

**Project Title:** Green NUTrients RECOVERY systems

Grant Agreement number:	606057
Funding Scheme:	FP7- SME-2013-1
Period covered – start date:	01/11/2013
Period covered – end date:	31/10/2014
Name of the scientific representative of the project's coordinator and organisation:	Dr. Jennifer Bilbao FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V
Tel:	+49 711 970 3646
E-Mail:	jennifer.billbao@igb.fraunhofer.de
Project website address:	<a href="http://www.greenaqua.dk/da/nutrec-project">http://www.greenaqua.dk/da/nutrec-project</a>
Date of preparation:	18 <sup>th</sup> December 2015



## ***Project context and main objectives***

Nutrient recovery from wastewater has been receiving growing interest, driven by stringent nutrient discharge limits from Wastewater Treatment Plants (WWTP) and by the potential for valorization of the recovered nutrients, e.g. for application as fertilizers, which can represent an additional revenue source to WWTP operators. The NUTREC project focused on the recovery of ammonia (N) and phosphorus (P) from wastewaters, in particular reject water from biogas production (rich in N and P) and leachates (rich in N) from landfills. The NUTREC consortium – led by a group of five SMEs (from four countries) within the WWT industrial sector – improved and optimized aspects of a recently developed, innovative technological process for recovering ammonia, as well as extended such process for the recovery of phosphorus from diverse wastewaters, and transforming the nutrient-rich by-streams into useful fertilisers. The technology has a very high potential for economic savings especially related to energy – and operational improvements in WWTPs.

## ***Description of work performed***

### **WP3: Process specifications and analysis of requirements**

During WP3 the process requirements for the further development of the GAAR process were determined. The parameters investigated were struvite precipitation and structure of the particles, the solubility of magnesium phosphate granules, determination of energy and mass balances, dewatering of solids and reduction of water velocity in the stirrer. Additionally, the regulatory requirements in Europe for wastewater treatment and fertilizer products were determined.

### **WP4: Process development and optimization for ammonia recovery and extension of the technology**

During WP4 a laboratory scale set-up was constructed for the process development and optimization of the struvite precipitation process. As a first step, the solubility of the magnesium phosphate granulates was studied. The results showed that solubility increased with decreasing pH value.

Subsequently, an experimental design was created based on the operating parameters (pH value, stirring speed, retention time, and granulates excess) of the current pilot plant. A clear effect on the N-NH<sub>4</sub> removal could be observed for the parameters stirring speed and retention time. For all stirring speeds examined the NH<sub>4</sub>-N-removal increased with ascending retention time. A maximum NH<sub>4</sub>-N-removal of 92% was achieved.



**WP5: Assessment of the fertilizer characteristics and development of a high-quality standardized product**

In WP5, the amount of N and P that can be recovered with the process was calculated based on the information of two WWTPs, namely Aaby and Hobro in Denmark. The inflow of wastewater corresponded to 90.000 PE (person equivalents) per year at Aaby and 29.200 PE per year at Hobro. A tentative guess was that the GAAR system could be included in the treatment of 46% of the wastewater in Denmark corresponding to 3,458,000 PE.

Nearly all P and about 10% of N in the reject water is extracted in the struvite process. With a 50% translocation of P from the sewage sludge into struvite the Aaby WWTP case showed, that it was possible to produce 1.78 kg struvite/PE corresponding to 0.10 kg struvite-N/PE and 0.22 kg struvite-P/PE.

Up to 90% of the NH<sub>4</sub>-N in the reject water is extracted in the GAAR process. Annually the GAAR system can produced 5,700 m<sup>3</sup> of a liquid N-fertilizer with a NH<sub>4</sub>-N concentration of 3.5 kg/m<sup>3</sup>, which is comparable to N-concentrations in pig slurry. In total it is 20 ton NH<sub>4</sub>-N/year and 0.68 kg NH<sub>4</sub>-N/PE. At a national scale a potential production of struvite from the wastewater would substitute 7.8% of the P in mineral fertilizers used in Denmark if sewage sludge was not applied to the fields.

The further planned work was not carried out due to the suspension of the project.

***Expected final results and potential impacts***

The impacts of the NUTREC project was plant to be the reduction of WWTP operating costs, enhancement of plant revenues, addressing regulatory challenges, provide sustainable treatment processes, and promote "green" practices, such as reducing carbon footprints and consumption of resources as well as provide more options for recycling and beneficially using wastewaters. This project was aimed to develop a technology assisting the wastewater industry in a transition from treatment based industry to a resources recovery and reclamation based industry that is both economically and environmentally sustainable.

The abovementioned factors thus document a clear need and opportunity for improvement of integrated and technically innovative solutions for EU SMEs in wastewater treatment and nutrients removal sector. From the analysis of the market for wastewater treatment technologies it can therefore be concluded that:

- NUTREC could contribute with novel techniques and technology innovation to a pertinent societal and economic problem, to which there is currently a high demand for solutions;
- The project aimed to address innovation and technological development of treatment technologies within a very large and growing market
- Municipal wastewater and sludge treatment and nutrients recovery market continues to be a growing and large part of the over-all market;



- Legislation drivers further stimulates the growth of the market and the need to invest in new technology and solutions
- Renewable nutrients provide an effective entry into other market segments due to their inherently difficult production, and a lack/decreasing of alternative resources
- The increasing privatisation of the WWT industry has created a new group of companies and SMEs – which due to internalised cost and stronger concerns with cost-efficiency – can break the current market barriers for introduction of advanced innovative technology;
- The NUTREC project represents a significant commercial opportunity for novel, SME and European-manufactured technologies to increase their share in the European and global market.

With the successful achievement of the NUTREC objectives it was planned to strengthen the competitiveness and economy of the SMEs in the consortium by providing them with a novel technology for treating high concentrations of ammonium and phosphorus in wastewaters, which can be very harmful for the subsequent biological processes and/or water environments. The SMEs could become key players in the production and commercialization of a new innovative and economically competitive technology that will allow end-users to save in energy costs and avoid several inhibition problems, while providing them with the possibility to explore a new market, i.e. renewable fertilizers.

This project is expected to generate a total turnover in the order of €80M in the initial 5-year period post project. Besides the benefit generated through sales, GAS, as the initiator of the idea, was planned to expand its business and succeed in internationalization of their innovative system. OHT expected to expand its business to the production of equipment for the vast and growing wastewater market. BIO, SIM and GEL aimed to strengthen their portfolio of solutions for customers in markets holding strategic interest for them. Moreover, the participation in an FP7 project allowed the SMEs to strengthen relations with strategic collaborators as well as to establish connections with RTD performers and relevant partners, facilitating future business opportunities.

