CRC for
Water Sensitive Cities

Program C: Future Technologies | Project C2.1 | Project duration: January 2014 – January 2017

Resource recovery from wastewater

Overview

Wastewater treatment currently uses significant amounts of energy to remove valuable nutrients such as nitrogen, phosphorus and potassium. These same nutrients are major components of agricultural fertilisers critical for plant growth and replenishment of depleted soils, which are industrially produced for the agricultural sector at immensely high costs.

This project aims to develop technologies which can recover energy, water and valuable elements such as phosphorous, nitrogen and potassium from wastewater making the resource recovery energy and cost neutral. The ultimate goal is to develop a suite of technologies that together can supplement or completely replace existing domestic wastewater treatment systems at all scales.

Key outcomes

The project will deliver groundbreaking new technologies such as the partition-release-recovery method that recovers nutrients from wastewater while also producing methane gas, which is recovered for generating electricity, making the system energy neutral. Industries who will derive massive benefits from these new technologies are the agricultural and water sectors, making their operations more cost-effective, sustainable and carbon neutral. Industry stakeholders, in particular technology providers, will be consulted throughout the project to assist in the development of these new resource recovery technologies. This will engage specific and highly specialised industry groups which include precipitation specialists, chemical suppliers (particularly of ion exchange resins and adsorpents), membrane suppliers and electrochemical equipment suppliers.

Early promising results of these technologies have prompted strong direct support from Victorian water utilities (via the Smart Water Fund) and from key industry bodies such as the Grains Research and Development Corporation to sponsor this project.

Early insights into promising resource recovery technology

This project is developing a world-first technology for a next-generation resource recovery process which will be able to replace existing wastewater treatment technology in the not so distant future.

This technology has the potential to recover vital fertiliser compounds such as potassium (close to 100% of this resource are currently imported) and phosphorous, which is a non-renewable essential element. Another huge advantage of this technology is that it meets or exceeds the technical performance capability of existing technologies. There is strong multi-sector support from the waste and wastewater industry, agri-industry and farmers.

An Australian Government Initiative

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Project design

The project consists of three modules looking at 3-step nutrient accumulation, release and recovery technologies. These three steps comprise separate technologies and are individually applicable to specific wastewater streams. It is intended that they be integrated from the start of the project for the purpose of domestic wastewater treatment at a range of scales.

In particular, the project is developing novel methods to enable fast growing, photoactive organisms such as purple bacteria and algae to remove nutrients rather than destructively converting them to nitrogen gas. When assimilated by these microbes, the nutrients transform into solid form. Solids are then separated from the water by filtering it through a membrane and are later further concentrated mechanically.

To extract the concentrated nutrients, they must be released back into a liquid stream. This is done by anaerobic digestion, producing a nutrient-rich brew one hundred times more concentrated than the original wastewater. Various chemical and physical methods are then used to finally recover the nutrients. Methane gas that is generated from anaerobic digestion is captured for electricity generation, making the system energy neutral. The nutrients can be processed into fertilisers that compare favourably with current commercial products. Another advantage of the partition-release-recovery method over traditional treatment is the small volume of sludge remaining at the end of the process, which means less waste for disposal and reduced transport costs.

Apart from actual technology development, a key requirement, especially for acceptance at a decentralised scale, is to build pilots to demonstrate its effectiveness in the field.

Outlook

The next steps are to continue to develop and refine the technologies in the laboratory before going into the field. A pilot processing plant will be built this year as part of the larger innovation centre at Brisbane's Luggage Point Advanced Water Treatment Plant. More pilots are also planned with the support of Victorian utilities.

A key step over the next two to five years will be to fit the technology into existing conventional infrastructure; for example, replacing nutrient destruction techniques with nutrient recovery. Within five years, it is expected that smaller-scale processing plants could be built using this technology. The system is designed to work as a drop-in replacement for existing treatment plants; so in the longer term the technology could be expected to roll out over decades replacing activated sludge treatment as new plants are built and ageing infrastructure is replaced.

About the Cooperative Research Centre for Water Sensitive Cities

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) brings together interdisciplinary research expertise and thought-leadership from Australia and the world to address current urban water management challenges facing our cities and regions. In collaboration with over 80 research, government and industry partners, it develops and synthesises knowledge into powerful tools and influences key players aiming to achieve sustainable, resilient and liveable water sensitive cities.

Further information

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