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Upcoming ESPP events

Agricultural valorisation of sewage biosolids

Tuesday 4th December, Brussels. Registration: info@phosphorusplatform.eu

Science and stakeholder dialogue meeting on safety and sustainability questions around use of sewage biosolids on farmland.

Save the date: ESPC4: The 4th European Sustainable Phosphorus Conference (ESPC4) is fixed for Vienna, 15 - 17 June 2020

See more events at www.phosphorusplatform.eu/upcoming-events

Help! Looking for granular apatite.

UK water industry operators (Severn Trent and Thames Water) are looking for a supplier of, in total, 15 - 20 000 ton/year of granular apatite (phosphate rock), particle size 2 – 10 mm depending on system design (a larger size could be reprocessed by crushing, fine apatite would need to be supplied granulated). The material will be used as substrate in reed bed or filter systems for tertiary phosphorus removal in small sewage works that are becoming subject to stringent phosphorus discharge limits in coming years. Around 200 UK sewage treatment works have been identified as needing this type of solution to meet the tighter phosphorus consents in the next 7 years. The average media requirement is around 500 m³ per site, with media replacement every 10 years. Previous trials carried out by Thames Water have proven the suitability of granular apatite for phosphorus removal in the UK. The selection of the apatite material and binder used to granulate apatite is critical in ensuring a good effluent quality (it needs to have high apatite purity (>90%), low metal and uranium content and not raise effluent pH). Companies interested in supplying non-pH-modifying granular apatite in such quantities, or to provide granulation – distribution services, are invited to contact as below.

Contact: Chris Thornton, ESPP, info@phosphorusplatform.eu

Past ESPP events

Outcomes 3rd European Nutrient Event at ECOMONDO 2018



The 3rd European Nutrient Event ([ENE3](#)), 8 - 9 November 2018, Rimini, was jointly organised by the European Sustainable Phosphorus Platform (ESPP) and EU Horizon2020 funded SMART-Plant project. The presentations, final programme, list of key speakers of the event can be downloaded [here](#). The event was focussed on the theme “towards the circular economy of phosphorous (P) and other nutrients”, in Italy, the Mediterranean region and the EU, including research, development and innovation. Day 1 focussed on phosphorus and nutrient recycling in Italy and the Mediterranean region and the start up of the Italian Phosphorus Platform. It included presentations by the Italian Ministry of Environment and Protection of Land and Sea, ESPP, European Commission DG RTD, key Italian institutes, EurEau, ISLE Utilities, OSTARA, CNP Cycles, Veolia, Suez, EasyMining, Outotec, Aqualia, Assofertilizzanti, Confagricoltura, ITALPOLLINA, Lombardy Region and CAP Holding. Day 2 was focussed on new nutrient recycling R&D projects, updates on current major projects, nutrient

management in Horizon Europe and the potential “Mission on Nutrients”. It included presentations by the European Commission DG RTD and EASME, and R&D project presentations by Horizon2020 funded projects Circular Agronomics, HYDROUSA, INCOVER, PeGaSus, P-Al/Fe-WTR, Run4Life, SABANA, SaltGae, SYSTEMIC, Water2Return; INTERREG funded projects BEST, No_Waste, NuReDrain, SEABASED; LIFE funded projects DOP, MEMORY, Newbies, TrialKyl, Vitisom; and other funded projects BiofuelcellAPP, HTC, MIND-P, PARFORCE, RAVITA and ViviMag. The full report will be published soon.

All information and outcomes of the event can be found at www.smart-plant.eu/ENE3

An overview of R&D activities by ESPP including a full description of the research projects and more information about the potential Mission on Nutrients can be found at www.phosphorusplatform.eu/R&D

The Mission on Nutrients will be further discussed during the European Sustainable Nutrient Initiative (ESNI) event, 22 January 2019, Brussels, www.biorefine.eu/european-sustainable-nutrient-initiative-esni-2019-0

Regulatory

Swiss phosphorus recovery / recycled fertilisers ordonnances published



The Swiss federal government has published a new ordonnance (in [German](#) and [French](#)) defining some of the conditions for recovery of phosphorus from sewage and from meat and bone meal (“animal flours and bone powders”), as required by the Ordonnance on Waste Treatment (4/12/2015). The new ordonnance RS916.171 specifies that phosphorus recovery from both sewage and from meat and bone meal must “eliminate pollutants present ... according to state of technology” (that is, BAT) and that, if the recovered phosphorus is used for fertilisers, these must respect the criteria for “**mineral fertilisers from recycling**”. The ordonnance modifies the Swiss fertilisers regulations to define these mineral fertilisers from recycling as those for which “part or all of the nutrients are obtained from municipal waste water treatment,

sewage sludge or sewage sludge incineration ash” (note: animal bone meal is not mentioned here). These mineral fertilisers from recycling must be authorised by OFAG (Swiss Federal Offices for Environment and for Agriculture) and must respect certain contaminant limits: (all as mg/kgP): lead 500, cadmium 25, copper 3000, nickel 500, mercury 2, zinc 10000, arsenic 100, chrome (Cr-total) 1000, aromatic hydrocarbons 25, PCB 0.5 and dioxins/furans 120 ngI-TEQ/tonneP. Certain specifications concerning phosphorus recovery under the Swiss legislation thus remain non defined, in particular what percentage of phosphorus must be recovered.

