Flushed with success

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SEAWATER TOILET FLUSHING, a common practice in Hong Kong, is surprisingly new for the rest of the world.

This simple idea has recently been developed by a research team led by the Hong Kong University of Science and Technology into a low-cost, low-energy and low-carbon-emission pollution control system.

Nowadays, about 925 million people do not have enough food and 900 million people lack safe drinking water.

About 80 percent of all diseases in the developing world are related to water pollution, resulting in the death of two million children every year.

The situation is worsening as a result of population growth, global warming and climate change.

Moreover, phosphorus (P) reserve, an essential fertilizer for all plants, is rapidly depleting. All these issues have one thing in common: they can be mitigated through exploitation of seawater.

Toilet flushing represents up to 30 percent of domestic and 70 percent of commercial water demand.

Using seawater toilet flushing saves not only water but also energy as production of freshwater takes twice as much energy as abstraction of water from the sea; reclaimed wastewater takes 10 times as much energy; and seawater desalination takes 100 times as much.

Moreover, as seawater cooling uses 35 to 50 percent less energy than air-cooling, even more energy can be saved by integrating it for centralized air-conditioning.

Furthermore, by installing two pipelines for collecting wash-water (gray water) and toilet-water separately, we can reuse gray water for various purposes, including irrigation.

Hong Kong International Airport is the first organization in the world to put this triple water supply (freshwater, seawater and gray water) system into use.

This has saved 52 percent in freshwater demand, HK$20 million in electricity bills (30 million kilowatt hours) and 17,000 tonnes of carbon dioxide emissions a year, an amount equal to greenhouse gas emissions by 5,500 cars.

Human urine comprises about 1 percent of the volume, but 50 to 80 percent of P-load in sewage. This also amounts to 5 percent of the Earth's P-reserves.

As every liter of seawater contains about 1.3g of magnesium, we have developed a new technology – the SUPR process – to use seawater directly to precipitate P from urine to produce a fertilizer called struvite (magnesium ammonium phosphate).

This process is simple. We need to use only a biological reactor to decompose urine for releasing ammonia, then add seawater in a ratio of 1:1; struvite will precipitate in 15 minutes.

This is a fertilizer commonly used to grow crops.

It is especially valuable for use by poor farmers in developing countries.

Use of seawater in Hong Kong is saving 740,000 cubic meters of freshwater every day. This amount exceeds those of water reuse programs in Singapore, Japan and Australia.

The SUPR system represents a new nutrient recovery technique for the next generation.

In the next article, we will introduce another seawater-based technology which breaks through century-old sewage treatment technologies.

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