

## **Abstract**

To create a sustainable society, the nutrients in household biodegradable solid waste and wastewater have to be recycled to agriculture. If the nutrients present in wastes from society were recycled, the use of fossil resources would decrease and so would the undesirable effects arising from discharge of nutrients to water recipients.

The main proportion of nutrients in the waste is to be found in the urine, faeces and the biodegradable solids. If all of these fractions are collected and recycled, 92% of the nitrogen, 85% of the phosphorus and 63% of the potassium out of the total flow of nutrients in the biodegradable fractions (urine, faeces, greywater and biodegradable solids) would be recycled.

An easy way to collect the urine, which contains the majority of the nitrogen and a lot of the phosphorus and potassium originating from households, is to use a urine-diverting toilet system. So far, it has proved possible to collect up to 80% of the urine excreted using such a system.

In the collected urine mixture (urine and flushwater), there is a tendency for three layers to form. The middle layer, consisting of more than 90% of the total volume, has a composition comparable to the urine mixture if it were homogenized. The top layer, which is less than 5% of the total volume, has a lower concentration of nutrients than the middle layer while the bottom layer, also less than 5% of the volume, has a higher nutrient concentration than the other two layers.

When using a water-flushed toilet, it is possible after a short transport to capture the faecal nutrients by separating the faecal particles from the flushwater. High disintegration of the faecal particles, such as may occur in long or vertical transport, results in extraction and suspension of the nutrients, which decreases the amounts of nutrients it is by particle separation possible to separate and recycle.

Currently, faecal separation can be performed by Aquatron or filtration. The nutrient separation efficiency of the techniques depends on several factors. Aquatron separation was investigated in the laboratory with a short soil pipe transport and in the Ekoporten block of flats with a long transport through up to four floors to the separation in the basement. The investigation in Ekoporten showed that it was possible to separate about 60% of both nitrogen and phosphorus but only 45% of the potassium. In the laboratory study, 70% of all the nutrients were successfully separated. This indicates that the pipe transport distance should be as short as possible, especially the vertical drops, to enable as many of the faecal nutrients as possible to be collected.

One of the separation systems available on the market today is based on filtration with filters that are emptied every six to twelve months. Investigations in the laboratory of biological and chemical activity when faeces are submerged into water showed a rapid degradation of the faeces and extraction of the faecal nutrients, which indicates the importance of fast removal of the filter cake after separation. The laboratory study of filtration with immediate removal of the filter cake on average separated 70% of the faecal nutrients in to the separated solids.

If 80% of the urine is diverted and 70% of the faecal nutrients are separated and collected together with the biodegradable solids, 67%, 66% and 48% of the nitrogen, phosphorus and potassium respectively can be collected locally in an easily recycled fraction.

Urine diversion and faecal separation are simple and effective methods for collecting recyclable and unpolluted nutrients from wastewater. This increases the sustainability of society and decreases the degree of pollution resulting from nutrients being discharged to the water recipients.