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4th Phosphorus in Europe Research Meeting (PERM)

Registration now open!

Online, 2nd June 2021

Event web page: www.phosphorusplatform.eu/PERM4
***Registration**: https://us02web.zoom.us/meeting/register/tZ0qcOmrrjouEtRlibbtiMrcZVSKb4MEvYyc*

Events

AquaEnviro Wastewater Resource Recovery Conference: 18 May 2021

One day conference on resource recovery from wastewaters and biosolids, covering nutrient recovery, hydrogen and other materials: experience from pilot and full scale plants; market pull, user confidence and business models, regulatory framework, links to net zero carbon 2030 agenda for the UK wastewater industry.

"The Art of the Possible: Resource Recovery from Wastewater and Bioresources", May 18th 2021 online
https://conferences.aquaenviro.co.uk/events/conferences/resource-recovery-from-wastewater/

SYSTEMIC: nutrients from biowaste, 27 May 2021

Webinar "Enabling a Circular Economy: How to encourage a viable agricultural market for nutrients recovered from biowaste", with William Neale, Advisor, European Commission DG Environment, Jan Huitema, Member of the European Parliament, Ludwig Hermann, Proman and ESPP President, Oscar Schoumans, Wageningen University and Research, Annabelle Williams, European Landowners Association.

SYSTEMIC (Horizon 2020 project) webinar, Thursday 27th May: 13h30-15h30 CEST Registration

4th Phosphorus in Europe Research Meeting (PERM): 2 June 2021

This meeting, co-organised by ESPP, Biorefine Cluster Europe and ETA Renewable Energies, will link science, industry, agriculture and policy makers. EU-funded projects on nutrient sustainability and phosphorus recycling (Horizon2020, Interreg, LIFE…) and national and company nutrient projects will present, enabling dialogue and synergies. PERM will address how to improve uptake of project recommendations by policy makers and users, through to market, and identify perspectives for research and policy, and implementation gaps.

In parallel to PERM, ESPP is updating our online 'inventory' of nutrient-related R&D projects here.

PERM4 – online – 2nd June 2021: event website: www.phosphorusplatform.eu/PERM4
***Registration**: https://us02web.zoom.us/meeting/register/tZ0qcOmrrjouEtRlibbtiMrcZVSKb4MEvYyc*
Proposals are welcome for presentations of studies into what factors in nutrient R&D projects improve uptake of conclusions by policy makers, industry and users.
***If you wish your project to be included** in the programme and/or added to the inventory of nutrient R&D projects, please contact info@phosphorusplatform.eu*

IFA plant nutrition innovation conference: 8-10 June 2021

The global fertiliser industry (International Fertilizer Association) "Smart & Green" conference will bring together scientists, industry and start-up technologies around controlled-release and stabilised fertilisers, biostimulants, incentivising and funding fertiliser innovation, digital fertiliser management, organic fertilisers and nutrient recycling.

IFA Smart & Green "where tech meets plant nutrition", 8-10 June, online here.

Nutrients, aquatic methane emissions and climate change: 22-27 June 2021

ASLO (Association for the Sciences of Limnology and Oceanography) Special Session (SS06) on **Methane Accumulation in Oxic Aquatic Environments:** Sources, Sinks and Subsequent Fluxes to The Atmosphere. Within the 2021 Aquatic Sciences Meeting (online, 22-27 June 2021). In partnership with the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) and ASLO, ESPP and SPA will follow-up with a webinar to exchange between science, water stakeholders and policy makers on implications of aquatic methane emissions for nutrient management. Proposals for input are welcome.

ASLO special session on methane in oxic aquatic environments: https://www.aslo.org/2021-virtual-meeting/session-list/
Contact Mina Bizic mbizic@igb-berlin.de
To contribute to the ESPP- SPA- IGB webinar: contact info@phosphorusplatform.eu

New dates for ESPC4: 20-22 June 2022

The 4th European Sustainable Phosphorus Conference (ESPC4) is postponed (because of Covid). New dates are **20-22 June 2022 in Vienna**. PERM, the European Phosphorus Research Meeting will be held virtually 2nd June 2021, see below.
Updates: see www.phosphorusplatform.eu and https://phosphorusplatform.eu/espc4

Policy

EU consultation on Urban Wastewater Treatment Directive (UWWT)

Open to 21 July 2021. The consultation document notes that the 2019 evaluation of the 1991 UWWTD concluded that it is largely fit for purpose, but some aspects need to be improved, and updates should align with Green Deal environment and climate objectives. The consultation is a general public questionnaire, plus additional questions for experts and operators – you do not have to answer all questions. General questions ask what you see as important risks from municipal wastewater, key mitigation actions, priorities for action (nutrients are one of seven proposed priorities), how to improve protection of nutrient "Sensitive Areas", addressing micropollutants, circularity (proposals include recovery obligations for phosphorus and other materials).

