Events

CRU Phosphates 2020

Registration is now open for the 13th CRU Phosphates Conference, 8-10 March 2020 Paris. This is the world's leading phosphate industry meeting, with over 400 industry participants from 40 countries expected, covering supply, market trends and industry processes and technologies for phosphate rock, fertilisers, animal feed and industrial phosphorus applications. The conference includes outlook presentations by executives of the world's leading phosphates companies; supply, demand and market trends; new phosphate processing technologies and operating experience. See summary of the 12th CRU Phosphates Conference (Florida, 2019) in ESPP eNews n°33. 10% registration fee discount for ESPP members.

CRU Phosphates 2020, 8-10 March Paris - https://events.crugroup.com/phosphates

European Sustainable Phosphorus Conference (ESPC4)

Registration is now open (on Eventbrite) for the 4th European Sustainable Phosphorus Conference, Vienna, 15-17 June 2020. This 4th ESPC will centre in plenary on business models, company success stories and city and regional actions towards nutrient circularity. Parallel sessions will mix research with application (see below, call for papers). The third day (17th June) will be the 4th European phosphorus R&D day, showcasing R&D into phosphorus recycling and recycled products and new approaches.

Registration: Eventbrite
Full details www.phosphorusplatform.eu/espc4

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

Calls for papers

Call for papers ESPC4

The **call for abstracts and posters is now open (closes 31/12/2019)** for the 4th European Sustainable Phosphorus Conference, Vienna, 15-17 June 2020. Abstracts are invited for presentations at the six parallel sessions, for plenary success story mini-presentations, for posters or for stands. The parallel session themes are: economy (of phosphorus sustainability and nutrient recycling), enhanced efficiency fertilisers, sustainable phosphorus removal from waste streams, R&D cooperation and platforms, taking R&D developments through to the market and phosphorus sustainability perspectives. Proposed success story mini-presentations (3 minutes, plenary) should present your company, local authority (city, region …) or stakeholder successes in implementing phosphorus recycling or phosphorus management. Posters and stands can address any subject related to nutrient sustainability.

Full details www.phosphorusplatform.eu/espc4

Call for texts: phosphorus stewardship and climate change

ESPP (European Sustainable Phosphorus Platform) and the Sustainable Phosphorus Alliance (North America) are preparing a special SCOPE Newsletter edition on "Nutrients and Climate Change". This will consist of selected short texts presenting expert perspectives on how climate change will impact nutrient emissions and eutrophication as well as actions to mitigate this. Proposed texts are invited from researchers, companies, stakeholders and any interested party. Around twenty texts will be selected for publication by an editorial committee chaired by Jessica Stubenrauch, Beatrice Garske (FNK Leipzig & University of Rostock), Anders Nättorp (FHNW Switzerland) and Jim Elser (University of Montana). The SCOPE Newsletter is circulated worldwide to 41 000 companies, stakeholders, regulators and media interested in nutrient management, with a detected opening rate of 12-14%, and is published on the ESPP website www.phosphorusplatform.eu **Submit your text to be included!**

Send us your ideas for action for on nutrients and climate change to appear with the world's leading experts.
Maximum 600 words. Deadline 31.01.2020 latest.
Call details and instructions here: https://phosphorusplatform.eu/callfortexts

Nitrogen regulations and "SafeManure"

Draft EU criteria for recycled manure products (Nitrates Directive)

The European Commission (JRC) has **circulated for comment** (**deadline 16 December**) first DRAFT proposed criteria for recycled manure products ("RENURE" – "Safemanure"). The criteria would define when nitrogen-containing recycled nutrient materials, recovered from manure, would NOT be treated as manure in Nitrates Directive Vulnerable Zones (that is, NOT subject to lower nitrogen application limits than for synthetic fertilisers).

NOTE: this concerns the Nitrates Directive implementation (art. 2g), and is not related to the implementation of the EU Fertilising Products Directive, nor to the STRUBIAS discussions.

The main proposed RENURE criterion is that **either total organic carbon/total nitrogen ≤ 300% or mineral-N/total-N ratio ≥ 90%.** This criterion is based on sample testing and biogeochemical modelling of five different materials recovered from manure: scrubbing salts, "mineral concentrate", liquid digestate, pelletised liquid digestate, pelletised solid digestate. ESPP raises questions about this criterion because it seems that a mixture of 90% raw manure + 10% urea would pass (whereas such a material, which is essentially "manure", should be excluded, as is specified page 91).

