FOCUS#3

Novaquatis - the Swiss Urine-to-Fertilizer Approach

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Introduction

Establishing urine separation technology in Scandinavia may have been difficult (and probably still is). Switzerland, however, may even be harder:

- The country is densely populated. A large part of the population is living in urban and periurban areas.
- A well developed sewer network stretches out to almost the last remote village. Consequently, the wastewater industry is of considerable economic importance [1].
- There does not seem to be a need for further action in water protection. The Swiss waters are much cleaner than they were 30 years ago, although now and then, a disturbing article about hormones that pass the sewage treatment plants and the damages they can do to fish makes its way into a local journal.
- The Swiss agriculture has a surplus of nutrients, not a lack, so why should it bother with urine, one might ask?
- Then, great sums have been invested, and there already are quite a number of stakeholders involved. The Swiss direct democracy makes sure that any one of them can join the discussion.

In this situation, a breakthrough of urine separation technology can only be reasonably hoped for, when the existing situation is taken into account carefully. The transition can only be gradual. An idea is needed, how the advantages of urine separation can be combined with the positive aspects of the existing wastewater management system.

How Novaquatis differs from the Swedish Approach

A potential plan for a gradual transition was first formulated in 1996 by T.Larsen and W.Gujer [2]. In short, their idea is to use the existing sewer system for transporting the urine. Urine stored in-house is "released into the sewers at controlled times and is transported to the wastewater treatment plant, where it can be diverted for separate treatment" [3]. The collected urine is then treated, converted into a fertilizer and reused in agriculture.

The Swedish approach, in contrast to that, seems much more "down to earth". Urine is stored in tanks which are emptied periodically and spread on the fields by farmers. No special treatment is foreseen (see also [4,5]).

The advantages of the Novaquatis approach in the given Swiss situation are quite obvious: Decentralized urine collection units can be installed when the old system is still in place. An immediate positive effect on the performance of the existing wastewater treatment plant can be expected when less and less nitrogen has to be processed.

A so called "peak shaving" [6] effect will be caused by holding back the nitrogen normally released with the morning urine, even if it were to be gradually released during the day. Less nitrogen, and thus, less ammonia, will be in the sewers during rainy periods, thus reducing the risk of fish kills due to sewer overflows.

Project Structure

The structure of Novaquatis reflects the cyclic nature of the topic. Figure 1 shows the proposed anthropogenic nutrient cycle and the Novaquatis workpackages (NOVA 1 - 7) connected with it (from [7], adapted).

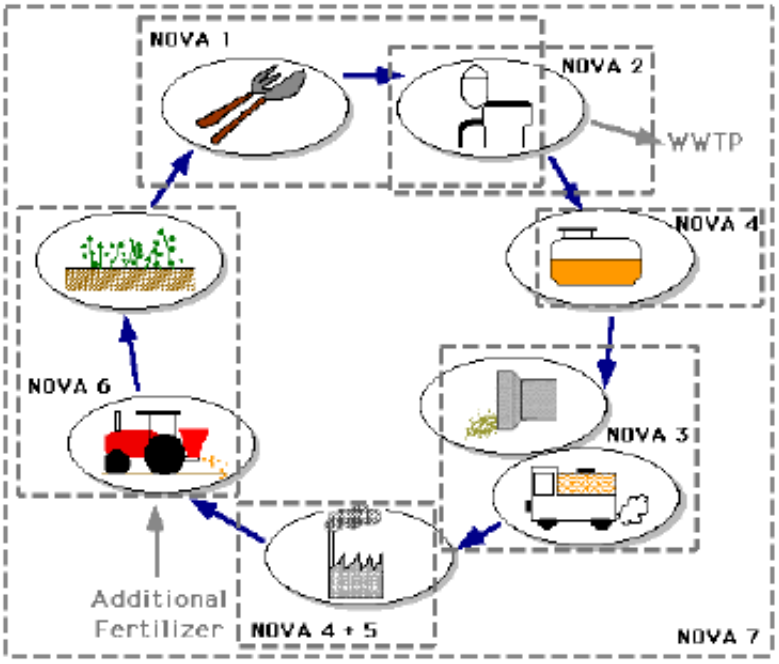

Figure 1: The anthropogenic nutrient cycle as it would arise if urine were separated at the source and returned to agriculture as a fertilizer. The workpackages of NOVAQUATIS are indicated. WWTP = Wastewater Treatment Plant. Drawn after [7]

Workpackages

NOVA-1: Evaluation of Consumer Attitude

This workpackage consists of 2 separate projects: The project of C. Pahl-Wostl is focussing on the "Consumer Attitudes towards Urine Separation Technology and Anthropogenic Nutrient Fertilizer Use in Organic Farming". This project part has almost been completed. Seven "focus groups" were conducted in fall and winter 2000/2001. In these groups, the ideas of urine reuse were discussed by 6 to 8 citizens on 2 evenings. Thematical input was provided by a web based "Interactive Citizen Information Tool" (ICIT), ("NoMix Tool"), available at http://www.nomix.ch (in German).

The project of R. Kaufmann-Hayoz concentrates on "The Integration of Urine Separation Technology into the Daily Routines of Users". Mrs. Kaufmann-Hayoz is a social scientist with special interest in ecological design and the factors leading to it.

