Events

Webinar on phosphorus and iron in wastewater, agriculture, recycling

This online workshop, in three 1-2 hour sessions 13-14 July, 2020, will look at how iron salts used for phosphorus removal (in sewage treatment or in drainage ditches) impacts phosphorus recycling and fertiliser value of sewage biosolids. Session themes are: Iron phosphorus interactions in natural systems and in wastewater ; Iron and phosphorus crop availability ; Iron for P-removal from aquatic systems ; and P-recovery from iron-containing waste streams. Presentations/papers will be available to participants before the event and the three web sessions will concentrate on discussion and questions, completed by an online forum. **Register now**.

Programme and register: https://iron-phosphate.eventbrite.co.uk

IWA nutrient recovery conference

The IWA Nutrient Removal and Recovery (NRR) virtual conference www.iwa-nrr.org **online 1-3 September 2020**, registration (early bird to end July) 63 – 273 €. Organised by Aalto University, Helsinki Region Environmental Services HSY and the IWA Nutrient Removal and Recovery Specialist Group. Will address removal and recovery of phosphorus, nitrogen, carbon in municipal wastewater, groundwater, natural waters, pulp and paper sector and others. The previous IWA-NRR conference was in Brisbane, Australia, in 2018

VDI Conference on sewage sludge treatment

The annual VDI (German Association of Engineers) conference on sewage sludge, 16-17 September 2020, Hamburg, Germany (VDI-Fachkonferenz Klärschlammbehandlung), will look at implementation of the German phosphorus recycling ordonnance, in particular possibilities for sludge incineration in either smaller or large centralised installations, and routes for recovery of phosphorus, nitrogen and other materials from sewage. The Conference includes a site visit to Hamburg's sewage sludge mono-incineration plant on 15th September Conference in German.

www.vdi-wissensforum.de/06KO006020

Phosphorus chemistry webinar series

A bi-weekly series of scientific webinars on phosphorus chemistry is running from May into August, with 20 or 40 minute presentations from phosphorus chemistry scientists or young researchers, followed by discussion. Subjects already scheduled include phosphorus-carbonyl chemistry, phosphorus heterocycles, synthesis of phosphiranes, phosphorus redox catalysis, phosphaborenes, black phosphorus …

The P-Chemistry Webinar series is moderated by Christian Hering-Junghans (LIKAT, Rostock) and supported by AG P-Chemie" (phosphorus interest group) of the GdCh (Gesellschaft Deutscher Chemiker - Society of German Chemists). Schedule of webinars here: https://phosphorus-chemistry.weebly.com/schedule.html

Covid

Coordinated sampling of sewers

The European Commission (JRC) is organising, with Eureau and Water Europe, a coordinated action across Europe to understand how Covid virus fragment monitoring in sewers can support public health information. Levels of Covid virus RNA in untreated sewage (inflow to sewage works) have been shown to reflect levels of public infection in several countries. Monitoring of sewage could maybe provide an early-warning system to identify new outbreaks of the virus. Sampling is being organised through an existing EU system at selected sewage plants. Data and methods will be coordinated to define a Covid monitoring system. Further partners wishing to join the exercise should contact rapidly JRC.

Contact: JRC-Waterlab@ec.europa.eu

Consultations

EU consultation open on sewage sludge

The European Commission has opened, **to 25th August 2020**, a public consultation on the 'roadmap' for re-evaluation of the EU Sewage Sludge Directive (86/278). This first consultation enables to input concerning the objectives of this re-evaluation, which will include a second, wide consultation on sewage sludge use in agriculture, announced for late 2020. The Commission's proposed 'Roadmap' underlines that the Directive aims to encourage the use of sludge in agriculture, under safety conditions, and that nutrient recovery (citing phosphorus) should be a core objective, coherent with the EU Circular Economy Action Plan, Green Deal, Bioeconomy Strategy and Farm-to-Fork Strategy. The need to take into account "contaminants of emerging concern (e.g. organic chemicals such as pharmaceuticals, PAH and PFAS, cosmetics and microplastics)" is noted. This consultation enables to input to the definition of the Purpose and Scope of the sludge directive re-evaluation.