The modelling suggests that use of the solid-fraction digestate products (which pass the proposed criterion) would lead in the long term to a reduction of 14-18% in crop NUE (nitrogen use efficiency), and so to probably a comparable level of increase in nitrogen soil leaching. The liquid fraction digestate as modelled also gives a lower NUE (and higher leaching), but not statistically significant.

ESPP regrets that other recycled materials from manure, for which full-scale recovery processes are today operational, are not included in this modelling (e.g. manure-recovered struvite, manure biochar), even if the nitrogen component of these is low.

There are also questions concerning analysis for the N-mineral criterion. Analysis may not be feasibly applicable to many recovered materials, because the analysis methods indicated (page 92: EN ISO 11732:2005, EN ISO 13395:1996, ISO/CD 23696 and ISO 10695:2000) are applicable to solutions in water, whereas the nitrogen in recovered materials may not be water soluble (e.g. struvite, solid materials containing organic nitrogen). Indeed, the JRC report notes (page 93) that "DG GROW has also requested the European Standardisation to develop a method for the determination of the organic N content." The proposed criterion may thus, for many materials, rely on development of a future test method which today does not exist.

ESPP proposed in 2017, after consultation of experts and stakeholders, a simpler criterion: organic carbon (TOC) < 1% of dry matter. This TOC criterion is now validated by co-decision of Parliament and Council in the EU Fertilising Products Regulation (2019/1009) as the definition of a "Mineral Fertiliser". ESPP regrets that this criterion has not been tested in JRC's modelling.

The JRC report notes the significant presence of pharmaceuticals in manure and in processed manure products (such as digestates), e.g. tetracyclines, sulphonamides and fluoroquinolones at 0.01 to 23 mg/kg wet weight in manure in the EU

(Spielmeyer 2018 is cited). JRC note (conclusions, page 3) that fixing limit values for veterinary drugs would have the benefit of inciting their removal in manure processing, but nonetheless conclude that fixing limits would not be appropriate, given the absence of evidence of risks to soil, plants or health.

The only contaminant limits proposed by JRC are: copper 300 mg/kgDM, mercury 1 mg/kgDM and zinc 800 mg/kgDM. This limit for mercury is the same as in the EU Fertilising Products Regulation FPR (for both organic and mineral fertilisers). For copper and zinc, however the proposed limits are lower than in the FPR (for mineral fertilisers, 800 and 1500 mg/kgDM Cu and Zn). ESPP notes that such differences in limits between regulations are liable to create market confusion. We suggest instead to specify that RENURE products must be certified under either applicable national or EU fertiliser regulations (so used by farmers under "Product" status and not "Waste" status). Use of RENURE products, under the Nitrates Directive, is more restrictive than general fertiliser regulation, so it could maybe be assumed that regulatory contaminant limits applicable to all fertilisers are adequate.

ESPP welcomes that the JRC report underlines the need for specific regional application and storage guidance for farmers, under Nitrates Directive Vulnerable Zone Management Plans, including addressing losses to air (page 4). This should include appropriate management of the phosphorus content of the RENURE product.

ESPP further notes that the JRC report does not address the important question of Nitrates Directive classification of products for which manure is only a small proportion of input material. At present, there is ambiguity: when a small amount of manure is taken in by an anaerobic digester then the whole output digestate may be classified as "processed manure" (and subject to Nitrates Directive limitations).

Comments are invited by JRC on the Safemanure interim draft report until 18 December. **Comments can be submitted ONLY using the JRC excel form** circulated to stakeholders. ESPP will be submitting comments. If you have comments, we can transmit them to JRC, **if you send to us by 12 December latest**, clearly specifying for each comment the relevant page and line number in the JRC report.

