ESPP dates 2024

- **22 February, 14h-15h30**: webinar on **EU Nitrates Directive** evaluation (consultation here) and Renure (criteria for "processed manure" recycled nutrients)
- 27-28 Feb. 2024: Warsaw CRU Phosphates 2024 ESPP panel on sustainable fertilisers
- **13-14 March 2024**: Brussels & online **ESPP workshops on Nutrient recycling policy**
  - 13th March: market policy tools to support pull for recycled nutrients (optional networking dinner)
  - 14th March: targets for nutrient recovery under the Urban Waste Water Treatment Directive revision
- **16-17 April 2024**: Brussels & online **NERM Nutrients in Europe Research Meeting**
  (with Fertimanure, Lex4Bio, Walnut, Sea2Land, Rustica)
- **8-10 October 2024**: Lleida, Spain **ESPC5 (5th European Sustainable Phosphorus Conference)**

ESPP workshops on Nutrient recycling policy

Market policy tools to support pull for recycled nutrients

Identifying policy tools to support market pull for recycled nutrients, which could achieve consensus across industry and users. Speakers from waste and water industries, fertiliser industries, circular economy policy experts. Proposals to be discussed will include targets, quotas, border tariffs, recycling credits, fiscal incentives, public purchasing, labelling … Industry and user positions can differ: The meeting aims to identify policies which could achieve consensus across recycled product producers (waste companies, recycling technology suppliers), industry and users (fertilisers industries, distributers, farmers), and to discuss ESPP proposals to submit to policy makers.

13th March *Brussels & online. Registration is open www.phosphorusplatform.eu/nutrientevents2024*

Defining targets for nutrient reuse and recycling from waste water

The proposed UWWTD revision text (art. 20) states: "*The Commission is empowered to adopt delegated acts … setting out the minimum reuse and recycling rates for phosphorus and nitrogen*", see eNews n°80. **This workshop will define ESPP proposals for these targets:** How to define "reuse" and "recycling" ? What % rate? What criteria for products ? What rates for different sizes waste water treatment works or type of sewage treatment ? …

14th March*: Brussels & online. Registration is open www.phosphorusplatform.eu/nutrientevents2024*

Your input and proposals are welcome: present your ideas on these questions (and why) in Brussels, 14th March. *We still have a few slots available. Please send short outlines of proposals for pitches to as soon as possible to info@phosphorusplatform.eu.*

ESPP new member

Toopi Organics

Toopi Organics is a french start-up, incorporated in 2019, processing separately collected human urine and valorising it in agriculture. Toopi Organics aims to save water and nutrient resources while offering green alternative solutions for farmers. Toopi collects urine at source from waterless urinals and uses it as a growing medium to perform submerged liquid fermentation, producing organic urine-based microbial biostimulants to increase nutrient use efficiency and reduce mineral fertilisers for crops. More information in ESPP eNews n°82.

https://toopi-organics.com/

Policy

Political agreement on EU Urban Waste Water Treatment Directive (UWWTD)

European Parliament and Council have announced agreement on the Urban Waste Water Treatment Directive (UWWTD) revision, probably enabling adoption before the June 2024 European elections. The agreement now must go to Parliament and Council environment committees for endorsement, then formal plenary vote by both institutions. The coregulators underline that the 1991 UWWTD has been highly effective in reducing water pollution because of the simplicity of its requirements. Announced points of the political agreement include obligations of secondary wastewater treatment for all agglomerations > 1 000 p.e. by 2039 and of tertiary (N and P removal) and quaternary treatment (organic micropollutants) for all large agglomerations and, in areas with identified risk, down to 10 000 p.e. by 2045. Energy neutrality targets for waste water treatment plants will be required by 2045. Other measures agreed in principle include monitoring of microplastics, antibacterial resistance, Covid virus tracers and PFAS, polluter pays (for quaternary treatment, applicable to pharmaceuticals and cosmetics industries), promoting treated sewage water reuse. The communications do not specify what agreement is reached on nutrient recycling. The European Commission proposal (art. 20) indicated that the Commission should be empowered to set "*minimum reuse and recycling rates for phosphorus and nitrogen*" see eNews n°80. Both Parliament and Council proposed amendments to conditions for this, but both retained the principle of phosphorus reuse and recycling targets, whereas Council proposed to delete nitrogen from this article. The full text of the agreement is not yet published.