Swiss Ordonnance on limitation and elimination of waste 4 December 2015 in French www.admin.ch/opc/fr/official-compilation/2015/5699.pdf and in German www.admin.ch/opc/de/official-compilation/2015/5699.pdf - see article. 15 “Wastes rich in phosphorus” and explanation in SCOPE Newsletter n°105 www.phosphorusplatform.eu/scope105

Swiss Ordonnance on Mineral Fertilisers from Recycling (OEng), 31st October 2018 in French

www.blw.admin.ch/blw/fr/home/politik/agrarpolitik/agrarpakete-aktuell/verordnungspaket-2018.html and in German

www.blw.admin.ch/blw/de/home/politik/agrarpolitik/agrarpakete-aktuell/verordnungspaket-2018.html

For information: the German phosphorus recycling ordonnance is here in German www.gesetze-im-internet.de/abfkl_nv_2017/AbfKl%C3%A4rV.pdf

EU Fertilisers Regulation: political agreement signs way to adoption



Under the Austria Presidency, a political agreement was **reached** on 20th November on the EU Fertilisers Regulation (between Council = Member States, European Parliament and the European Commission), after nearly a year of 'trilogue'. This in particular includes the question of cadmium limits, which has been the principle political blockage: the proposed initial cadmium limit of 60 mgCd/kgP₂O₅ will apply three years after entry into force of the new Regulation, and a review will then consider whether or not lower limits should be applied seven years later. Member States will be able to apply lower cadmium limits if they so wish. Final technical wording issues are expected to now be discussed before the end of the year, and the compromise proposal then will go the Member States Ambassadors and the Parliament IMCO Committee and then the Parliament Plenary and Member States Ministers for final approval. Ahead of the final trilogue meeting on 20th

November, the joint letter coordinated by ESPP supporting the Regulation adoption was signed by over 100 companies and other stakeholders, underlining the importance of the EU Fertilisers Regulation to open the European market, remove obstacles and facilitate investment in circular economy nutrient products and recycling technologies.

Fertilizers Europe **welcomed** the Regulation progress as "balanced", considering the short implementation delay for the cadmium limit to be a challenge, welcoming the announced inclusion of industrial by-products and the opening of the CE mark to organic fertilisers and biostimulants, but regretting that the low minimum nutrient levels in the Regulation will not ensure quality products.

Growing Media Europe, despite supporting the objective of opening the European market, **regret** that the new Regulation as currently proposed will exclude nearly all growing media products because of unrealistic Conformity Assessment requirements, and underline that the new Regulation does not include quality standards on agronomic efficiency.

European Parliament press release 20/11/18 "Fertilisers/cadmium: Parliament and Council negotiators reach provisional deal" www.europarl.europa.eu/news/en/press-room/20181119IPR19407/fertilisers-cadmium-parliament-and-council-negotiators-reach-provisional-deal

Fertilizers Europe 20/11/18 "New Fertilizer Regulation – acceptable compromise but challenges remain" www.fertilizerseurope.com/media/news/single/article/press-release-new-fertilizer-regulation-acceptable-compromise-but-challenges-remain

Growing Media Europe, 20/11/18 "New EU Fertilisers Regulation - Missed opportunity for the growing media industry?" www.growing-media.eu/single-post/2018/11/21/NEW-FERTILIZERS-REGULATION---Missed-opportunity-for-the-growing-media-industry