EU public consultation open to 25th August 2020 "Sewage sludge use in farming – evaluation" (Roadmap). Input can be as a simple text statement (max 4000 characters) and/or upload of a document.

ESPP input on calls for Farm-to-Fork and Circular Economy

ESPP submitted comments on two of the eleven proposed Horizon 2020 R&D calls to support the Green Deal. For the proposed "Farm-to-Fork" call, ESPP welcomed the specific references to phosphorus and nitrogen, suggesting to add reference to recycling of nutrients and to include in the call the need to assess economic and policy barriers to sustainability of food systems, including food pricing. For the proposed call on territorial demonstration of the Circular Economy, ESPP again welcomed the specific inclusion of recycled fertilisers and suggested to better make the link between local circularity and sustainable food systems. These calls are expected to be published in September 2020 with submission deadline January 2021.

European Green Deal Call

ESPP comments on "by-products" in EU fertilisers regulation (FPR)

ESPP submitted detailed comments to the JRC proposals for a "framework" for criteria for "by-products" in CMC11 of the EU Fertilising Products Regulation. These proposals are the first step towards defining "agronomic efficiency and safety" criteria for CMC11 "By-products" by July 2020 (art. 42.7). ESPP received and integrated input from several stakeholders. ESPP noted the importance of ensuring that the same material should have the same status across Europe (not be considered a "by-product" in one Member State but a waste in another), but also that the FPR should not generate new definitions of "by-products" parallel to waste legislation. ESPP questioned the proposed "positive list" approach, in that cataloguing all relevant by-products does not seem feasible, and would require traceability contradicting fact that by-products are placed on the market. ESPP underlined that a wide range of by-products may be used in small quantities as additives, to improve processing, handling or product characteristics: listing all of these does not seem realistic, and it would be appropriate to not limit use of non-hazardous additives used at very low concentrations.

RC report on "By-Products" under the FPR (CMC11) and ESPP submitted comments: www.phosphorusplatform.eu/regulatory

ESPP new member

MonGOS circular economy for water and wastewater

The objective of the MonGOS project is to develop a circular economy monitoring framework for the European water and sewage sector. The Circular Economy is an EU political priority and poses many challenges for this sector. MonGOS will identify and assess the potential for Circular Economy transformation in the water and sewage sector, exchange good practices and transfer knowledge between leading scientific institutions in Europe, develop a framework for monitoring transformation towards the Circular Economy in the water and sewage sector, disseminate research results internationally. One of the key areas of project is an identification of circular strategies for management of sewage sludge and sewage sludge ash, which are important source of phosphorus. Specific indicators for the recovery of phosphorus will be defined and proposed.

MonGOS (project "Monitoring of water and sewage management in the context of the implementation of circular economy objectives" 2020-2022) is financed by the Polish National Agency for Academic Exchange (NAWA) under the International Academic Partnerships Programme. Website. Contact: Dr. Marzena Smol smol@meeri.pl

Agriculture

Organic Farming: IFOAM and ESPP press for recycled phosphates

A joint letter, signed by IFOAM EU, the European umbrella organisation for organic food and farming, and by ESPP, has been sent to the European Commission requesting that struvite recovered from municipal wastewater and calcined phosphates be added to the "authorized fertilisers" annex of the EU Organic Farming Regulation 2018/848. The letter reminds that these two recycled phosphate materials were assessed by the official committee EGTOP (Expert Group for Technical Advice on Organic Production) recommending 2/2/2016 (see ESPP eNews) their authorisation for Organic Farming, under certain conditions, subject to their being authorised as EU fertilisers. This condition is now being resolved with their inclusion in the EU Fertilising Products Regulation with the STRUBIAS annexes (underway).

IFOAM EU – ESPP joint letter 17th June 2020 June 2020
http://www.phosphorusplatform.eu/regulatory

FAO Fertiliser Code implementation

Nearly 500 participants from 90 countries took part in a Global Soil Partnership (GSP) webinar on 19th May to discuss implementation of the FAO's International Code of Conduct for the Sustainable Use and Management of Fertilizers. The Code was endorsed by the 41st FAO Conference in 2019. It provides a locally adaptable framework and set of practices for stakeholders involved with fertilisers, with the objective of improving nutrient management for sustainable agriculture and food security, by addressing overuse, underuse and misuse. FAO underlined the need for countries to have national plans to implement the Code, the importance of incentives and smart subsidies for sustainable nutrient management, covering both mineral fertilisers and organic nutrient materials such as manure or sewage biosolids. The webinar confirmed interest worldwide in national implementation of the Code.