SAFEMANURE draft report "Developing criteria for safe use of processed manure in Nitrates Vulnerable Zones above the threshold established by the Nitrates Directive" (Interim Report), European Commission - Joint Research Centre (JRC), D. Huygens et al., September 2019. Online here: http://www.phosphorusplatform.eu/regulatory

Emission Ceilings Directive: ammonia

The European Commission has published its 2019 (for 2017) report on the National Emissions Ceilings Directive (NEC), which covers five emissions (nitrogen oxides, ammonia, sulphur dioxide, non-methane volatile organic compounds NMVOCs and fine particulates $PM_{2.5}$) and implements the EU's commitment to the Gothenburg Protocol to the UNECE Long-Range Transboundary Air Pollution Convention (LRTAP). Ammonia emissions are largely related to livestock and manure management, and so actions taken to address these emissions strongly impact phosphorus reuse. Six Member States exceeded their ammonia emissions ceilings in 2017: Austria, Croatia, Germany, Ireland, The Netherlands and Spain. In total, the EU was below its ammonia emissions target, but to achieve the 2030 reduction commitment will require a total 16% reduction.

"NEC Directive reporting status 2019", European Environment Agency (EEA), 28th June 2019

Germany tightens regulations on manure and fertiliser use

Following the European Court of Justice ruling in 2018 that Germany had not respected the EU Nitrates Directive (see ESPP eNews n°24), Germany already issued a tightened Fertiliser Ordinance in 2017 (not considered in the 2018 judgement), and has now submitted proposals to Brussels to further tighten regulations on fertiliser and manure use. Proposed changes include: longer non-fertilisation periods for grassland, increased distance from surface water, tighter limits for use on slopes or on frozen ground and actions to reduce phosphorus losses to water bodies, including a complete ban on phosphorus fertilization from 1st December to 15th January.

Germany has also published its National Air Pollution Control Programme, aiming to reduce atmospheric emissions, including of ammonia (see above, NEC Directive). This specifies that by 2025 liquid fertilising products must be injected and/or acidified (this presumably concerns manure, but also digestates, etc.). This alone represents over ¼ of the ammonia emissions reduction objective defined by the law

Nitrates Directive information thanks to Jana at the German Phosphorus Platform DPP
"Nationales Luftreinhalteprogramm des Bundesrepublik Deutschland" (German national air pollution control programme), 22nd May 2019

Netherlands crisis package to cut nitrogen emissions

Following the national High Court decision cancelling of part of The Netherlands nitrogen policy (ESPP eNews n°35) in May this year, the government has announced an emergency package of emission reduction measures. The High Court decision has blocked some 18 000 construction projects, including roads, airport extensions, wind farms and housing. The Dutch research institute EIB is reported to estimate that construction output will fall by 8%, losing tens of thousands of jobs, by 2021. The emergency package includes reducing national road speed limits to 100 km/h and cutting the protein levels in animal feeds.

"Netherlands cuts speed limit to reduce nitrogen pollution" Reuters 13/11/2019

Digestate and compost

Characteristics of digestate in Austria

A study assesses literature data on some 564 samples of digestate from Austria, from 132 digesters taking agricultural crops or by-products and 27 plants taking wastes (food wastes, manure). These plants are estimated to take around 1 Mt/y ww (wet weight) input, producing 750 000 tww/y of digestate (more than might be expected, because some digesters add rainwater from buildings and silos into the digester). This is around half of the total estimated digestate production for Austria of 1.5 Mtww/y. The digestate showed an average dry matter content of around 8%. The authors note that nutrient content of many of the analysed digestates is too low for classification as "organic fertilisers" under Austrian regulation or under the new EU Fertilising Products Regulation: this is to be expected for the crop material digestates which make up most of the sample. A small number of digestates did show adequate nutrient content (e.g. phosphorus), possibly corresponding to digestates from manures. The contaminant and pathogen levels in the digestates are generally conform to both Austrian and EU Fertilising Product Regulation (FPR) requirements. The authors conclude that digestates cannot general be eligible for fertiliser PFC1 under the FPR, but are generally eligible for PFCs: organic soil improver, growing media, non-microbial biostimulant. *ESPP suggests that these conclusions are misleading: firstly, this is possibly not applicable to manure digestates (higher nutrient contents) and secondly low-nutrient digestates (CMC3 or CMC4) can be PFC1 under the EU FPR, by adding nutrients (e.g. mineral nutrients CMC1). On the other hand, demonstrating that a digestate is a biostimulant may be challenging.* Also, the authors conclude that it is important to establish legal End-of-Waste criteria for digestate. *ESPP reminds that the achievement of FPR CE-Mark status (eligible digestate CMC, PFC criteria, labelling, conformity assessment) establishes European End-of-Waste status, and a regulatory process exists for site permitting of use of digestate from waste as fertiliser in Austria (described in the paper).*