In particular, the question (p32 of the questionnaire in PDF) "*How appropriate are the following proposed measures for building a more circular waste water treatment sector?"* offers the option "*Setting minimum levels for recovering phosphorous and other materials*" (please NOTE: '5' = important). ESPP will propose, under comments to this question, to Include materials from wastewater as a priority stream for development of EU End-of-Waste criteria under the Circular Economy Action Plan.

"Water pollution – EU rules on urban wastewater treatment", Eu public consultation open to 21 July 2021.

Joint action for End-of-Waste status for materials recycled from wastewaters

Over 120 (to date) industry and public water operator federations, companies and research institutes, have signed a joint letter to the European Commission requesting that materials recovered from wastewaters be included in the priority streams for development of EU End-of-Waste criteria, currently being defined under the EU Circular Economy Action Plan. **Further organisations are still welcome to join this initiative** and sign the letter (see below).

Recycled materials suggested include algae or plant biomass grown using wastewater; fibres, fatty acids, proteins, gums, fats and oils; phosphates and other chemicals or minerals for industrial applications (the route to EU End-of-Waste status for fertiliser applications already exists via the EU Fertilising Products Regulation); CO_2; grit and sand. The request was initiated by ESPP and signatories to date include Eureau (European Federation of National Associations of Water Services), Aqua Publica Europea (European Association of Public Water Operators), EABA (European Algae Biomass Association), Biorefine Cluster Europe, Water Alliance Netherlands, AquaMinerals BV, ACR+ (Association of Cities and Regions for sustainable Resource management) …

Further signatory organisations are welcome: contact info@phosphorusplatform.eu
The joint letter can be consulted here: www.phosphorusplatform.eu/regulatory

"Environmental Hazard Potential" of the CRM "Phosphate Rock"

The final report (Task 2) to the European Commission for preparation of the new working plan for the Ecodesign Directive proposes as a new horizontal Ecodesign initiative "Scarce materials and critical raw materials", because "very relevant in relation to the circular economy action plan and also in relation to the individual product's lifecycle".

Phosphate Rock, which is on the EU Critical Raw Materials list, is identified to have "High EHP" (Environmental Hazard Potentials). This is based on Dehoust et al. 2020 (UBA report).

Dehoust classifies Phosphate Rock as medium concern for governance, but high impact for global material and energy flow and for aggregated Environmental Hazard Potentials. The latter is based on suggested medium EHP for heavy metals, accidental hazards due to landslides etc, water stress and deserts, protected areas and governance, but high for association with radioactivity, surface mining and use of chemicals in processing (acids, flotation). This seems to indicate in some cases misinformation, for example acid used in processing phosphate rock is systematically a by-product. The report concludes that Phosphate Rock is "environmentally critical".

The EU Critical Raw Material "Phosphorus", that is P4, is not considered in the Ecodesign report, which is inappropriate in that P_4 and P_4-derivatives are essential for e.g. electronics manufacture and plastics fire safety, both of which are necessary for many energy using products addressed by EU Ecodesign criteria. This may be because "Phosphorus" (P_4) is not considered in the Dehoust / UBA document.