29th January 2024.
European Commission communication: More thorough and cost-effective urban wastewater management (europa.eu)
Council: Urban wastewater: Council and Parliament reach a deal on new rules for more efficient treatment and monitoring
European Parliament: Deal on more efficient treatment and reuse of urban wastewater

Digital labelling of fertilising products is a missed opportunity according to industry

Council and Parliament have reached agreement, but Fertilizers Europe considers that the proposal will not significantly reduce complexity of on-package labels and of packaging wastage required every time a label needs to be modified. Digital labelling enables to include additional information on product use and characteristics, which is not possible or not legible on a physical label. It also allows different types of user (blender, distributor, farmer, public consumer …) to access different information according to their requirements. The agreed rules (not yet published) will not allow digital-only labelling for any packaging other than bulk, with key information continuing to be required on physical labelling on packaged products. Fertilizers Europe suggests that digital-only labelling should also be an option for professional and industrial end-users. The industry federation indicates that nearly 2 million fertiliser packages (only taking into account packages above 500kg) have to be discarded every year in Europe because of physical labelling modifications.

"Commission welcomes the political agreement on the voluntary digital labelling of EU fertilising products", European Commission 23 January 2024 here.

BAT for slaughterhouses published: includes struvite recovery

The European Commission has published the updated BAT for "for slaughterhouses, animal by-products and/or edible co-products industries", including struvite recovery as a possible BAT (Best Available Technology, under the EU Industrial Emissions Directive), replacing the previous 2015 BAT BREF. Relevant to nutrients, the adopted BAT includes measurement of wastewater phosphorus and nitrogen, including mass flows (but not calculation of mass flows in incoming animals and output food products or animal by-products), P and N removal from wastewater, and now includes struvite precipitation from waste waters with > 50 mgP/l (indicative concentration):

- BAT 2 and BAT 7: Environmental management system including measurement in waste waters of average concentration and mass flows of phosphorus, nitrogen species and organic carbon.

- BAT 14: Waste water treatment including where appropriate: N removal (down to 2 -25 mgN_{total}/l) , P removal (down to 0.25 - 2 mgP_{total}/l) by precipitation, enhanced biological P removal (EBPR) and/or struvite recovery.
- BAT 12: Resource efficiency: “Phosphorus recovery as struvite” (e.g. waste water with P > 50 mg/l) and/or anaerobic digestion.

European Commission decision 2023/2749 “establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions, for slaughterhouses, animal by-products and/or edible co-products industries” (32 pages), 18/12/2023 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AL_202302749

Research and innovation

Benefits of organo-mineral fertilisers

Yara summarise the sustainability benefits and challenges of combining mineral fertilisers with organic materials for optimal agronomic and environmental benefits and developments engaged by the company. 65-year field trials at Yara’s Hanninghof research centre, Dülmen, Germany, show that combining organic fertiliser (farmyard manure) and mineral fertiliser (potato/cereal rotation) resulted in increased soil organic carbon, increased water use efficiency (3x improvement) and highest yield and profitability. Yara is developing organo-mineral fertilisers (OMFs) in order to deliver such benefits to farmers, and to enable optimal recycling of local organic nutrient resources. Yara has carried out greenhouse tests and is now doing field trials, looking both at efficiency for crops, impacts on soil and risks of nitrogen losses (possible ammonia or N_2O emissions to air). OMFs are delivered as pellets to farmers, to facilitate handling and enable spreading (which is important for yield). Local transformation routes are needed as organic secondary resources are scattered locally and transport would be inefficient and expensive. Nitrogen uptake alone does not explain increased yields from OMFs, so these are considered to result from other benefits such as soil organic carbon (40 – 80 % of organic carbon applied is shown to be stored in soil in the rhizosphere) and soil microorganism activation. Application timing must however be adjusted to adapt nutrient release to crop needs and so minimise nutrient losses.

