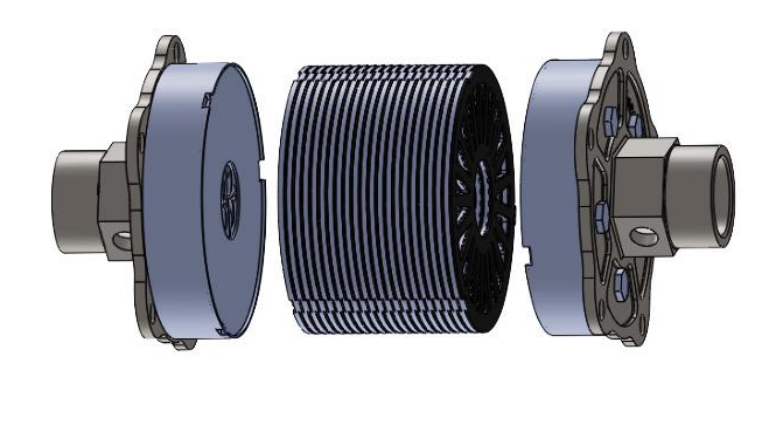
WATERAGRI

FACTSHEET

MICROFLUIDUC SYSTEM FOR NUTRIENT RECOVERY



Key information

This solution uses microfluidic networks and adsorbent microbeads to recover nutrients from wastewater. Through the intricate positioning and isolation of particles in the absence of turbulence in microchannels, microfluidics offers enhanced nutrient recovery in micro-confinement. The method has been tested in the laboratory for the treatment of agricultural runoff.

Target audience: Future farmers, advisors and consultants.

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 858735.

A. Brief Introduction:

A microfluidic system is being developed by Eden Tech for the in-situ recovery of nutrients from agricultural runoff. These nutrient recovery systems are based on microfluidic networks inscribed on CD sized disks that can capture nutrients from waste streams. In WATERAGRI, the solution is being developed based on the technical recommendations obtained from the analysis results for agricultural runoff water samples from Italy, Hungary, and Poland. The system has been validated in lab scale for the recovery of the adsorbent microbeads capable of recovering nutrients. The treatment solution be connected to drainpipe outlets after initial treatment systems and needs electricity for pumps to circulate the water through the system.

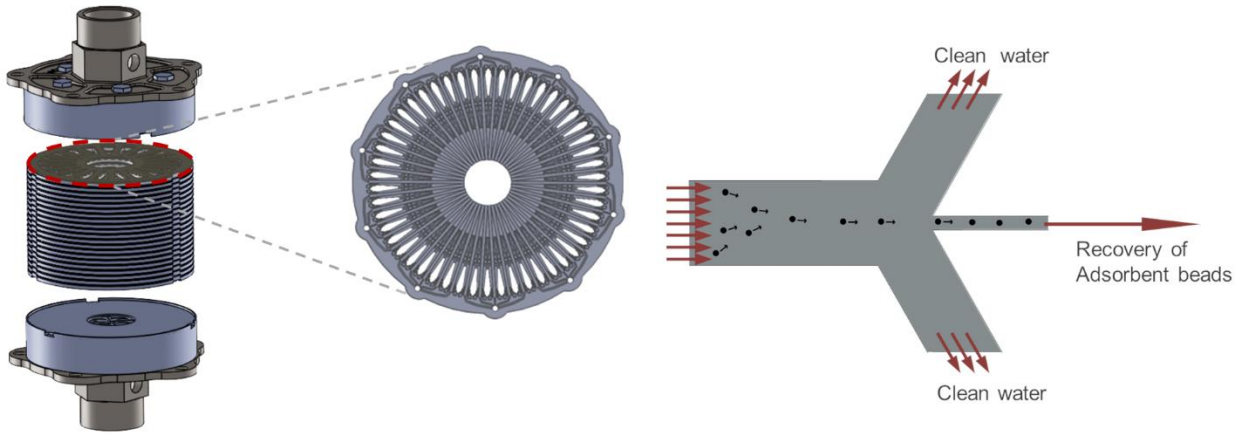


Fig. 1 Operation principle.