"Legal requirements for digestate as fertilizer in Austria and the European Union compared to actual technical parameters", B. Stürmer et al., Journal of Environmental Management 253 (2020) 109756 DOI: 10.1016/j.jenvman.2019.109756

European Compost Network promotes soil organic carbon

ECN (European Compost Network) and ISWA (International Solid Waste Association) have launched a "Manifesto: Save Organics in Soil". The document underlines the importance of soil as a carbon sink, for supporting food production and other ecosystem services including biodiversity and nutrient and water cycle regulation. ECN indicate that Europe is, after Indonesia, the world's biggest emitter of CO_2 through soil organic carbon degradation, and that Europe is losing some 100 000 ha/y of land to urban sprawl and infrastructures. The EU currently has no policy goals nor coherent policy to reduce soil erosion, increase soil organic matter or reduce soil contamination, although there are elements of policy in e.g. the CAP (agriculture), waste, water and chemicals policies. ECN suggests that EU policy should protect existing carbon-rich soils (e.g. permanent grassland, wetlands), minimise organic carbon losses in all soils, develop the return of stabilised organic carbon to soils (e.g. composts and digestates) and encourage nutrient recycling. See also "Seven ways to save our soils", The Soil Association UK, in SCOPE Newsletter n°120.

"Manifesto: save organics in soils", ECN, 2019
https://www.compostnetwork.info/s-o-s-soil-initiative-sign-online/

Ongoing discussion of "compostable" plastics

The presence of plastic fragments in composts or digestates can be a significant obstacle to nutrient and organic carbon recycling to soil. A problem being examined by the European Commission is how to regulate this appropriately, in order to ensure possible use of appropriately decomposable plastics only when they do bring benefits (e.g. biowaste bags have been shown to increase food waste separate collection rates and to reduce contamination), but avoid the introduction into composting or digestion of plastics which will not be effectively decomposed in the process.

A proposal for decision criteria for defining actions, prepared by consultants EUNOMIA for DG Environment, was presented to a stakeholder meeting on 22nd October 2019. The consultants proposed priority "1" criteria for "the beneficial use of compostable plastic". Some of these priority criteria concern local waste management conditions: effective waste sorting and treatment in place. Some concern the plastic's uses: plastic contaminated with food waste (clean plastics should be recycled) or not adapted to recycling or reuse. Other priority criteria concern the plastic product itself: it should not combine compostable and non-compostable plastics, its waste sorting route should be clearly identifiable by the consumer, the term "biodegradable" should not be used, the product should meet EN standards. The consultants note that "compostable" criteria should address both the polymer and also additives in the plastic. ESPP notes that the quality of waste sorting and treatment cannot be guaranteed in all regions, and that it could therefore be argued that plastics should only labelled as "compostable" if they are fully decomposed in industrial composting conditions, in all widely used anaerobic digester conditions, and in household composting, but that they should also be biodegradable in the environment (soil, sediments). This study is ongoing.

ESPP also notes that there is often confusion between "compostable" or "biodegradable" and "biosourced": in fact, bio-sourced polymers can be either biodegradable or not, and similarly for petro-sourced polymers. Biodegradable and compostable should mean chemical decomposition (to CO_2), not disintegration into smaller plastic particles.

Outline of ongoing DG Environment study on 'Relevance of biodegradable and compostable consumer plastic products and packaging in a circular economy' here

Platforms and networking

Proposals for Canada Nutrient Recovery and Reuse Framework

A report by IISD (International Institute for Sustainable Development) proposes a Nutrient Recovery and Reuse (NRR) Framework for Canada and a Phosphorus Recovery and Reuse action plan. The report is based on outputs of the stakeholder Forum 8th march 2018 (80 participants). Existing initiatives identified include a fertiliser produced from sewage biosolids approved by the Canadian Food Inspection Agency (municipalities of Guelph, Saint Thomas, Elora in Ontario), Quebec policy banning incineration and disposal of organics to landfill by 2022 accompanied by 560 MCAD subsidy support for waste valorisation such as composting and anaerobic digestion, Lake Winnipeg Bioeconomy Project demonstration of non-point nutrient recycling through biomass harvesting, Lake Erie Action Plan incitement of phosphorus recycling technologies, neighbourhood manure management partnerships (Ontario), Canada strategic fertiliser project (mapping supply, demand and defining responsibilities for recycling). The NRR Framework proposed has the following pillars: information (e.g. phosphorus flow data, social costs), defining strategy, research coordination, establishing a Canadian Nutrient Network, supporting technologies and BMP (best management practices), market and funding mechanisms (including economic incentive policies).