“Optimising crop production by combining organic-based and mineral fertilizer sources: Agronomic performance, soil and environmental considerations”, A. Becerra, Yara, at the IFS (International Fertiliser Society) annual conference, Cambridge, UK, 6-7 December 2023. IFS events here.

The 2024 IFS annual conference will take place 11-13 December 2024, Cambridge, UK.

“65 years-long research concludes: Mineral fertilizer supports sustainable agriculture”, Yara press release, 5th September 2023.and book chapter “Effect of Balanced and Integrated Crop Nutrition on Sustainable Crop Production in a Classical Long-Term Trial”, M. Jate, J. Lammel, in “Sustainable Crop Production - Recent Advances” 2022 here.

Testing thermal plasma treatment of dried sewage sludge

Study presents tests to convert sewage sludge and recovered carbon dioxide (CCUS) to ash and syngas, with a 2-hour test run of a 220 litre interior volume, 15 kg/h, 1200°C thermal plasma reactor. The reactor used an argon-water stabilised DC plasma torch (max 150 kWe) with rotating copper disc anode. The torch generated a plasma at around 18 000 °C at its outlet, resulting in temperature of c. 1200°C measured on the reactor walls. The feedstock for this reactor was dried anaerobically digested sludge (c. 6% water) from a Czech municipal sewage treatment plant (15 kg/h), as was CO2 (c. 1200 l/h): the objective was to capture industrial carbon dioxide and convert it to syngas by reacting with sewage sludge (CCUS = carbon capture utilisation stockage). The cold gas efficiency (energy recovered in syngas / electric energy consumed by plasma torch plus energy potential in sewage sludge) was c. 35% (the authors suggest this could be increased to nearly 50% by thermal insulation of the reactor / heat recycling). This does not take into account energy used upstream for drying of the sewage sludge. Very low char production meant that carbon conversion (carbon to syngas) was over 95%. The authors suggest that an advantage of this route for sewage sludge treatment is that phosphorus in the reactor will be volatilised to elemental phosphorus (high temperature, reducing conditions, silicates in sewage sludge). In these trials, the phosphorus was found in the offgas filter (particles) and retained in the reactor.

“Integration of thermal plasma with CCUS to valorize sewage sludge”, V. Sikarwar et al., Energy 288 (2024) 129896, DOI.

Long-term phosphate fertiliser application and heavy metals in soils

Field trials show increased soil P, but also increased soil cadmium, uranium, chromium, vanadium and arsenic, in topsoil, after 45 years of repeated fertilizer application. Results are based on soil samples from five plots with different levels of P fertiliser application from 1966 to 2022 (zero control up to 72 kgP/ha, that is up to 3 – 4 x crop requirements) at Tidewater Research Station, North Carolina, USA. P content of topsoil was strongly correlated to soil concentrations of Cd, U, Cr, V and As, all of which were present in the applied fertilisers at levels above soil background concentrations (23 mgCd/kg, 163 mgU/kg, 179 mgV/kg, 132mgCr/kg). The correlations shown include the plots with repeated high excess fertiliser application, it is unclear to what extent the results are significant for plots with fertiliser applied according to agronomic recommendations. The paper does not show data for the relation fertiliser application – soil meta(loids), but shows correlations soil P – soil metl(loids). Potassium fertiliser, which was also applied, had low levels of these metals. The metal(loid) increases were mostly found only in topsoil, not in deeper soils. The authors note that the increase in plant available P (Mehlich-III) may cause mobilisation of metals already present in soil, but conclude that the data indicate that the rate of P-fertiliser application is correlated to occurrence of the metal(loid)s in topsoil. The possible significance of the changes in heavy metal levels was not analysed and possible increased uptake of the metal(loid)s by crops was not assessed.