Study shows wide variation of agricultural phosphorus regulation in Europe



Office
International
de l'Eau

A **desk study** by the International Office for Water (OIE) compares agricultural phosphorus (P) regulation in Denmark, Germany, Italy and The Netherlands, concluding that the regulatory framework is strongly heterogeneous. The study is based on only 12 literature sources and interviews of 3 regulators and 3 researchers (total for the four countries studied). In particular, Fien Amery et al. paper "Agricultural phosphorus legislation in Europe" is not cited – see SCOPE Newsletter n° 104 for summary of this study. The OIE desktop study underlines (as did already Amery et al.) that there is no European legislation specifically addressing phosphorus in agriculture. In Denmark, the national Nitrates Directive "derogation" (negotiated with Europe) includes from 2017 national ceilings for phosphorus application, covering all forms of fertiliser or organic materials, and covering the whole country, with stricter limits in phosphorus vulnerable catchments. In The Netherlands, phosphorus application is limited within Nitrates Directive implementation, with a table of 'Application Standards' limiting P input for different crops. In Germany, the fertiliser application ordinance (DüV Düngeverordnung) obliges farm nutrient balances for P, with P surpluses limited to 10 kgP/ha/year from 2018 or zero if the soil already has high P. If soil P is high, P application must also be aligned to plant uptake. In Italy, on the other hand, the OIE study identifies not regulation limiting agricultural P application, other than some regional or local recommendations to farmers.

"Agricultural phosphorus regulation in Europe – Experience-sharing for 4 European countries"; S. Barreau et al., OIE 2018 www.oieau.fr/eaudoc/notice/Agricultural-phosphorus-regulation-Europe-%E2%80%93-Experience-sharing-4-European-countries

Phosphorus recovery by struvite precipitation considered as BAT

ESPP participated at the final EID Forum discussion of the BAT BREF revision for the Food Drink and Milk and feed industries (Best Available Technology, under the IED Directive). The **document**, BAT9 (page 647), specifies that all production sites should use one or more of several possible resource recovery techniques: anaerobic digestion, separation/use/recovery of residues e.g. in animal feed, use of wastewater in agriculture to valorise nutrients and water, struvite recovery. ESPP submitted 18 comments to the final text, of which 16 have been accepted (as submitted, or adjusted). Struvite recovery is now specified as applicable to wastewaters with > 50 mg total-P/l and with a significant flow. Following an ESPP proposal, the BAT9 also now refers to valorisation of digestate (and not only of biogas) from anaerobic digestion. Other modifications brought by ESPP include referring in the process description texts (pages 170-171) to white phosphorus (P₄) as well as phosphate rock as EU Critical Raw Materials, to recovery of phosphorus (P) in forms other than struvite and to clarifications of the struvite process description. The BAT document also describes phosphorus removal techniques, necessary for wastewater treatment, including EBPR (enhanced biological phosphorus removal) and chemical phosphorus removal (using calcium, aluminium or iron precipitants) as well as nitrogen (N) removal techniques. Emission levels to water (BAT-AELs, page 649) are fixed at 2-20 mg/l

total N and 0.2-4 mg/l total P. A proposal by some Member States and stakeholders to increase the authorised levels of total P emissions to 7 mgP/l for some cheese production sites was not agreed. The final draft BAT document, with the agreed modifications, is expected to now be officially published by the European Commission, and will then become applicable to all sites in Europe falling within the defined scope, that is all food, drink, milk or animal feed processing sites with capacity above 200 – 600 tonnes/day input depending on the sector.

“Best Available Techniques (BAT) Reference Document in the Food, Drink and Milk Industries”, final draft October 2018
<http://eippcb.jrc.ec.europa.eu/reference/fdm.html>

Food and drink environmental footprinting



The European food & beverage industry federation, FoodDrink Europe, has published a [summary of experience](#) of European Commission pilot testing of Produce Environmental Footprint Category Rules (PEFCRs) 2013-2017. This falls within the mandate to the Commission in the 2012 Resource Efficiency Roadmap to “establish a common methodological approach to enable Member States and the private sector to assess, display and benchmark the environmental performance of products, services and companies based on a comprehensive assessment of environmental impacts over the life-cycle ('environmental footprint')”. The Commission has [announced](#) the objective to start policy discussion, in the framework of Integrated Product Policy / Sustainable Consumption and Production (IPP/SCP), to implement the PEFCR pilot test conclusions into

EU policies. Half of the PEF tests carried out concerned food or drink products (beer, coffee, dairy, fish, meat, pasta, olive oil, wine, as well as pet food and animal feed). FoodDrink Europe’s report is based on consultation within industry, including participants in the pilot tests. The industry federation’s conclusions underline the need to improve methodology and databases (e.g. harmonised LCAs), concern that PEF is today appropriate for communicating within industry (within company environmental improvement and business to business) but not for consumer communication, issues in defining the ‘benchmark’ for PEF comparisons, need for industry implication in PEF criteria governance, need to define stable PEFCR rules. The European Commission’s own [Review Report](#) of the pilot tests (June 2017) concludes that the PEF process is highly technical and complex, has potential to harmonise LCAs, and also notes that the PEFs are perceived as interesting for communication within business and to feed into GPP (Green Public Purchasing) but with questions about the pertinence for communications to consumers.