IISD "Nutrient Recovery and Reuse in Canada: Foundations for a national framework" 2018, 94 pages, funded by Ontario State, Everglades Foundation and Climate Change Canada

Scientific opinion: training for nutrient sustainability

A short opinion signed by some 40 scientists outlines why training should be put in place to for sustainability professionals to work with science, industry and governments, to equip them with the expertise necessary to develop and implement nutrient sustainability programmes, linking phosphorus, nitrogen and carbon. The scientists underline the need to incorporate resource planning across national and regional regulatory frameworks, in particular targeting the circular economy and phosphorus recovery. They consider that with the Critical Raw Materials policy, the EU can provide leadership. The scientists call to establish a coordinated programme to train, monitor and mobilise professionals in nutrient sustainability, underlining the importance of networks and of industrial internships.

"New Training to Meet the Global Phosphorus Challenge", K. Reitzel et al., Environ. Sci. Technol. 2019, 53, 8479−8481, DOI: 10.1021/acs.est.9b03519

Recycled fertilisers

Recovered struvite improves soil fertility in organic farming

A one-season field trial in 2018 compared recovered struvite to manure on organically managed dairy grassland in Tingvoll, North West Norway (soil pH 5.7 – 6.2). The struvite was from the Hias IKS, Hedmark, Norway sewage works, which operated, for three months, a 10.000 p.e. prototype biological P-removal plant with sludge dewatering using a disc filter, and "P-stripping" (anaerobic conditions causing soluble phosphorus release). Struvite was precipitated from the stripping liquor and the final anaerobic digester output liquor. This Hias IKS prototype achieved dissolved phosphorus outflow levels of 0.17 mg PO4-P/L whereas the sewage works is currently operating phosphate precipitation to 0.4 mgP/l (95% P-removal). In a field trial with 4 replicate plots per treatment, the effect of a single spring application of struvite (40 kgP/ha) was compared to no struvite addition on plots already receiving five different treatments: digested dairy manure or raw dairy manure, at high (220 kgN/h) or low manure application rates (110 kgN/ha) rates, plus control (no manure). In the seven previous years, the fields had received the same manure applications. Results showed that struvite significantly improved clover-grass (ley) yields, especially in the control (no manure) and low manure plots. Importantly, struvite also significantly increased topsoil phosphorus content (measured in September) The authors conclude that struvite can significantly contribute to restoring soil phosphorus levels. This is especially relevant in organic farming systems with restricted access to animal manure. Even in organic dairy cow systems, soil P concentrations tend to decline over time, and some nutrients should be applied to balance those removed in farm products. An article in one of Norway's national newspapers, "Nationen" summarises the study conclusions, underlining that struvite is today authorised as a fertiliser in many countries, including Norway, and that authorisation in Organic Farming has been recommended by the EU expert committee EGTOP and is pending inclusion of struvite in the EU Fertilising Products Regulation annexes (STRUBIAS).

"Ta fosforet tilbake", Nationen newspaper, 24 September 2019
"Effects of struvite application on soil and plants: a short-term field study", Norsøk report vol. 4, nr. 10, ISBN 978-82-8202-091-6, 2019, T. Rittl, A-K. Løoes et al., http://orgprints.org/36472/

ReFARM project will valorise carbon and nutrients from manure

The project ReFARM of Wetsus and funded by EIT Climate-KIC aims to pilot a combination of anaerobic digestion with bio-crystallisation to treat dairy manure and separate nutrients for recycling. Manure is pre-treated with a screw-press into a thin and a thick fraction. The thick fraction has a low nutrient content and can (potentially) serve as a soil amendment to increase organic matter. The thin fraction, containing 80-90% of the phosphorus in dairy manure, will go to a 4.5 m3 pilot up-flow anaerobic sludge bed (UASB) reactor, from which methane and calcium phosphate are recovered. Calcium phosphate precipitation in the

reactor will be biologically induced. The effluent of the UASB reactor contains high concentrations of nitrogen and can potentially to be treated with an electrochemical process to recover nitrogen as ammonium.