Task 2 "Identification of product groups and horizontal measures", final draft, March 2021.
Task 3 "Preliminary analysis of product groups and horizontal initiatives", "Scarce and environmentally critical raw materials", draft, February 2021.
https://www.ecodesignworkingplan20-24.eu/
"Environmental Criticality of Raw Materials, An assessment of environmental hazard potentials of raw materials from mining and recommendations for an ecological raw materials policy", G. Dehoust et al., UBA TEXTE 80/2020
https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2020-06-17_texte_80-2020_oekoressii_environmentalcriticality-report_.pdf

Sewage Sludge Directive revision workshop

A stakeholder workshop organised for the European Commission (20-21 April, online, over 270 participants) addressed the revision of the EU Sewage Sludge Directive (SSD) 86/278/EEC. The European Commission, DG Environment, explained that the objectives of this Directive, in the 1980's, were to encourage the recycling of sewage sludge to agriculture and to ensure safety. The 2014 evaluation of the SSD here concluded that it is effective in returning carbon to soil, but inadequate for promoting the Circular Economy, or for controlling pollutants other than heavy metals, and that a number of Member States have today stricter rules. The 2019 evaluation of the Urban Waste Water Treatment Directive concluded that better account should be taken of energy use and greenhouse emissions related to wastewater treatment, and that materials recovery and safe use should be promoted by the SSD. The revision of the SSD should also take into account the EU soil and pharmaceuticals strategies.

Workshop presentations included:

- Alberto Pistocchi, European Commission JRC, modelling toxicity risks of sewage sludge to surface waters and soil and concentrations of micropollutants in soil, crops and humans;
- Rachel Hurley, NIVA, microplastics in sewage sludge and in soils, and trnasfer to surface waters;
- Aoife Kyne, Irish Water and Anders Finnson, Swedish Water Association, quality standards systems for sewage biosolids and actions to reduce pollutants at source;
- Christian Kabbe, EasyMining, different routes for phosphorus recovery;
- Bertrand Vallet, Eureau, valorisation of sewage biosolids beyond agriculture, such as greening of disused mines or ski slopes;
- Dries Huyguens, JRC, direct and indirect greenhouse emissions from sewage treatment: energy use, NOx emissions, chemicals use, on-site renewable energy, displaced emissions from nutrient or materials recovery;
- Jóannes Jørgen Gaard, consultant to the Denmark Environment Ministry, significance of NOx emissions in sewage treatment and opportunities for reducing these.

Workshop conclusions, after breakout sessions, suggested that safe reuse of sewage biosolids in agriculture and recovery of secondary raw materials remain Circular Economy priorities, conform to Green Deal objectives, with possibilities also for biosolids reuse in land reclamation, for which standards should be defined. A priority is reduction of contaminants at source. There is a high potential to reduce greenhouse gas emissions in wastewater treatment, with questions on how and where to define greenhouse emissions objectives.

Possible policy measures proposed include permitting of emissions to sewers of sectors such as car-washes or hair salons, tracking contaminants to source, chemicals and product policies to avoid pollution at source, minimum recovery requirements for phosphorus and for other materials, and water reuse.

European Commission Sewage Sludge Directive web page and evaluation web page.

Safe recycling of nutrients to animal feed

The EU Animal Feed Regulation 767/2009 (art. 6(1) and annex II $1 and $5) excludes materials derived from wastewaters or manures irrespective of treatment or processing. Interpretation of this could pose problems for several recycling routes. For example, if phosphoric acid is recovered from sewage sludge incineration ash, it could be considered that this should not be placed on the commodity chemicals market or only with traceability indicating "not to be used in production of animal feed".

ESPP has consulted operators and identified three relevant recycling routes, and has proposed to the European Commission to address these appropriately in order to lift potential obstacles to the Circular Economy:

- Phosphate chemicals recovered from ashes after incineration of sewage sludge or manure. Such chemicals can be used directly as animal feed (e.g. calcium phosphates) or sold as commodity chemicals (e.g. phosphoric acid). In that this is via ash, there should be no safety risk (incineration will eliminate pathogens).
- Nitrogen chemicals from ammonium gas stripping of sewage, manure or digestates, placed on the market as commodity chemicals. Evidence may need to be gathered to prove that pathogens are not transferred through the gas stripping and chemical processing.
- Algae or other biomass using wastewater or manure as growth medium: case specific safety assessment may be necessary.

ESPP's letter is supported by a table detailing relevant processes, uses of recovered products, status of implementation and safety questions. Comments and input are welcome.