B. Design concept and experimental set up:

The Microfluidic system can recover nutrients providing a continuous process with *in-situ* recovery and regeneration of adsorbents without the need of change of cartridges or stopping the process. It is composed of filtrating discs, about the size of a CD, stacked in groups of 10s and 100s, depending on the clients' needs with a capacity of processing up to 1000L/sec of water. The discs are engraved with networks of microchannels, organized into smart energy microfluidic grids. One cartridge is composed of stacked CDs of varying numbers, combined to create a miniaturized factory. When treating low-concentration nutrient solutions, the process can be sped up by enclosing the adsorbent and contaminants in microchannels, resulting in substantially quicker adsorption kinetics. The surface-to-volume ratio in microchannels is also greatly raised, which increases the active trapping rate while keeping the overall size of the device compact. When compared to the similar bulk procedures, the amount of adsorbent utilized is also greatly reduced.

Each microfluidic CD core has a diameter of 10 cm and a thickness of 1 mm. The first step of nutrient recovery from agricultural runoff involves prefiltration to remove any suspended particles and organic materials. Followed by the careful selection of commercially available adsorbent microbeads based on the target nutrient. These microbeads are mixed with the contaminated water followed by circulating the water through a series of micrometer-sized channels, a scale where

fluid flow is highly controllable. Our system for isolating microbeads involves the manipulation of water through a series of micrometer-sized channels. The device efficiently guides the microbeads for collection at a significantly higher concentration, up to 1,000,000-fold. After concentration the microbeads are further processed for recovery, regeneration and recirculated through the system.

C. Technical information:

The microfluidic system makes use of commercially available adsorbent microbeads to adsorb the nutrients in microchannels, which is known to enable process intensification thereby enhancing the adsorption kinetics. These adsorption microbeads are then isolated and concentrated utilizing a microfluidic network engraved on the CDs. This isolation of microbeads from the water is done by utilizing a combination of inertial microfluidics technology and obstacles within the microfluidic channels. This ensures high separation while operating at large volumes of water. The laboratory tests carried out demonstrated a separation efficiency of >98% while operating at 100L/min. Thanks to its compact nature, it can be easily deployed, either retrofitted into existing facilities or incorporated into the design of brand-new plants. The system requires an external pump to circulate agricultural wastewater. The system consists of a prefiltration cartridge, a microfluidic stacked CD cartridge, and a regeneration agent reservoir.

D. Costs and Benefits:

The solution is made available by providing the technology as a service, known as Product as a Service (PaaS). Customers subscribe to the product and pay recurring fees. With PaaS, products are offered in subscription models that are offered with services attached, which results in a lower initial cost and no installation fees. This reduces the clients' CAPEX and OPEX. The initial cost is minimal, and the end-user gains access to the advantages of the technology, without the burden of complex maintenance.

Our nutrient recovery system provides financial benefits to future farmers, utility companies and other stakeholders. The recovered nutrients can be marketed, or farmers can reuse them as a pure and effective fertilizer, produced from resources that would otherwise be wasted. If scaled up, this might make a significant contribution to lowering agricultural carbon footprint and nutrient loading into rivers while also providing an extra income stream for wastewater treatment plants.

E. Challenges and opportunities

The method has not yet been tried out in field scale for treatment of agricultural runoff. The system required electricity.

F. Reference and demonstration:

Solution website: https://eden-microfluidics.com/eden-cleantech/
Project website: https://wateragri.eu/wateragri-solutions/

WATERAGRI

Contact Information

Eden Tech,
4 Rue de Rambervillers
Paris 75012, France
Tel : + (33) 188 327 405
https://eden-microfluidics.com/

Abhilash Venkateshaiah, PhD
abhilash.venkateshaiah@eden-microfluidics.com
Cecile Perrault, PhD
cecile.perrault@eden-microfluidics.com
Wei Zhao, PhD
wei.zhao@eden-microfluidics.com

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 858735.