SuNha or later…
Pre-study, and proposal of master thesis project
2014 - 2015

SUBSTANCE FLOW ANALYSIS FOR NITROGEN IN SCANIA

Background

Phosphorus recovery and removal from wastewaters are hot topics due to limitation of easily available and high quality phosphate rock reserves and problems with eutrophication in receiving waters. The nitrogen in the atmosphere is unlimited for anthropogenic usage, but industrial nitrogen fixation together with other human activities, agricultural fixation via cultivation of leguminous crops, fossil-fuel combustion and biomass burning, have led to an dramatic increase of reactive forms of nitrogen to such an extent that biogeochemical flow of nitrogen is exceeding its the planetary boundary for a safe operating space (Rockström *et al.*, 2009). Excess of reactive nitrogen is (partly) responsible for acidification, eutrophication, global warming and ozone depletion, but has on the same time enhanced food production via fertilisation (Sutton *et al.*, 2013). Industrial fixation of nitrogen into ammonia is very energy-demanding, and, today, heavily dependent on fossil fuels.

In Sweden, the value of nitrogen in the toilet waste is around five times more worth (in money) compared to the phosphorus content when equalled to chemical fertiliser prizes (Jönsson, 2011), but less than 20% of nitrogen ends up in the wastewater sludge at municipal wastewater treatment plants (WWTPs). The potential of CO_2 savings is almost 80% higher for recycling nitrogen than for recycling phosphorus from toilet waste (Jönsson, 2011). The amount of nitrogen in the toilet waste corresponds to 20% of the sold mineral fertilisers in Sweden (Jönsson, 2011). Also, the Swedish EPA has proposed that at least 10% of the nitrogen in Swedish wastewater should be recovered (Swedish EPA, 2013), which, together with the aim of at least 40% phosphorus recovery (Swedish EPA, 2013), means that wastewater sludge from conventional WWTP will not be enough to recover sufficient amount of nitrogen. Source separation of toilet wastes can lead to almost closed nutrient loops, the dependency of imported mineral fertilisers will decrease and local markets of fertilisers are created.

VA SYD and Sweden Water Research have proposed a large study called SuNha or later… (SuNha = Sustainable Urban Nitrogen Handling) to evaluate different methods for recycling a larger part of the urban nitrogen flows in Sweden. This document describes a proposal of a pre-study, which should explore the potentials of nitrogen recovery from urban flows compared to manure, mineral fertilisers and atmospheric deposition. Today, there are quite good ideas about the flow of phosphorus on a national level in Sweden (Linderholm *et al.*, 2012). On region level, there have been some studies on both phosphorus and nitrogen flows (Danius & Burström, 2001 (N in Västerås, Sweden); Sörenby, 2010 (P in Stockholm, Sweden); Teknikmarknad, 2012 (N and P in Värmdö, Sweden); Coppens *et al.*, 2013 (N and P in Flanders, Belgium), but no such study has been performed for the Scania region of Sweden, and no survey has been performed on the national level in Sweden.

Aim

This pre-study should result in a substance flow analysis for nitrogen in the Scania region in southern Sweden. A method for doing substance flow analysis for plant nutrients in regions will be developed. The study should also examine potentials and effects of future changes of current urban nitrogen handling regarding energy, nitrogen recovery and greenhouse gas emissions. Suggested changes to study are urine collection, dietary change and total autotrophic nitrogen removal at wastewater treatment plants, but the flow analysis and the pre-study may also discover other potentially favourable alternatives.

The effects of this study should lead to:

- establishment of contacts to experts and stakeholders that works with R&D regarding recycling of plant nutrients,

- possibilities to larger project applications for further R&D activities with external financing in potential and prioritised questions/techniques regarding recycling of plant nutrients from urban areas,
- the phosphorus flows in Scania should be quite easily determined as well,
- a scientific journal paper of the study is written.

Method

A master thesis student situated at the consultant company Ecoloop in Stockholm will perform the largest part of the pre-study. The thesis is mainly a literature based study. However, interviews of researchers will be included, as well as study visits.

A preliminary activity list:

1. Start meeting – more precisely defining limitations, boundaries, deliveries and time plan.
2. Establishment of reference group
3. Literature study
4. Substance flow analysis
5. Study of alternative systems
6. Report writing
7. Preliminary results is presented at IWA Sweden conference on Source-separating Systems of Wastewater April 22, 2015
8. End meeting with reference group + interested (external) people (policy-makers, stakeholders, researchers etc) for further studies and project applications

Project owner

Sweden Water Research (David Gustavsson, VA SYD)

Project leader

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Subject reviewer of master thesis project

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Supervisors of master thesis project

Supervisor: Mats Johansson, Ecoloop. Co-supervisor: David Gustavsson, Sweden Water Research/VA SYD

Parallel studies

Transition in wastewater composition and handling in Malmö towards a sustainable future – a master thesis project at Sweden Water Research/VA SYD in cooperation with Lund University, November 2014 – March 2015.

Urine volume reduction with a biomimetric membrane – a master thesis project at Sweden Water Research/VA SYD in cooperation with Lund University and the company Aquaporin, January-May 2015.

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Coppens J. *et al.* (2013). Substance flow analysis for nitrogen and phosphorus in Flanders. (In Dutch). MIRA, MIRA/2013/09, University of Ghent, Belgium.

Interested in the master thesis project?

Send an e-mail with a few words about you, your CV and why you are interested in this master thesis to mats.johansson@ecoloop.se and david.gustavsson@vasyd.se. This project is planned for Jan-May 2015.