Summary of the FAO – CSP webinar Fertiliser Code's implementation, 19th May 2020

Netherlands study on manure processing economic incentives

A study by Wageningen UR for the Netherlands Agriculture Ministry concludes that nearly half of the nitrogen applied to farmland in the country (total 530 ktN) is as mineral fertilisers, that is around a quarter of this nitrogen could in theory be replaced by processing manure, but that costs are significant, and increase as a higher replacement target is fixed (more expensive processing becomes necessary). Only around 10% of phosphorus applied in The Netherlands is as mineral fertilisers, so the processing must enable separation of phosphorus into a form which can be exported. Replacing just 16% of The Netherlands' mineral N consumption with processed manure is estimated to cost 360 million € (average = 4 300 €/tN note: this is not per tonne of manure). The report concludes that funding this by a levy on mineral fertilisers is not administratively feasible and that the increase in fertiliser price would be so high that it would lead to reduced agricultural productivity. The report proposes to subsidise manure processing. The report also notes that around 115 ktN of nitrogen is lost in emissions to the atmosphere from manure in The Netherlands (from a total of512 ktN in manure) and that some of this could be recovered and recycled as fertiliser by air stripping from manure storage or from stables, but that in many cases this requires significant modification of livestock farm installations.

"Vervanging kunstmest door dierlijke mest, Verkenning van opties voor de inzet van financiële instrumenten", (Replacement of fertiliser by animal manure, exploring options for using financial instruments), T. de Koeijer et al., Wageningen Economic Research Rapport 2019-103 | Projectcode 2282200520, 2019 https://doi.org/10.18174/504407

Nutrient recycling

ReCaPHOS: P recovery in sewage sludge incineration

A 3-year Marie Curie Individual post-doc Fellowship at ZSW (Center for Solar Energy and Hydrogen Research Baden-Württemberg), 2019-2022, ReCaPHOS ("Phosphorus extraction in the context of the high-temperature thermal treatment of sewage sludge") will develop phosphorus recovery integrated into fluidised bed sewage sludge incineration, considering both a new plant and retrofitting to an existing incinerator. The project will lead to design of a demonstration plant and estimation of economic potential. Calcium oxide (quicklime) will be used for phosphorus adsorption in the incineration process or from the outcoming ash, with heavy metal removal by thermal treatment.

ReCaPHOS information on Cordis and ZSW www.zsw-bw.de ZSW is a member of the German Phosphorus Platform DPP

Easymining – Hitachi Zosen potassium recovery

ESPP members EasyMining (Ragn-Sells group) and Hitachi Zosen Inova have together developed a new process, Ash2Salt, to recover potassium and other elements from municipal solid waste incineration fly-ash (ash separated out in incinerator exhaust gas filters). This fly ash can contain 10 – 40% w/w as salts (calcium, sodium, potassium chlorides) and an average around 2 - 3% potassium (K). This is recovered as high purity potassium chloride salt, appropriate for industry markets. Ammonium sulphate can also be recovered (from ammonia added to exhaust gases to prevent NO_x emissions). The new plant under construction near Stockholm will have a capacity of 130 000 t/y of incinerator fly ash, sufficient to take the fly ash from Sweden's current 15 municipal waste incinerators. Commissioning is planned for 2022.

"Ragn-Sells partners with Hitachi Zosen Inova for building circular fly ash plant", 26th May 2020

LCA of P-recovery vs. mineral P fertilisers

A report published by UBA Germany compares the environmental footprint of phosphorus recovery from sewage, as required by the German Sludge Ordinance (2017), to mineral phosphate fertilisers. The LCA calculates c. 27 MJ/kgP (27 MJ/kg P_2O_5) as the average energy input for mineral phosphate fertiliser on the German market, of which more than half is related to sulphuric acid production (this figure will thus depend on "allocation" in that sulphuric acid is a by-product). The production of 1 kgN requires 4-5x this energy, and given that plants require nearly 7x nitrogen than phosphorus (Redfield ratio), the energy footprint of mineral fertilisers is principally for nitrogen not phosphorus. Energy requirements for P-recovery are identified as varying widely depending on the process. The report suggests that the environmental footprint of all fertilisers is principally in the use phase, that heavy metal content may have significant impact (will depend on levels in the fertiliser) and also phosphogypsum disposal (but this is not relevant if disposal has no environmental impact or if the phosphogypsum is valorised). The report notes that an important environmental question is to implement NO_x mitigation for sewage sludge incinerators.

