of chemical inputs. The phosphoric acid is an attractive product for fertiliser production, as it is already used by the fertiliser industry. This avoids the need for process adaptations. It is also an attractive chemical for non-agricultural applications. The ion exchange resin in time also accumulates organics, mainly humics that are present in wastewater and surface water. These can be removed with a second regeneration approach. We will subject this regenerant to a combination of membrane filtration and electrochemical pH swing recovering the regenerant as well as a concentrate of humics. EPHIC will thus create a second product, a humics concentrate, that is attractive as a soil improver, promoting plant growth and helping, for example, detoxify heavy metals in soils.

EPHIC builds on a team with complementary expertise from 4 countries. The ion exchange process will be developed to use electrochemically recovered regenerants at Cranfield University (The United Kingdom), whereas the electrochemical processing, both for phosphoric acid and humics, will be developed at Ghent University (Belgium, project coordinator). RWTH Aachen University (Germany) focuses on membrane filtration and separation of the humics. Finally, the BETA Technological Centre at the University of VIC (Spain) will investigate the use of the recovered phosphoric acid and humics towards agriculture.

We are supported by a wide group stakeholders across the value chain, from utilities to product offtakers and sector organisations, and invite others to join us over the course of the project. The scientific insights generated during EPHIC come at multiple levels, from operational aspects, technological designs and flowsheets to product specifications and verified use cases. Geared towards real-life impact this project will make an EPHIC contribution to a sustainable, future-proof phosphorus cycle.



## Project coordinator

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## Project partners

- CRANFIELD UNIVERSITY - UNITED KINGDOM
- RWTH AACHEN UNIVERSITY - GERMANY
- BALMES UNIVERSITY FOUNDATION - SPAIN


## Funding organisations

FWO (BELGIUM) / UKRI (UNITED KINGDOM) / BMFTR (GERMANY) / AEI (SPAIN)


## Duration

3 years


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**KEYWORDS**

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membrane separation,
nutrient recovery,
fertilizer production, humics