"Evidence for the accumulation of toxic metal(loid)s in agricultural soils impacted from long-term application of phosphate fertilizer", J. Hu et al., Sci. Total Environment 907 (2024) 167863 DOI.

Second JRC study again suggests that UE+UK soils are accumulating phosphorus

Modelling suggests average soil P accumulation of 0.11 kgP/ha/y in arable soil (total 190 ktP/y),2010-2019, somewhat higher than 130 ktP/y in a previous JRC study (Panagos et al. 2023, see ESPP eNews n°73**), with high regional variations.** This represents c.8% of applied phosphorus (6.5 kgP/y from manure and 6.4 kgP/ha/y from mineral fertilisers, other organic P inputs not considered). Net P losses by soil erosion (minus deposition) are estimated as 0.25 kgP/ha/y, that is more than twice soil P accumulation. The study uses the DayCent model to estimate daily dynamics of C, N, P and S between plants, soil and air, at a 1 km^2-grid level, considering six different soil P pools: P_{Org}) and five mineral P pools: P_{labile}, P_{sorbed}, $P_{strongly\ sorbed}$, P_{parent}, and $P_{occluded}$. Model inputs included LUCAS soil and water data, CLC land-use, meteorological data, CORDEX climate project data, Eurostat (crops, irrigation, mineral fertiliser inputs), FAO livestock distribution, SAGE agronomy parameters and literature numbers for P excretion, soil P partition, etc. The authors model consequences of management scenarios to 2050, concluding that increased use of N-fixing cover crops can reduce the P-surplus by increasing crop productivity (N availability, whilst also reducing erosion losses. The authors note that results for national P budgets from this modelling study correspond for some countries to those from the empirical Panagos 2023 study or to national statistics, but diverge for other countries.

"Assessing the phosphorus cycle in European agricultural soils: Looking beyond current national phosphorus budgets", A. Muntwyler et al., Sci. Total Environment 906 (2024) 167143 DOI.

Iron phosphate precipitation from electronics industry wastewater

Lab tests looked at use of ferrous sulphate to precipitate soluble phosphorus from mobile phone metal shell polishing wastewater, achieving over 95% P-precipitation and a precipitate with c. 25% vivianite, 75 % iron phosphate colloid. The industrial process water contains over 200 mgP/l and had pH <3. Optimal conditions for P-precipitation showed to be c. 1.5:1 molar ratio Fe:P and pH around 7. At these conditions, the iron phosphate precipitated contained <25% vivianite, and was mostly colloidal iron phosphate, that is lower vivianite content than expected from literature and modelling. Given the low proportion of vivianite in the precipitate and that no evidence is provided to suggest that the precipitated phosphate material could be recycled, the title of the paper seems to misleading.

"Efficient removal and recovery of phosphorus from industrial wastewater in the form of vivianite", Y. Zhang et al., Environmental Research 228 (2023) 115848 DOI.

To where does nitrogen in sewage go?

Analysis of data for France suggests that only c. 10% of N from human excreta is recycled (despite 3/4 of sewage going to agriculture), half is lost to the atmosphere and 40% goes to surface and ground water. The study analyses data from all of France's sewage treatment plants (over a decade), autonomous sewage treatment, population, diet, nitrogen in human faeces and urine. Nitrogen removal in sewage works varied from around 60 to 85%, with higher removal rates in Nitrates Directive "Nitrate Vulnerable Zones" and in larger sewage works. No data is available for nitrogen losses to air in sewage works, but nitrification – denitrification converts much of inflow N to N_2 lost to air. The authors estimate around 10% N losses to water upstream of sewage works. Of the N arriving at sewage works, around 50% is lost to air in sewage works, 40% to surface waters and only around 10% recycled to land. In autonomous sewage treatment systems, losses to underground water are estimated to be around 3/4. N in urine represents c. 15% of French mineral N fertiliser consumption (0.3 vs 2 MtN/y) and the authors estimate that recycling N from human sewage, via separate collection of urine, could cover around 10% of France's protein production with current diets, or up to around 30% if diets moved away from meat to plant-based.