"Ökobilanzieller Vergleich der P-Rückgewinnung aus dem Abwasserstrom mit der Düngemittelproduktion aus Rohphosphaten unter Einbeziehung von Umweltfolgeschäden und deren Vermeidung" (LCA comparison of P-recovery from wastewater with fertilisers from mineral phosphates, including environmental damage and how to avoid it), F. Kraus et al., UBA-FB 002759 2019

Reviews: nutrient recovery from organic materials

A 470 page book from Ghent University, Belgium, presents different aspects of nutrient recovery from biomass and organic waste streams. Chapters written by over 100 hundred authors discuss nutrient flows and food systems, policy, nutrient recovery from manure, wastewater, food processing by-products and urine, ammonia stripping, struvite recovery, membrane filtration, mineral concentrates, pyrolysis, digestate drying and pelletisation, agricultural performance and soil behaviour of recovered fertilisers, energy intensity of recovery processes, modelling and optimisation.

Elsewhere, a review paper from China summarises biological nutrient removal and recovery from manures. The authors state that China alone generates 2 billion tonnes/year of livestock manures, considered to contain metals (copper, zinc, arsenic), pathogens and antibiotic pharmaceuticals. Processes considered include : composting, underlining the importance of process control and the interest of using co-substrates which improve bulking (aeration in composting) and increase the C/N ratio (improving composting and reducing ammonia losses and odour); anaerobic digestion and digestate processing; biological nitrogen removal; bio(electrical processes; micro-algae production to recover nutrients and provide biofuel feedstock; duckweed; macrophyte wetlands; cation adsorbent or ion-exchange systems. The authors see as perspectives: composting of solid fraction of digestate after anaerobic digestion processes (such as sodium hydroxide) to breakdown cellulose remaining in solid fraction of digestate, development of biological cultivation processes to reuse nutrients from manure (algae, plants, solider fly …) and hybrid processing combining several of these.

"Biorefinery of Inorganics: Recovering Mineral Nutrients from Biomass and Organic Waste", E. Meers et al., 2020, €140-160 https://www.wiley.com/en-be/9781118921456
"Biological nutrient removal and recovery from solid and liquid livestock manure: Recent advance and perspective", M. Zubair et al., Bioresource Technology 301 (2020) 122823 https://doi.org/10.1016/j.biortech.2020.122823

Research

Do global nutrient balances impact human health?

A paper by several environmental scientists states in its title that ratios between different elements (modified by human activities) "link environment change to human health". This is misleading, because the paper's intent is to explore ecological stoichiometry as a framework to understand how changes in biogeochemical cycles may impact health. The paper suggests that nitrogen fertiliser use may contribute to the prevalence and severity of infectious diseases, based on Townsend 2003, whereas this is a conceptual framework, not evidence. The paper suggests that human activities may lead to excess carbon availability in soil (ESPP comment: whereas most agronomists underline the need to restore soil organic carbon), leading to reduced N:C ratios in crops (no studies are cited linking this to human health), but the paper also suggests that increasing nitrogen may lead to increased N:C ratios in crops, suggesting possible links to changes in pests on cotton and in species diversity in natural areas (no link to human health). The paper points to decreasing environmental P:N ratios. Confusion seems to be made between nutrient balances and basic healthy diets: for example, Jacka 2017 is referenced under dietary stoichiometry and mental health, whereas in fact this study (of 67 persons only) suggests only that a generally healthy diet (fruit, vegetables, fibres, vitamins …) improved mental health and does not in fact mention elements. The paper was developed through Woodstoich 4, an event designed to expand the conceptual boundaries of ecological stoichiometry. ESPP recognises that the concept of ecological stoichiometry is interesting, and that human activities have significantly modified nutrient ratios in the environment, but regrets the use of a title which suggests that there is evidence of human health impact, when this is not the object of the paper.