NOVA-2: Development of New Bathroom Technology

The only project, guided by T. Larsen, focusses on the "Informal cooperation with sanitary firms and information transfer from the relevant NOVAQUATIS projects".

NOVA-3: Transport of Anthropogenic Nutrients

In the only project of this workpackage, W. Rauch concentrates on the "Impacts of the Anthropogenic Nutrient-Technology on Urban Drainage Management".

NOVA-4: Processing of Anthropogenic Nutrients

This workpackage is focussing on methods for solving three important problems of using urine as fertilizer:

- Ammonia emissions
- Toxicity
- Transport (volume reduction)

At least one promising method for stabilizing stored urine has been identified by

K.Udert in his dissertation [8] and is currently being examined in more detail: By lowering the pH of stored urine, it is possible to prevent a loss of gaseous nitrogen to the atmosphere. At the same time, a reduction of organic microcontaminants has been observed, although the interpretation is yet unclear.

Another technology which will receive further attention is membran filtration.

H.Siegrist, H.P.Kohler and M.Boller are involved in this workpackage. The fertilizer produced by the technology chosen will be used for toxicity assessment in the following workpackage.

NOVA-5: Toxicity Assessment of Urine Fertilizer

This workpackage wants to [7]]:

- develop suitable test systems to assess and follow the toxic potential of organic microcontaminants in urine and fractions thereof
- contribute to the development of a urine treatment method that can be certified as safe for organic agriculture
- identify suitable partners which will be able to specifically test the effects of urine in the soil matrix

The three projects of this workpackage will work with a battery of ecotoxicological test sytems (e.g. membrane toxicity testing) and on estrogenicity testing. It will also try to follow representative substances, e.g. pharmaceuticals, caffeine, cleansing agents, through the urine treatment process. B.Escher, R.Eggen, M.Suter, C.McArdell and A.Alder are involved in this work.

NOVA-6: Assessment of Agricultural Nutrient Demand and Farmer Attitude

The work in agriculture, under the auspices of A.Berner at the Forschungsinstitut für Biologischen Landbau (FiBL) in Frick, Switzerland, was going to focus on three main aspects:

- the acceptance of urine as fertilizer
- the nutrient requirements
- the effects on the environment

As first step, a survey was made among 120 Swiss farmers about the acceptance of urine fertilizer [9]. The results showed that contamination with human pharmaceuticals was of major concern to the farmers. A product smelling like urine would meet widespread resistance. Concerning the potential application of this fertilizer on their fields, the farmers had mixed opinions. Supporters and opponents had almost equal shares.

Unfortunately, the work in this important workpackage has come to a halt at the end of 2000, due to funding problems.

NOVA-7: Comprehensive Evaluation of the Urine Separation Technology

This workpackage wants to answer the question, whether urine separation technology is an overall improvement over today's sanitary technology. The technology will be evaluated using methods and technologies such as: decision analysis, economic cost-benefit analysis and life-cycle assessment.

Outside of these workpackages, there is one more project located at the University of Applied Sciences at Waedenswil dealing with the production of an organic fertilizer from urine.

Outlook

Novaquatis had its official start in July 2000. Thus, it is still too early for results. Nevertheless, the project has received a lot of attention in the Swiss public. It has been covered by various newspaper articles and even a TV transmission, and seems to have come just right.

This seems amazing, considering the Swiss situation and the fact that the first two full scale urine separation toilets in Switzerland have just been built into a new building in Zurich. There is very little practical experience with the technology at all. And - needless to say - you can't easily buy a urine separation toilet in Switzerland today.

A possible explanation for the large interest is, that contamination of Swiss waters with hormone residues has been quite a topic in the last two years. A fish decline is being observed (see also http://www.fischnetz.ch) and organic microcontaminants are seen as one of the reasons.

I hope that we will be able to report on some results of Novaquatis in later issues of this newsletter.

References, Links

- [1] Lehmann, M., 1994, Volkswirtschaftliche Bedeutung der Siedlungswasserwirtschaft, GWA 6, 442-447
- [2] Larsen, T.A., Gujer, W., 1996, Separate management of anthropogenic nutrient solutions. Water Science and Technology 34(3-4), 87-94
- [3] Larsen et al. ES&T 2001
- [4] Jönsson, H., EcoEng Newsletter 1/2001
- [5] Johansson, M., Nykvist, M., EcoEng Newsletter 1/2001
- [6] Larsen, T., Rauch,W., and Gujer, W. (2001): Waste design paves the way for sustainable urban wastewater management. Proc. International Unesco Symposium 'Frontiers in Urban Water Management: Deadlock or Hope?', pp.219-229, UNESCO, Paris, 2001. [Paper can be downloaded at http://www.nomix.ch/Publications.html]
- [7] http://www.nomix.ch/project.html
- [8] Udert, K., 2001, EAWAG Dissertation
- [9] Haller, M., 2000, Düngeverhalten von Bio- und IP-Landwirten - Umfrage zur Akzeptanz des Novaquatis Projekts. Semesterarbeit. ETH Zürich [in German]

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