ESPP letter to the European Commission (DG SANTE), 7th May 2021, and supporting table: www.phosphorusplatform.eu/regulatory

European Parliament on Circular Economy

The European Parliament has voted a resolution on the new EU Circular Economy Action Plan. Parliament calls for binding EU targets to reduce material and consumption footprints and harmonised circularity indicators. Parliament calls for investigation of the sources, fate and effects of micro-plastics in wastewater treatment and for equipping new washing machines with microfibre filters. For the Key Product Value Chain "Food, Water and Nutrients", Parliament calls for action to reduce food waste, separate collection of bio-waste, increased replacement of fossil materials with renewable bio-based materials, measures to close the agricultural nutrient loop, reduction of EU dependency on imported vegetable protein for animal feed and increased recycling of animal manure and other organic nutrients. Parliament calls for a circular approach in waste water treatment and "highlights that resources can be recovered from wastewater, ranging from cellulose via bioplastics to nutrients, energy and water".

European Parliament, 10th February 2021, resolution P9_TA(2021)0040 on the New Circular Economy Action Plan
https://www.europarl.europa.eu/doceo/document/TA-9-2021-02-10_EN.html

Fertilising Products Regulations

Digestate and compost in the EU Fertilising Products Regulation

Some 280 participants took part in the EBA – ECN webinar on 28th April.

David Wilken, German Biogas Association, presented conclusions of the EBA – ECN European survey on perspectives for CE-marking of compost and biogas under the EU Fertilising Products Regulation (FPR), when it enters into implementation in July 2022. The survey received over 100 answers from 21 countries. A large majority of respondents considered that the future CE-mark will be relevant for composts and digestates, in particular as a route to obtaining End-of-Waste status and better marketability, although many do not expect it to bring higher sales revenue and most expect it to involve significant administrative burdens and costs (in particular for conformity assessment). Most respondents consider that digestate will need some process of upgrading to achieve FPR criteria (CMC5), e.g. composting of digestate, drying, liquid/solid separation. Manure is seen as a very relevant input material, as well as sewage sludge (which is however excluded from EU FPR composts and digestates), as well as a wide range of other materials.

Theodora Nikolakopoulou, DG GROW, addressed a range of questions concerning application of the FPR to composts and digestates : manures and animal-by products as inputs – do they have to be pasteurised upstream of composting/digestion?; multiplication of conformity assessments if one compost producer supplies several fertiliser producers; definition of "sludge"; additives used upstream of the digestion process (e.g. flocculation agents) – must be declared as a distinct CMC; demonstrating conformity to PAH limits – does not necessarily mean testing …

Digestate valorisation under the EU Fertilising Products Regulation, webinar, 28 April 2021 here. Links to slides and conference report.

ESPP proposals for "CMC-WW"

As indicated I ESPP eNews n°53, the European Commission has proposed a new Component Material Category for the EU Fertilising Products Regulation, "CMC-WW", open to any by-product coming from a "production process" or from a gas processing / gas emissions control process" which offers "high purity" and does not contain specified contaminants. ESPP has input proposals suggesting that:

- CMC-WW should be extended to "and derivates", that is authorise use of such by-products as precursors for producing fertilising materials (not only use directly as such). E.g. by-product sulphuric acid used in phosphate fertiliser production, but not used itself in fertilisers.
- Not require testing for a contaminant if there is no reason for it to be present
- Replace the concept of "high purity" by safety requirements

ESPP submitted list of possible candidate materials for CMC-WW, collated from stakeholders, including: ammonium and sulphur compounds from gas cleaning, sulphur from oil refining, wax by-products, spent acids, ammonium salts from fire extinguisher refurbishment, mineral salts from waste incinerator ashes, by-products from drinking water production, PHBV from fatty acid fermentation, vivianite, nutrient residues from wood bioethanol production …

ESPP proposals to the European Commission on CMC-WW for by-products in the EU Fertilising Products Regulation
www.phosphorusplatform.eu/regulatory

France proposes "half waste" status for sewage sludge composts

The French Government seems to be proposing a new legal status for composts and digestates containing sewage biosolids, manure, biowaste, etc. fulfilling the AFNOR NFU 44 095 standard (that is recognition as a French 'national' fertiliser product). These organic fertilisers would have "Waste" (not "Product") status, but could be placed on the market and would NOT be subject to a spreading plan (the producer is responsible "until they are used by the farmer").

The proposed decree would establish three categories A1 ("Product"), A2 = all composts and digestates containing sewage sludge, manure, food waste, etc ("Waste", but not subject to waste spreading plan) and B ("Waste", subject to spreading plan).