"Elemental Ratios Link Environmental Change and Human Health", R. Paseka et al., Frontiers in Ecology, vol. 7, art. 375, 2019 DOI.

EEA: Europe's nutrient footprints exceed safe boundaries

A joint report by the European Environment Agency (EEA) and the Swiss Federal Office for the Environment (FOEN) finds that Europe's footprints exceed safe limits (planetary boundaries) by a factor of 2x for phosphorus losses, 3.3x for nitrogen losses and 1.8x for and land use. Europe's freshwater use does not exceed planetary boundary limits, but does suffer local and regional over-consumption and scarcity problems. The report considers different possible European shares of total planetary resources, not only on equity (per person) but also related to human needs, suggesting that Europe could have a 2.7% to 21% share (Europe has 8.1% of world population). The phosphorus footprint for Europe (corresponding to the biogeochemical flow of phosphorus) is in this report calculated as P release from agriculture plus P losses from urban waste water, that is c. 0.13 MtP/year (2011), using data from Exiobase. This is more than two times lower than the 2.9 MtP/y (2005) phosphorus losses from the European agrifood system calculated by Van Dijk et al. (see SCOPE Newsletter n°106 page 11) and would represent only 6% loss of phosphorus use in Europe (assuming Europe uses 10% of 17 – 24 MtP/y in worldwide phosphate rock production, see ESPP Factsheet), implying that 94% of P used annually is lost via other routes not taken into account, or is stored in landfill or soil, which seems unlikely. It is not clear whether the report methodology takes into account "exported" phosphorus footprint (e.g. phosphorus losses from agriculture in countries growing animal fodder crops imported into Europe to feed livestock). The report notes that the 2x exceedance of limits for Europe's phosphorus footprint is the same as the global exceedance, whereas for nitrogen Europe's footprint exceedance of 3.3x is twice the global exceedance of 1.7x.

"Is Europe living within the limits of our planet? An assessment of Europe's environmental footprints in relation to planetary boundaries", Joint EEA/FOEN Report, EEA Report N° 01/2020, ISSN 1977-8449 https://www.eea.europa.eu/highlights/europes-environmental-footprints-exceed-several

Replacing P4 is still "in its infancy"

An overview of possible processes concludes that "the only industrially practicable way" to produce organophosphorus chemicals is today via P4 (white phosphorus). The reactive potential of P4 [+3 oxidation state, P(III)] is conserved in traded 'vector' chemicals such as PCl_3 or PMIDA (phosphonomethyliminodiacetic acid) which can be used to produce organophosphorus chemicals for sectors such as fire safety, agrochemicals, pharmaceuticals, water treatment, lubricants, catalysts, metal extraction … However, P4 production requires a high-temperature reduction furnace and is very energy consuming, and there is no production today in Europe (P4 is on the EU Critical Raw Materials list). Other possible routes to organophosphorus chemicals from inorganic phosphates [+5 oxidation state, P(V)] have been tested at the lab scale: phosphate esters from phosphoric acid by phosphorylation of alcohols; reduction of trimetaphosphate by trichlorosilane (but this is currently produced from silicon, itself from a reducing furnace, so with similar energy costs to P4); PCl_3 from calcium phosphate by hydrogen chloride. Another route could be recycling of industrial chemicals already containing reactive phosphorus, such as electrolytes from lithium ion batteries. In nature, inorganic phosphate is biologically converted to organophosphorus chemicals (e.g. ATP, natural phosphonates …) via the starting molecule PEP. At present, PEP can be produced via P4, but could possible be produced using enzymes. The authors also suggest that P4 could possibly be produced by electrochemical reduction, analogous to an experimental route for silicon production.

"Let's Make White Phosphorus Obsolete", M. Geeson & C. Cummins, ACS Central Science 2020 https://dx.doi.org/10.1021/acscentsci.0c00332

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: https://www.linkedin.com/company/european-sustainablephorphorus-platform/

Twitter: @phosphorusfacts

Slideshare presentations: www.slideshare.net/NutrientPlatform

ESPP members