ReFARM is funded by the EU's European Institute for Innovation and Technology (EIT) under Climate-KIC. The project brings together three Dutch partners: WETSUS, Mulder Agro and Oosterhof Holman. Contact: Valentina.Sechi@wetsus.nl

Different qualities of recovered struvite

The SUSFERT project (EU Horizon 2020, Bio-Based Industry Joint Undertaking BBI-JU) has published a short report on suitability of different recovered struvites for use as fertilisers. 14 struvite samples were analysed, coming from recovery from solid/liquid separated wastewaters, from UASB (up-flow anaerobic sludge blanket) effluent from potato processing and from municipal wastewater digestate (upstream of solid/liquid separation). Results show variable granule size and size distribution, with struvite precipitated upstream of solid/liquid separation (filtration or centrifuge) showing small granules, poorer quality, lower consistency and granules which are not spherical but instead long rhomboids. Fertiliser blending or marketing (distribution, application) however generally requires homogenous, largely spherical granules > 1mm. Reprocessing struvite which does not achieve these characteristics will be problematic, because granulation general takes place at temperatures >40°C at which struvite molecules will start to decompose releasing ammonia.

In addition to recovered struvite as a fertiliser, the SUSFERT project is looking at bio-sourced and bio-degradable coatings for fertiliser coatings (lignosulphates from forestry by-products), probiotics to enhance plant uptake of phosphorus and of iron and siderophores (iron chelating molecules released by certain micro-organisms and which enable uptake of poorly-soluble iron compounds by plants).

SUSFERT SUStainable FERtilisers (Sustainable, multifunctional fertilisers for plant phosphorus and iron supply fitting into existing production processes and EU agricultural practice) www.susfert.eu
Deliverable 1.4 "Recommendations for struvite producers to make their product suitable for use as phosphorous source in fertilisers", M. Spiller et al. 27/6/2019

Wastewater grown algae tested as fertilisers

Algae harvested from a pilot-scale synthetic municipal wastewater plant was tested as a fertiliser after drying and pressing, as directly harvested (paste) or after extrusion to slow-release pellets with other organic materials and the biosourced polymer polylactic acid (PLA). Results, as well as a literature review and discussion, are presented in an Iowa State University thesis 2018. The plant was a RAB (rotating algal biofilm) system. Fertiliser performance was compared for several crops (maize, French marigold, tomato, daisy) to commercial mineral and organic fertilisers in five month container growth trials. Results showed that the algal materials gave similar fertiliser effectiveness to commercial fertilisers. This confirms previous results from Coppens 2016 and Mulbry 2005 and 2006, using algae harvested from aquaculture and from digested manures.

"The horticultural potential of wastewater-grown algae fertilizers", J Gimondo, thesis 2018 Iowa State University
https://lib.dr.iastate.edu/etd/16358
See also "Recycling of manure nutrients: use of algal biomass from dairy manure treatment as a slow release fertilizer", W. Mulbry et al., Bioresource Technology 96 (2005) 451–458 DOI: 10.1016/j.biortech.2004.05.026 and "Biofertilizers from Algal Treatment of Dairy and Swine Manure Effluents: Characterization of Algal Biomass as a Slow Release Fertilizer", W. Mulbry et al., Journal of Vegetable Science, Vol. 12(4) 2006

Paris: public tasting of urine-fertiliser grown bread

The Paris Region OCAPI project (Optimisation of Carbon, Nitrogen and Phosphorus cycles In the city, see ESPP eNews n°22 and n°27) has organised public tasting of bread made from wheat grown with urine as fertiliser, with the participation of the regional Chamber of Agriculture. The urine is collected in separative urinals at festivals and in public places in Paris, and is stored for several months before application. The bread was considered a great success, with the public showing more interest in the address of the baker than in how it was grown, and the tasting was covered by press and TV. OCAPI is also working on the history of collection for recycling of sewage ("night soil") in Paris, which continued into the nineteenth century; a mapping of toilets which are today not connected to sewerage, agronomic testing of urine compared to mineral fertiliser, analysis of contaminants (including pharmaceuticals), and design and installation of urine-separating toilets.

OCAPI Newsletter n°5, Autumn 2019.