“Product environmental footprinting. Experience and recommendations of the food and drink sector” 21/11/2017, FoodDrinkEurope
www.fooddrinkeurope.eu/uploads/publications_documents/FoodDrinkEurope_Product_Environmental_Footprinting.pdf
European Commission Product Environmental Footprint http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm and *footprinting pilots* http://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm

EU consultations

EU consultation open on water policy

A public EU consultation is open to 4th March 2019 “Fitness Check of the Water Framework Directive and the Floods Directive”. You can provide your input via https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-5128184/public-consultation_en

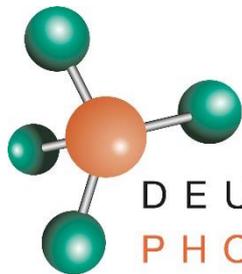
ESPP input on CAP – water and environmental implementation review

ESPP submitted comments to two EU public consultations on Roadmaps for future evaluations of (1) the [second “Environmental Implementation review”](#) and (2) the [impacts of EU farm policy on water](#), both closed on 26th November 2018. ESPP’s input underlined the importance of European Commission compliance enforcement of EU regulation in driving environmental improvement across Europe, for example for municipal wastewater treatment or for the Nitrates Directive, and suggested to widen the environmental implementation review to include pharmaceuticals, microplastics, the Circular Economy and Critical Raw Materials, as well as the Common Agricultural Policy. Concerning the assessment of farm policy on water, ESPP underlined the need to consult stakeholders (such as water basin management organisations), to consider key elements of the new (June 2018) CAP proposals (in particular the FaST = Farm Sustainability Tool for Nutrients) and coherence with CAP impacts on other policy objectives (such as Circular Economy) and impacts on water of Rural Development Funding.

ESPP inputs to EU consultations are published at: www.phosphorusplatform.eu/regulatory
Proposed Evaluation Roadmap “Evaluation of the impact of the CAP on water” https://ec.europa.eu/info/law/better-regulation/initiative/1951/publication/320178/attachment/090166e5beca8f7a_en
EU public consultation on the proposal for “Environmental Implementation Review” https://ec.europa.eu/info/law/better-regulation/initiative/1969/publication/319625/attachment/090166e5bec82559_en
EU Environmental Implementation Review webpage http://ec.europa.eu/environment/eir/index_en.htm and 2017 first report http://ec.europa.eu/environment/eir/country-reports/index2_en.htm

Technologies

Phosphorus recovery fact sheets



DEUTSCHE
PHOSPHOR
PLATTFORM

The German Phosphorus Platform (DPP) has published up-to-date and detailed [fact sheets](#) (each 2-4 pages) presenting fourteen different technologies for phosphorus recovery from municipal sewage. These outline how the process operates, including inputs required and final product; specify the percentage of phosphorus recovery claimed; indicate the size of tested pilot or operational installations; provide contact details for technology supplier; and in some cases indicate estimated costs and other constraints (personnel, installation) and process advantages. Technologies covered are: struvite precipitation (Ostara Pearl, AirPrex, MSE-Mobile Schlammwässerung), EasyMining Ash2Phos, AshDec, EuPhoRe, Budenheim Extraphos, KRN-Mephrec, Parforce, P-bac Fritzmeier (producing iron aluminium phosphate), P-RoC Karlsruhe (calcium silicate hydrate

precipitation), Pyreg (biochar), Stuttgart process, TerraNova.

German Phosphorus Platform DPP phosphorus recovery technology fact sheets (in German) www.deutsche-phosphorplattform.de/information/dokumente (left side: click on 'Kennblätter')

Innovation and success stories

ExtraPhos process with cement valorisation conform to German P-recovery obligation

An article in the German waste industry professional magazine '[Müll und Abfall](#)' summarises the requirements of the new German phosphorus (P) recycling obligation. Germany produces around 1.8 million tonnes (dry matter) sewage sludge per year. The new regulation will require phosphorus recovery from all sewage works > 50 000 p.e. (after 15 years), that is c. 61% of German sewage. Smaller sewage works can continue to valorise sewage biosolids to farmland, under conditions of sludge quality and spreading specifications. Budenheim's ExtraPhos process is presented, underlining that it is compatible with both respect of the legal P-recovery obligations and continuing thermal valorisation of the sewage sludge (after P-recovery) in cement production (without requiring sewage sludge mono-incineration installations). Phosphorus recovery will also improve the value of the sludge for the cement kilns, because phosphorus impacts cement setting time and strength, and has to be counteracted by increased lime levels. The ExtraPhos process (see SCOPE Newsletter [n°95](#)) uses carbon dioxide (10 bars) to adjust pH to 5 - 6 and dissolve phosphorus, which is then precipitated using lime to produce DCP (di calcium phosphate, fertiliser). A mobile pilot unit (1-2 m³/h) is currently under testing since April 2018 at Itzehoe municipal sewage works, near Hamburg (treating anaerobically digested sludge at a sewage works which uses a combination of chemical and biological phosphorus removal) and has also been tested at Mainz sewage works from May 2017 to March 2018. The article suggests that widespread application of the ExtraPhos process and sewage sludge valorisation in cement production (1 Mt_{DM}/y) could economise 10% of cement clinker combustion energy.