The official Opinion of the French national agency for health, food, environment etc. (ANSES) states that "*the concept of these three categories is not intuitive and their appropriation is not immediate and the whole decree has to be read to understand the distinction*" (20 pages!).

It is unclear to ESPP whether this "half-waste" status (waste, but not subject to waste management plan) is conform to European regulation (Waste Framework Directive). Also, if the producer responsibility stops when the A2 materials are spread on a field, given that they are spread as a "waste", presumably the legal responsibility is transferred to each farmer, which is unlikely to be welcome.

Manure and Animal By Products in "STRUBIAS"

After consultation of stakeholders and operators, ESPP has written to the European Commission (SANTE and GROW) proposing approaches to the currently outstanding question of use of manure or other Animal By Products (ABPs) in "STRUBIAS" materials under the EU Fertilising Products Regulation (FPR), that is struvite and precipitated phosphates, ash-derived materials, pyrolysis and biochars.

The technically-finalised "STRUBIAS" criteria authorise the use of certain ABPs (inc. manure) as inputs for the three STRUBIAS categories, but only if ABP End Point "has been determined". In order to move this forward, ESPP proposes:

- For ashes and ash-derived materials: ABP ash is already today widely used as fertiliser (e.g. poultry litter ash) so determining this ABP End Point should be a priority. In that the incineration combustion conditions defined in the STRUBIAS ash criteria are those recognised in the ABP Regulations as ensuring safety, this should be rapidly possible without requiring any data collection or risk assessment.
- For precipitated phosphates: there appears to be only one installation recovering struvite or precipitated phosphates (of STRUBIAS quality) from manure or ABPs in Europe (NuTriSep Geltz, Germany). Most manure struvite projects recover from digestate, where the digestor can already ensure the ABP End Point. ESPP therefore proposes no further action for this STRUBIAS category at present.
- For biochars: ESPP notes that the JRC report concluded that the pyrolysis conditions defined under STRUBIAS will ensure elimination of pathogens. ESPP requests that EFSA be mandated to define an ABP End Point for STRUBIAS biochars and pyrolysis materials.

ESPP letter to the European Commission on "Animal By Product End Points for EU Fertilising Products Regulation STRUBIAS materials", 16th April 2021 www.phosphorusplatform.eu/regulatory
STRUBIAS criteria, as published for the public consultation February 2021
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12136-Pyrolysis-and-gasification-materials-in-EU-fertilising-products
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12162-Thermal-oxidation-materials-and-derivates-in-EU-fertilising-products
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12163-Precipitated-phosphate-salts-and-derivates-in-EU-fertilising-products

Industry

Florida: state of emergency for disused phosphogypsum pond

Up to 1.8 billion litres of polluted water are being released from a disused phosphate fertiliser factory's 31 ha phosphogypsum pond, at Piney Point, near Tampa, Florida. The State Governor has declared a state of emergency and evacuated 300 households because the pond walls risk collapse, after starting to leak. The fertiliser factory was operated from 1966 to 1999. Media reports suggest that problems with the pond walls have been known for nearly 20 years. The water released from the pond contains phosphorus and nitrogen which will contribute to eutrophication of Tampa Bay and environmental NGOs have warned of risks of red tide algal blooms. The phosphogypsum in the pond also contains radioactive elements, but the Florida authorities say that levels in released water meet quality standards.

The Guardian UK, 4th April 2021, and other media online.

New phosphate production planned in Sweden

Two significant projects to "mine" phosphate from secondary resources in Sweden were presented at the Nordic Circular Materials Conference: 21-22 April 2021. In both cases, the projects will extract phosphate from apatite minerals (phosphate rock family) present in tailings of from iron ore mining, either from operating iron production sites or from stocked tailings from closed mines. The apatite is mainly rare earth element substituted fluorapatite, e.g. monazite, low in cadmium and arsenic, and the extraction of the rare earths with the phosphate will enable economic viability.

Ulrika Håkansson, LKAB, presented the company's project treating ore tailings from iron mines in Kiruna and Malmberget. LKAB's objective is to be operational by 2027, producing c. 50 000 tP/year (five times Sweden's mineral P fertiliser consumption), as apatite concentrate, and c. 30% of EU rare earth needs.