Science and research

LIFE pilot tests electrodialysis for nitrogen removal and recovery

The EU-funded LIFE-Newbies project (led by ESPP member, WETSUS) has started up a pilot plant in Girona Spain that will recover 1-2 kg NH3-N per day. In this pilot, the ammonia is first separated and concentrated from the wastewater using an electrodialysis cell. This electrodialysis cell consists of multiple compartments separated by ion exchange membranes. Then ammonia-nitrogen from the concentrated stream is recovered using a membrane contactor. This membrane contactor uses a gas permeable hydrophobic membrane (i.e. Trans-Membrane Chemi-Sorption/ammonia membrane stripping) to recover it as concentrated ammonium (NH4+) solution. Initial lab scale tests treating urine with a similar design showed an electrical energy input of ca. 4 kWh/kgN recovered, significantly lower than conventional ammonia recovery technologies. 74% of input ammonia-

nitrogen is recovered as ammonia solution (up to 1.5 M (NH4)2SO4), which is suitable for use as fertilizer. The pilot will be evaluated using reject water, source separated urine and landfill leachate as wastewater inputs. This pilot aims to improve the overall performance of the technology through a reduced energy input, improved recovery and product concentration. The final intended product is an ammonia solution above 25 wt% and to provide pre-industrial demonstration scale.

EU LIFE-Newbies project: http://life-newbies.eu/
Partners : WETSUS (NL), Catalan Institute of Water Research - IRCA (ES), W&F Technologies (NL), Evides Industriewater (NL).

Could urban agriculture feed the world

A paper from the US, Sweden and Australia provides data on the potential food production of urban agriculture (UA) compared to cities' food needs, as well as an analysis framework. UA is taken to be food production within the urban area, either outdoors (gardens, urban farms, raised beds) or indoor systems. Collated data from several sources suggest that urban agriculture could product 10-70% of cities' fruit and vegetable consumption, but <10% of calorific demand. In the past, UA has made significant contributions to food production: 55% of US fruit and vegetables in the 2nd world war Victory Gardens; up to 50% of calorific intake in Cuba by the year 2000 with a government programme of cultivating 10 m^2 of urban land per person. The sustainability impacts (land use, water, labour, CO_2) for lettuce production by outdoor or indoor urban agriculture in Minneapolis-Saint-Paul are compared to production in California (produces 70% of US lettuces). The California production has the highest land consumption, but lowest labour; indoor urban agriculture has the highest CO_2 emissions (nearly one and a half times production and transport from California) whereas outdoor urban agriculture has the lowest CO_2 emissions. It is noted that urban food production interacts with land prices in cities. The authors conclude that whether cities could and should be self-sufficient in food production is a simple question but with a complex answer.

"Would a sustainable city be self-sufficient in food production", G. Small, R. McDougall, G. Metson, Int. J. of Design & Nature and Ecodynamics. Vol. 14, No. 3 (2019) 178-194 1755-7445 (online) doi: 10.2495/DNE-V14-N3-178-194

Conceptual framework for evaluation of organic fertilisers

A 100-page report from Wageningen UR, The Netherlands, proposes an outline framework for evaluation of organic fertilisers, looking at characterisation of organic fertilisers, impacts on soil quality (in particular, nutrients and organic carbon), contaminants and risk assessment, economic value to farmers and to land owners. The work is based on literature, expert opinions, and an expert workshop on contaminants. The materials principally considered are manures and slurries, raw, digested and solid/liquid separated, and various composts. Conclusions note the importance of assessment of short- and long-term biodegradability of organic carbon in organic fertilisers, including in the soil; the need for studies on specific soils and crop rotations. A first wide listing of possible contaminants is proposed, but further work is needed to define risk priorities. A challenge is the current absence of methods to define the economic value of soil quality or of organic carbon content, resulting in a value attributed by farmers to the materials considered which is based only on nutrient content.

"Development of a conceptual framework to evaluate organic fertilisers. Assessment on soil quality and agronomic, environmental and economic aspects", O. Schoumans et al., Wageningen University & Research, October 2019, ISBN 978-94-6395-163-0

