

Phosphorous Recovery Made Easy

The Japan Sewage Works Agency has developed a promising new technology for the efficient recovery of phosphorous from sewage.

The Japan Journal reports.

Phosphorus is an essential element for animals and plants. It is also indispensable as an agricultural fertilizer. At the moment, the annual amount of phosphorus ore produced globally is approximately 150 million metric tons. Japan imports a total of one million metric tons of phosphorus ore per annum to meet its entire local demand. However, international phosphorus prices skyrocketed after the major producing countries raised tariff rates and imposed export restrictions. Also, some warn that the reserves of phosphorus ore will be depleted within several decades. Against this backdrop, attention in Japan is now being directed toward a research project aimed at recovering phosphorus from sewage.

“Useful resources are dissolved in sewage, and phosphorus is one of them,” says Hitoshi Nakazawa of the Japan Sewage Works Agency. “A huge amount of sewage comes to sewage treatment plants where it is easy to recover phosphorus at a high level of efficiency.”

Human excrement contains phosphorus. It flows through the sewer system to sewage treatment plants. In Japan, sewage treatment plants nationwide treat approximately 14 billion metric tons of sewage per year. It is said that it contains around 0.0004% (4mg/l) phosphorus. It is also said the ash of sewage sludge contains around 10% phosphorus. Little phosphorus has hitherto been recovered from sewage for technical and cost reasons. However, technological advancement and the increase in phosphorous prices in recent years are making it more likely that the operation of recovering phosphorus will be viable.

The aim of the operation is to collect phosphorus from sewage sludge

and treated sewage effluent generated in the treatment process. The magnesium ammonium phosphate (MAP) method is the principal means of recovering phosphorus from sludge. After the tiny crystals of MAP and magnesium hydroxide are added to the sludge, the MAP takes in the phosphorus and nitrogen contained in the sludge and grows into larger crystals. These resulting crystals are collected.

Phosphorus can also be recovered from treated sewage effluent through adsorption. However, the rate of adsorption is low using conventional adsorbents, meaning that treatment of an enormous amount of sewage requires a large amount of adsorbent. To make matters worse, sewage contains cadmium, mercury and other impurities. It was therefore difficult to efficiently recover phosphorus alone without using large quantities of chemicals.

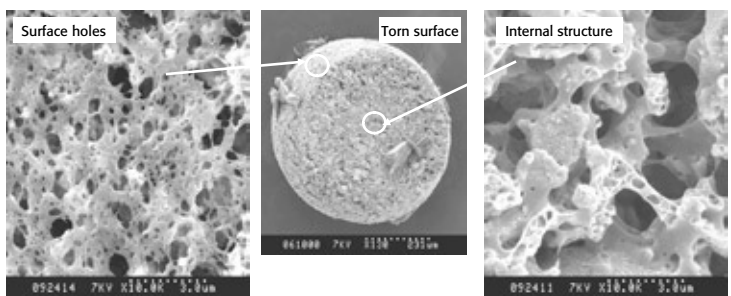
However, earlier this year, the Japan Sewage Works Agency and Asahi Kasei Chemicals Corporation conducted a successful experiment to collect phosphorus in high purity comparable to phosphorus ores from secondary effluent using the adsorption method at a speed ten times quicker than the conventional approach. The key to this breakthrough was a newly invented adsorbent. It is made of ceramics and resins and has a ball-like shape. A single grain is about 0.6 mm across. It has pores several micrometers in diameter on its surface. When secondary effluent passes through the adsorbent, phosphate in the effluent is selectively adsorbed. After catching the phosphorus, the ad-

sorbent is detached from the phosphorus using a solution of sodium hydroxide. Calcium is added to this solution to collect calcium phosphate at high purity. The method allows massive cost reduction as the adsorbent and the sodium hydroxide solution can be reused.

Nakazawa explains, “The practical application of this technology will pave the way for a cycle of phosphorus recycling, in which humans consume vegetables grown with fertilizers containing phosphorus recovered from human excrement.”

While the phosphorus concentration in the secondary effluent ranged from 0.1 to 3.2 mg per liter, the phosphate concentration after phosphorus removal using the adsorbent was 0.01 mg or less per liter. Japan and other countries alike face the problem of eutrophication caused by phosphorus, which deteriorates the aquatic environment in ponds, lakes, ports and other closed waters. In the light of this, Japan has introduced stringent regulations concerning the level of phosphorus in effluent. There has been a method of removing 99% of phosphorus from treated sewage effluent, but it was necessary to use a large amount of chemicals.

“With the newly developed method, it is possible to remove phosphorus and to easily recover it as a resource,” says Nakazawa. “It has yet to reach the level of practical application in terms of cost, but this method has great potential.”



Electron microscope images of the new adsorbent