"Phosphate recycling and co-incineration of sewage sludge in cement clinker production", E. Schmidl, *Müll und Abfall* 50, July 2018
www.muellundabfall.de

Vermont "Phosphorus Innovation Challenge" finalists named

The State of Vermont has [announced](#) the finalists for its challenge for innovative systems for phosphorus (P) recovery from agricultural and wastewater discharges. The Challenge was launched in April 2018, and 27 submissions were received to stage 1. From these, six finalists have been selected and will receive funding (US\$ 250 000 in total, divided between finalists according to needs and co-funding) to build and test (within four months) a demonstration prototype and propose a business model. Final winners will be invited to build a full-scale unit before end 2019. The six selected finalists are:

- DVO (see ESPP eNews [n°12](#)) and University of Vermont: production of a high-phosphorus solid "cake" from 13 anaerobic digesters in Vermont, for national resale as a fertiliser product
- Rock Dust Local: production of biochar and testing for field application, animal bedding and as a filtration media
- Green State Biochar: production of biochar from organic wastes, for use as a soil improver
- Agrilab Technologies: combination of existing P-recovery technologies and testing of approaches to add value to a "phosphorus cake"
- Digested Organics: use of ultrafiltration to process dairy manure to purified water which can be used on fields and a concentrated nutrient solution (concentrate) which can be transported as a fertiliser
- UVM and Village of Essex Junction: adaptation of pipe descaling technology using varying electrical fields to precipitate struvite in wastewater treatment plants, followed by recovery in an electric-filtration cell

"Vermont's Phosphorus Innovation Challenge progresses to Stage Two", October 2018, Vermont Agency of Agriculture, Food and Markets:
<http://agriculture.vermont.gov/VPICSTAGE2>

Newfert BBI-JU project final meeting



Ludwig Hermann, ESPP President and Proman, opened the meeting with an overview underlining the criticality of phosphorus (P) as a non-renewable material and the need for a paradigm shift to move away from society's current economic growth model based on increasing consumption of raw materials. **Tiffanie Stefani, Fertilizers Europe**, explained that the mineral industry is

strongly engaged in the Circular Economy through industrial symbiosis, with use of by-products central to production. She underlined that Fertilizers Europe wants the EU Fertilisers Regulation to be finalised and implemented, to reduce barriers to recycling of nutrients, under the condition that products offer reliably plant available nutrients, quality and safety (low contaminant levels). The European fertiliser industry has experience and competence in recycling and in supporting improved fertiliser use by farmers, and is open to partnerships with waste companies to develop quality nutrient recycling. **Chris Thornton, ESPP** (European Sustainable Phosphorus Platform), emphasised the importance of EU water protection legislation in pushing towards sustainable phosphorus management (Nitrates Directive, Urban Waste Water Treatment Directive, Water Framework – this latter is currently [open to public consultation until 4 March 2019](#)) and of the Common Agricultural Policy ([currently](#) in political decision phase). The proposed EU Fertilisers Regulation will also be very important in opening the market for both recycling technologies and recycled nutrient products: but there may be a risk that this is blocked by failure of Parliament and Council to reach agreement in triologue.

Javier Branas, Fertiberia, emphasised that Europe is very strongly dependent on imports of nutrients for its fertilisers and food production: natural gas (for nitrogen fertiliser), potassium and phosphorus. The **Newfert project** www.newfert.org has worked to define the conditions under which biowastes can be recycled within the mineral fertiliser industry: quality (nutrient concentration and availability), safety, stability, availability and logistics, suitability for processing and economic conditions. 50 samples of very different types of biowaste were analysed, showing that <30% were suitable for introduction into mineral fertilisers; in particular nutrients in many ashes are not plant available. Two processes have been developed: DMPHOS (laboratory scale) sulphuric acid dissolution of ashes, neutralisation and filter-press recovery of mono- and di-calcium phosphate; and a biological process to solubilise phosphorus in pig manure (bio-acidification) followed by P-recovery as struvite. Production of complex (NPK) fertilisers has been made successfully with more than 15% of nutrients from bio-waste recycling.