Christer Lindqvist presented the Grängesberg Apatite Recovery Project, which aims to recover apatite from stocked tailings of the Grangesberg iron mine (John Matts dam), which was the world's biggest iron ore producer in the nineteenth century. The following rare earth elements will be produced: Y, La, Ce, Pr, Nd, Tb, Eu. Production will be around 13 000 tP/y, with the aim of starting within 3-4 years. The stocked tailings will support around seven years production, and this may be extended with a project to re-open the iron ore mine

Slides from Nordic Circular Materials Conference
LKAB secondary P-mining project: www.ree-map.com
Grängesberg Exploration Holding AB https://grangesbergexploration.se/

Irish Water and Ostara to produce 14 t/day of struvite

Murphy Ireland and Ostara have announced construction of a new Ostara Pearl® struvite recovery installation, with WASSTRIP®, as part of the upgrade of Irish Water's Ringsend waste water treatment plant to 2.4 million p.e. capacity and conversion to biological phosphorus removal. Struvite production should start in 2023. Ringsend treats around 40% of Ireland's wastewater and discharges into the nutrient Sensitive Area, Lower Liffey Estuary and Dublin Bay.

"Ostara and Murphy Partner to deliver part of Ringsend Wastewater Treatment Plant Upgrade Project for Irish Water", 28th April 2021 press release.

Benefits of struvite

An article by Ostara in World Fertilizer provides an accessible summary of different benefits of recycling phosphorus from sewage as struvite, as operational with 22 commercial Ostara reactors running worldwide. The paper outlines the Planetary Boundary challenge for phosphorus and summarises environmental footprint study data comparing recovered struvite to production of mineral phosphate fertiliser ("emergy" approach, see ESPP eNews 35). Agronomic benefits of struvite are also outlined. Because struvite is crop-available (soluble in weak organic acids) but it is not water soluble, there is no risk of burning germinating crops, lower osmotic stress on soil micro-organisms, and reduced risks of phosphorus run-off to surface waters. Trials have shown that a combination of struvite and mineral fertiliser can increase yield and crop quality in potatoes, above standard fertiliser practice.

"Greener Cycle", R. Leatherwood & R. van Springelen, Ostara, World Fertilizer, March 2021 http://bit.ly/3vf9ZFG

CRU Phosphates Conference 2021

"Phosphates 2021", the only annual global event for the phosphate mining, processing, phosphorus chemicals and phosphate fertiliser industries, brought together some 560 delegates, online, 23-25 March 2021. The online format increased attendance by +50% compared to previous physical conferences.

https://www.phosphates2021.com/

Global phosphate market outlook

Chris Lawson and Glen Kurokawa of CRU outlined current world market trends for phosphates. After falling from around 2012 to end 2019, prices have risen rapidly since 2020, and are back to their 2012 levels (but still less than half the peak prices reached in 2008-2009). This recent increase mirrors increases in agricultural crop prices, and is driven by high world phosphorus demand (including in China, despite a long-term trend to better P efficiency here), low stocks, Covid supply disruption and specific impacts of new import tariffs for the USA.

CRU consider however that the current price level will not be sustained because increases in production (e.g. in China) will bring prices down somewhat in the coming year.

Over the next five years, significant increases in capacity will come online, e.g. in Morocco. Nonetheless prices are expected to remain high over this period because of continuing global demand and increasing costs of raw materials, wages, and (in China) environmental restoration measures.

Over coming decades, the phosphate market is expected to be impacted by long-term trends including continuing growth in agricultural demand, and circular economy initiatives (especially in Europe) to develop recycled products.

New EU Fertilising Products Regulation (FRP)

Johanna Bernsel, European Commission DG GROW, explained that the new regulation is very ambitious, widening to cover many different products related to nutrient use in agriculture, including biostimulants which can improve fertiliser nutrient use efficiency. The regulation has Circular Economy objectives, opening the European market for both recycled nutrient materials and recycling technology providers. It will also bring new protection to EU consumers, because for the first time contaminant limits are introduced for CE fertilisers, including for cadmium.

It is important to note that when the new Regulation enters into implementation in June 2022, producers will no longer be able to market under the old regulation 2003/2003, but will have the choice of using the new regulation (CE-Mark) and/or selling under national fertiliser regulations, which will remain in force in each Member State ("Optional Harmonisation").