"Fate of nitrogen in French human excreta: current waste and agronomic opportunities for the future, T. Starck et al., 2024, Nitrogen in agro-food systems and the environment, 912, pp.168978, DOI.

P-recovery potential from biofuels production

US Sustainable Phosphorus Alliance webinar with R. Cusick (University of Illinois) shows the significant potential and environmental benefits of for phosphorus recovery from maize processing to biofuels. The US harvests nearly 1.5 Mt/y of maize for biofuel (bioethanol) production, that is around 1/3 of US maize production. The maize contains phosphorus which is not wanted in the biofuel (in combustion it would generate corrosive phosphoric acid) and ends up in distillers' grains which mostly go to animal feed. High P in feed is transferred to manure, and can contribute to eutrophication of water bodies. Maize processing (CBs = corn biorefineries) generate liquor streams with higher P concentrations than in wastewater or manure, they are large installations, mainly clustered in US Mid-West States, where there is high demand for fertilisers. Most of the phosphorus in the input maize is in phytate, but the processing partly breaks this down and mineralises or solubilises the phosphorus, making it available for P-recovery processes. Total P in distillers' grains in the US is estimated to be around 230,000 t/y, that is around 13% of P mineral fertiliser consumption in the US. In bioethanol producing states such as Iowa, that percentage can be as high as 37% mineral P fertilizer consuption. Total P-recovery potential from maize biofuel production (corn biorefineries) in the US is estimated to be around twice that from municipal wastewater (as struvite), with the median recovery potential for corn biorefineries estimated to be three orders of magnitude greater than a wastewater treatment plants (1,000 vs 0.5 t/facility).

"Mapping the National Phosphorus Recovery Potential from Centralized Wastewater and Corn Ethanol Infrastructure", K. Ruffatto et al., Environ. Sci. Technol. 2022, 56, 12, 8691–8701 DOI.

"Modeling National Embedded Phosphorus Flows of Corn Ethanol Distillers' Grains to Elucidate Nutrient Reduction Opportunities", K. Ruffatto et al., Environ. Sci. Technol. 2023, 57, 38, 14429–14441 DOI.

"Big Opportunity for Phosphorus Recovery from Bioethanol Processes", Sustainable Phosphorus Alliance "Science Now" webinar, 21 minutes, date November 8, 2023, available online here.

Bacterial biorecovery of ammonium sulphate from digestate

Lab trials (100 ml, 15 days) showed production of ammonium sulphate by *Acidithiobacillus thiooxidans* from liquid fraction of dairy manure digestate, generating a material showed 90% ammonium sulphate content after drying @ 60°C. The manure digestate was lab centrifuged, resulting in zero measured solids, 100 mM ammonia, 0.1 mMP and 10 mM K. *Acidithiobacillus thiooxidans* was stepwise acclimatised to ammonia at 400 mM-N, then incubated with the digestate liquor and with elemental sulphur. The bacteria reduced the digestate pH from c. 9 to 2 over 15 days. This produced c. 6g of ammonium sulphate (after drying), so in 100 ml of digestate/inoculum that is 6% ammonium sulphate solution (1.2 %N) with 10 % impurities.

"Biorecovery of ammonium from manure digestate by Acidithiobacillus thiooxidans", B. Jalili et al., Chem Eng J Chemical Engineering Journal 466 (2023) 143094 DOI.

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