Fernando Gonzalez-Andrés, Universidad de León, summarised the assessment, carried out as part of the Newfert project, of nine complex (NPK) fertiliser products containing phosphorus derived from secondary nutrient sources produced in industrial testing by Fertiberia. The nine products included up to 30% of phosphorus content from different recycled materials including struvites and materials derived from different ashes. Greenhouse pot trials with barley and maize showed that these secondary-derived products gave plant growth results not significantly different from commercial mineral fertilisers after 90 days (with two soils, pH 5.9 and pH 7.8) In a few cases, there were small significant yield differences after 60 days. There were no significant differences in soil metabolism or soil microbiology. Fertiberia concludes that significant partial substitution of secondary raw materials in their production process does not impact final product agronomic performance.

Marie-Line Daumer, IRSTEA Rennes, France, presented of work within Newfert on biological acidification of pig manure to increase phosphorus solubility and so enable phosphorus recovery as struvite. Different local agricultural by-products already used as co-substrates for the anaerobic digestion plants were tested as sources of VFA (volatile fatty acid) for the bio-acidification. This was trialed full scale in a specific reactor with c. 24h residence time in different configurations in the manure anaerobic digestion system treating slurry from a 285 sows pig farm producing 7000 pigs/year, Guernequay, Brittany. Addition of 10% (by mass) of animal feed crop waste enabled to recover 65% of the total phosphorus (of the P in the manure and co-substrates) i.e. nearly twice the pig manure P content as struvite. Biogas production was not changed or was even slightly increased due to acidic hydrolysis of the substrates during the bio-acidification step. The mineral struvite based product was tested and showed to be an interesting secondary raw material technically for fertiliser production by Fertiberia.

Ute Bauermeister, GNS Germany, presented the company's experience operating nitrogen (N) recovery from biogas plants (anaerobic digesters). The FiberPlus BENAS biogas plant, near Bremen, Germany, treats 160 ton/day maize, 75 t/d chicken manure and 50 t/d other crops. An ammonia stripping installation uses specific technologies to avoid the problems caused by foaming (contamination of the gas), viscosity and fibre content, enabling recovery of 200 tN/y of nitrogen as 5% ammonium sulphate, authorised as a fertiliser in Germany and valuable for foliar application (no burning nor crystallisation). Around 40-60% of total plant input N flow is recovered. Ammonium stripping also improves biogas yield and allows recovery of ammonia-free fibres from the solid fraction of the digestate. These have been successfully tested in fibreboard and paper production. Total economic net benefit of the ammonia stripping is estimated at 13€/ton of digestate (at this site). The site is one of the [SYSTEMIC](#) demonstration sites.

Ana Ruiz, Bio-Based Industries Joint Undertaking BBI-JU (Private Public Partnership within Horizon 2020) underlined that the BBI JU Newfert project has achieved its objectives by contributing to build up a breakthrough concept for the fertiliser industry. NewFert has set out the basis to establish a new bio-based value chain based on nutrient recovery from bio-based waste to manufacture NPK fertilisers. Furthering engagement together of industry and research has been as well part of the achievements of this project.

The afternoon was organised in **round tables to discuss societal trends relevant to phosphorus recycling, legislative drivers, obstacles and economic aspects**. Conclusions are that nutrient recycling will continue in coming years to be driven by regional nutrient surpluses and implementation of regulations limiting nutrient discharge to the environment (water protection policy = eutrophication and limitations of ammonia emissions to air = National Ceilings Directive), by the tendency towards more sustainable farming systems, concerns about criticality of phosphorus. Public confidence in quality and safety of recycled products is essential. The proposed new EU Fertiliser Regulation is seen as important to remove barriers, by clarifying End-of-Waste status. Economics of nutrient recycling can be improved by cooperation (to facilitate upscaling), cross-compliance obligations in EU agriculture funding (CAP) and new financial instruments to cover innovation risks and facilitate long-term recycling contracts. Financial support tools such as “nutrient credits” or “recycling support tariffs” should be tested. In the long term a restructuring of farming and the food industry and distribution, and food prices sufficient to cover environmentally sensitive farming, will be necessary.