Microplastics in soil shown to impact plants

A German study has tested in pot trials the effects of six different microplastics, added to soil, on soil characteristics and on development of spring onion (Allium fistulosum) plants. Six different microplastics were added to sandy soil (from Berlin), one primary microplastic (polyamide microplastic beads 15-20 µm d = diameter) and five secondary microplastics: polyester wool, manually cut to average length 5000 µm, d = 8 µm) and high density polyethylene, polypropylene, polystyrene and polyethylene teephthalate (PET) milled to diameters mainly around 200 – 800 µm. Polyester was added to soil at 0.2% fresh weight, and the other microplastics at 2%. These loadings were considered by the authors to be "relevant for sites exposed to high human pressure" – but this seems to be based on Fuller, 2016, who found 7% microplastics in soil in around an industrial area in Sydney but stated "The microplastic concentrations were related to the vicinity of sample locations to the industrial area". At the levels of microplastics tested, the authors found significant changes in soil physical parameters, such as increased soil bulk density or increased evapotranspiration (increased water availability). The microplastics also significantly impacted plant growth, but not in consistent directions. Most of the microplastics led to increased plant biomass, in some cases nearly doubled onion bulb dry mass. The authors suggest that this may in some cases result from nitrogen- or phosphorus-containing compounds released from the plastics (additives, unreacted polyamide monomers …) but this is only hypothesis.

European Commission, Science for Environment Policy, issue 535, 19th November 2019, "Microplastics alter soil properties and plant performance, Germany" and "Microplastics Can Change Soil Properties and Affect Plant Performance", A. de Souza Machado et al., Environ. Sci. Technol. 2019, 53, 6044−6052, DOI: 10.1021/acs.est.9b01339

Microplastics in soil shown to impact earthworms

A study from Cambridge, UK, has tested in 1.3 litre pot trials the effects of three different microplastics on rye grass and on earthworms (Aporrectodea rosea). The microplastics were bio-sourced, biologically degradable PLA (poly lactic acid), high density polyethylene HDPE (both average size 65 – 105 µm) and clothing fibres, and were mixed into soil at 0.1%, 0.1% or 0.01% dry weight. Results showed statistically lower rye grass seed germination in pots with PLA or textile fibres, compared to control (no microplastics). All microplastics decreased the MWD (aggregate mean weight diameter) of soil, and HDPE

decreased soil pH. Impacts on rye grass growth varied, with shoot length was statistically lower with PLA, root biomass was higher with HDPE, shoot biomass was not significantly different, chlorophyll a/b ratio was significantly different for all microplastic containing pots. Impacts on earthworm growth were however coherent, with significant growth (weight increase) in control pots, but weight loss in pots with microplastic.

"Effects of Microplastics in Soil Ecosystems: Above and Below Ground", B. Boots et al., Environ. Sci. Technol. 2019, 53, 11496−11506, DOI: 10.1021/acs.est.9b03304

Overview of national phosphorus flow studies (P-SFAs)

A review compares information on phosphorus in waste management in 14 national phosphorus flow studies (also 2 others considered), covering Australia, Austria, China, Denmark, Finland, France, Japan, Netherlands, New Zealand, Norway, South Korea, Sweden, UK and USA. Unfortunately, these studies are not comparable (as some look at only one sector, for example, the UK study only considers wastewater, whereas others include phosphate mining), and manure is not taken into account (whereas it is the largest secondary phosphorus resource). The conclusions of the overview publication suggest very widely varying "waste sector recovery rates", from over 67% in Finland, and around 50% in Denmark, France and the UK, to below 0.5% in the USA. The USA number is attributed to mining industry wastewater, despite the mining industry having a 91% material use efficiency, but this does not explain why China, which also has phosphate rock mining, is calculated to nearly 40% nor why Finland, which also has phosphate rock mining, is indicated to have zero phosphorus flow from industrial waste. It seems that the only conclusions which can be taken from this publication are that national phosphorus flow studies are often not comparable, and that numbers for "recycling rates" or "recovery rates" depend primarily on how system boundaries are fixed and what is defined to be recycling or recovery.

"Determining the potential role of the waste sector in decoupling of phosphorus: A comprehensive review of national scale substance flow analyses", S. Rahmana et al., Resources, Conservation & Recycling 144 (2019) 144–157, DOI: 10.1016/j.resconrec.2019.01.022

ESPP members

Stay informed

SCOPE newsletter: www.phosphorusplatform.eu/SCOPEnewsletter

eNews newsletter: www.phosphorusplatform.eu/eNewshome

If you do not already receive SCOPE and eNews (same emailing list), subscribe at www.phosphorusplatform.eu/subscribe

LinkedIn group: www.linkedin.com/groups/4783093 (or search for ESPP)

Twitter: @phosphorusfacts

Slideshare presentations: www.slideshare.net/NutrientPlatform