Newfert (nutrient recovery from bio-based waste for fertiliser production) final project meeting, Brussels, 30th October 2018 www.newfert.org

Questions around sewage biosolids

Pharmaceuticals elimination and struvite recovery from sewage

The LIFE project [LIWE](#) (Lidköping Innovation Wastewater Eco-Hub) will test full-scale ozonation to eliminate pharmaceuticals and full-scale phosphorus recovery as struvite at the Ången municipal waste water treatment plant (61 000 p.e.). The plant will operate biological phosphorus removal and chemical post-precipitation (down to a discharge consent of 0.2 mg P/l yearly average, with an operating target of 0.1 mg P/L) and anaerobic digestion of the sewage sludge (producing 1000 MWh/year of renewable electricity). In order to improve water quality in the receiving waters (river Lidån and lake Vänern) pharmaceuticals will be eliminated by ozonation and micro-plastics will be removed by disk filter. Within sludge treatment the objective is to recover at least 30% of inflow phosphorus as struvite (55 ton struvite/year), which can be used as a phosphorus fertiliser. The struvite precipitation is planned to be installed on a centrate from (i) bio acidification and (ii) anaerobic digestion, after dewatering using a (i) belt thickener and (ii) screw extruder. The sewage biosolids, after anaerobic digestion, are currently planned to be used in agriculture.

LIWE LIFE (2018-2023) is a project by Lidköping municipality, Lund University, the Federation of Swedish Farmers (LRF) and Berlin Centre of Competence for Water (KWB) www.kompetenz-wasser.de/en/project/lidkoeping-innovation-wastewater-eco-hub-liwe and <https://blogg.lidkopings.se/angensarv>

Comparative LCAs for mineral fertilisers, recycling, sewage sludge

Fabian Kraus, Kompetenzzentrum Wasser Berlin, led a half-day [workshop](#) to discuss Life Cycle Analysis of mineral phosphate fertilisers (based on the German market situation) and of different phosphorus (P) recycling processes: different struvite precipitation systems in sewage works, use of sewage sludge incineration ash in the Ecophos or TetraPhos processes to recover phosphoric acid, use of this ash in the fertiliser industry or thermochemical treatment of this ash in the AshDec processes. This work is carried out within [Phorwärts](#) project.

Energy and greenhouse gas emissions (E/GHG)

Most mineral fertilisers sold in Germany are ‘complex’ fertilisers, with more than half being DAP (di ammonium phosphate). For this product, the phosphate part is a relatively **small contributor to energy use and potential greenhouse gas emissions (E/GHG)**, compared to the nitrogen (N) component. Most production is via phosphoric acid, produced using sulphuric acid. The largest factor in the E/GHG calculation for the phosphate component is the sulphur used to produce sulphuric acid, but the allocation of E/GHG to sulphur must be decided. Sulphur is a by-product from industrial processes, e.g. it must be removed from fuels in oil refineries and in this case must be decided whether or not to allocate part of the refinery energy consumption to sulphur production. Also, energy is produced when sulphur is burnt to produce sulphuric acid: in some circumstances this energy can be valorised in energy production (e.g. OCP El Jadida, see SCOPE Newsletter [n°86](#)) so could be counted negatively against fertiliser production E/GHG, but in other cases the energy is consumed in the fertiliser factory for phosphoric acid concentration. The E/GHG conclusions of the LCA for phosphate mineral fertilisers thus depend mainly on the LCA boundary and allocation choices made, and especially on the LCA allocation choices made for sulphur and sulphuric acid.

Other environmental impacts and risk assessment

The LCA suggests that, if included in the LCA boundaries, the most significant potential impacts of mineral phosphate fertilisers are in the use phase, with **fertiliser use estimated to contribute 19% of total freshwater eutrophication** in Germany (applicable to both phosphate rock based and recycled fertilisers) and to contribute **0-12% of total toxicity because of cadmium** in mineral phosphate fertilisers (2% based on the average of phosphate rock as currently used in fertilisers in Germany, and assuming no decadmiation, percentage of total toxic substance release due to human activities and natural toxins). Risk assessment suggests that the toxicity risk to human health is however “acceptable”. The levels of uranium present in phosphate fertilisers are less relevant. The LCA study considers two decadmiation technology routes: calcination of phosphate rock, and solvent extraction of phosphoric acid. The additional E/GHG impact of decadmiation of fertilisers would be “moderate” compared to current fertiliser production and negligible compared to total human emissions, whereas the reduction of human toxicity potential would be significant. LCA’s of the considered P recycling routes suggest that struvite recovery is advantageous, in particular because of reductions in sewage sludge production, but this route is only applicable in EBPR

(biological phosphorus removal process sewage works). The processes for phosphorus recovery from sewage sludge incineration ash show comparable net E/GHG emissions to mineral fertiliser production. Risk assessment of the considered P recovery routes and also for application of sewage biosolids or sewage sludge ash to crops was carried out. This concluded that **environmental or toxicity risks from organic contaminants or pharmaceuticals in sewage biosolids are acceptable or negligible**. For soil organisms, only zinc posed possible risks (for both sewage sludge and ash): although zinc is a micro-nutrient it should be managed appropriately. The most sensitive endpoint appeared to be groundwater, with risks for copper and zinc from sewage biosolids and ash, and for cadmium in phosphate-rock based mineral fertilisers.

German P recovery legislation and a move to mono-incineration?

The German P recovery legislation will in effect mean that (for all sewage works > 50 000 p.e.) P recovery from sewage sludge incineration ash will be required unless P concentrations in sewage sludge are reduced to 20gP/kgDM (dry matter) or by 50%. This dry matter threshold is more difficult to achieve if organic carbon removal is increased in the sewage works, in particular by anaerobic digestion of sludge. Struvite recovery, combined with some sludge digestion process to solubilise phosphorus, may achieve this but is only applicable in biological P removal sewage works (EBPR). Other processes may be developed enabling recovery of sufficient phosphorus from sludge, but if not then Germany will have to invest around 1 billion € in new mono-incineration logistics and incinerators (incineration of sewage sludge on its own, not with lignite, municipal waste or other low phosphorus materials), at a cost of 2 to 4 €/person/year and resulting in a 0.2% increase in Germany's total energy consumption. **Development and demonstration of other processes to recover phosphorus from sewage sludge, including where iron or aluminium salts are used for phosphorus removal, is therefore an important research and technology development objective.**

N₂O emissions from sludge mono-incineration:

The assessment further concludes that 70-90 % of the direct greenhouse gas impacts of mono-incineration (status-quo in Germany: around 150-200 mg N₂O/Nm³ or 1 g N₂O/kg DM) can be avoided by installation of N₂O abatement technologies in the incinerators (example Zurich: around 10 mg N₂O/Nm³ or 50 mg N₂O/kg DM).

PHORWÄRTS Dissemination Event "Comparative Life-Cycle Assessment of phosphate recovery from wastewater path and phosphate rock based fertilizer production" 29 October 2018 www.kompetenz-wasser.de/en/event/phorwaerts-informationsveranstaltung-und-newfert-abschlussworkshop

PHORWÄRTS project www.kompetenz-wasser.de/de/project/phorwaerts

Greenhouse emissions from different sewage sludge valorisation routes

A Canada [study](#) evaluates greenhouse gas emissions from sewage sludge processing and end use, and provides a tool enabling waste water treatment operators to enter configuration and data from their process to calculate CO₂ equivalents/year. The assessment covers thickening and dewatering (polymer use, belt press or centrifuge), storage lagoons, thermal drying, aerobic digestion, anaerobic digestion (assuming use of generated biogas for electricity production), liming, composting, landfill, combustion and land application. For combustion, the model is based on theoretical values of calorific value and water content, and IPCC default values for methane and N₂O emissions (see the F. Klaus, Phorwärt study above concerning the significance of these emissions). For land application, N₂O emissions are taken to be 1% of applied nitrogen (IPCC default value for mineral fertilisers: a conservative value as literature suggests that emissions are probably lower for biosolids) and offsets for nitrogen and phosphorus content (estimated values of 4 and 2 kgeCO₂ for N and P respectively) and for carbon sequestration (increases in soil carbon resulting from sewage biosolids application, based on literature). The assessment concludes that optimised dewatering & incineration results in higher greenhouse emissions than optimised anaerobic digestion & land application (net emissions -34 vs -4 teCO₂/100t biosolids dry matter), because of offsets for fertiliser value and carbon sequestration (23 and 25 teCO₂ respectively).

"Calculator Tool for Determining Greenhouse Gas Emissions for Biosolids Processing and End Use", S. Brown et al., *Environ. Sci. Technol.*, 2010, 44 (24), pp 9509–9515 <http://dx.doi.org/10.1021/es101210k>

UBA report: antibiotics and resistance in sewage sludge and manure



A [report](#) by UBA (the German Federal Environment Agency) summarises challenges and available information (nearly 80 studies cited), and proposes actions, on antibiotics and antibiotic resistance (ABR) in the environment. Routes to the environment considered are: treated wastewater, livestock housing air, sewage sludge and manure/slurry application. The report cites one study suggesting that ABR introduced into soil can remain present for several months (Pietsch 2015), that sewage sludge spreading can lead to ARG (antibiotic resistance genes) in soils which persist over time, and that veterinary antibiotics in manures can reach lower soil levels, accumulate and reach groundwater. Twenty-eight options for action are proposed with, in addition to upstream actions to reduce pharmaceutical use and

losses and actions to improve removal at wastewater treatment plants, include banning the use of sewage sludge in agriculture and reducing the use of manure/slurry by "needs-based fertilisation" and nutrient testing of both soil and manure.

"Antibiotics and antibiotic resistances in the environment. Background, challenges and options for action", Umwelt Bundesamt (German Environment Agency), October 2018, 40 pages

www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/181101_uba_hg_antibiotika_engl_bf_low.pdf

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