Producers should refer to the Frequently Asked Questions and to the Labelling Guidance, both of which documents provide important clarifications on implementation of the new regulation.

In questions from conference participants, it was clarified that the new regulation will limit cadmium to 60 mgCd/kgP2O5 in all CE-Mark mineral phosphate fertilisers from June 2022, as well as limits on certain other heavy metals, and that producers have the option to label "Low Cadmium" when below 20. However, the Commission is mandated by the regulation to review the cadmium limit by 2026, and also to assess a possible uranium limit. Johanna Bernsel also underlined that possible action is also envisaged on contaminants in all fertilisers (organic and mineral, CE-Mark or national fertilisers) with a study underway (see ESPP eNews n°52.

European Commission FRP "Frequently Asked Questions" here
European Commission FRP labelling guidance document C(2021)726 (18/2/2021) and Annex here

Fertiliser market trends in Europe

Konstantin Golambek, Fertilizers Europe, presented latest conclusions from the federation's annual analysis of European fertiliser markets and estimates for trends for the coming decade. Phosphorus consumption in mineral fertilisers has fallen by around half in Europe since the 1980's and has been fairly stable since the late 2000's. Fertilizers Europe estimates that P use in mineral fertilisers in Europe will fall very slightly, maybe c. 2%, over the next ten years, and N by maybe -5 to -6%. However, there are major regional differences in mineral P fertiliser use across Europe, partly related to differences in density of livestock production (and so manure availability and use).

Fertiliser use will be influenced by crop choice, by climate and by the global agri-food commodity market, by innovation in agriculture, by regulation and also in the long term by a move towards more plant-based diets and by the need for the EU to replace imported animal feedstuffs, such as soy. Farmers in Europe are under high pressure because of labour costs, food industry purchasing and regulation.

Fertilizers Europe sees as key to responding to these challenges: balancing all nutrients and use of both mineral and organic fertilisers, adapting to different regional contexts, increasing knowledge per hectare, Circular Economy and high-efficiency fertilisers. The aim is to improve Nutrient Use Efficiency and maintain soil fertility. Nutrient Management Plans in the Common Agricultural Policy will be critical for this.

How EU policies will influence phosphorus use

Chris Thornton, ESPP, summarised European policies and regulations which will significantly impact phosphorus use in Europe in coming years. The Green Deal Farm-to-Fork and Biodiversity Strategy target to reduce nutrient losses by 50% by 2030 should considerably impact use of mineral fertilisers, organic fertilisers and livestock manure. This is driven by the ongoing problem of eutrophication, likely to be accentuated by climate change, with phosphorus the main (non-morphological) cause of failure to achieve Water Framework Directive quality status requirements in surface waters. Farm-to-Fork also announces actions to promote a shift towards healthy and sustainable diets, with more plant-based foods and less red meat. However, these objectives require clear requirements on balanced nutrient management in the European Common Agricultural Policy (CAP), and this is not yet defined. Other EU policies which significantly impact phosphorus use include the confirmed inclusion of both phosphate rock and P4 on the EU Critical Raw Materials List, the EFSA safe limit (ADI) for phosphorus in food (2019) and Circular Economy policies.

ESPP presentation slides here: https://www.slideshare.net/NutrientPlatform

EasyMining phosphorus recycling

Yariv Cohen, Sara Stiernström and Christian Kabbe presented the EasyMining (a subsidiary of Ragn-Sells) **Ash2Phos** process for recovering phosphorus in a purified form from sewage sludge incineration ash. The process uses acid then lime to extract phosphorus from ash and separate off the inert silica (as a sand, useable in the construction industry). The phosphorus is purified (>96% removal of impurities including heavy metals) to produce a precipitated calcium phosphorus (PCP) which is for example 80% soluble in NAC (conform to the new EU Fertilising Products Regulation requirement of >75%) or can be converted to di-calcium phosphate (DCP, 100% NAC soluble). Iron and aluminium can be recovered and recycled as coagulants for sewage treatment. Because of the purity of the recovered PCP, this is currently being trialled for use in animal feed (see ESPP eNews n°52). Easymining today have a 30 000 t-ash/year plant currently in the permitting process in Helsingborg, Sweden, a second 30 000 t-ash/y plant under planning near Berlin Germany and aim to have a third 300 000 t-ash/year capacity in Germany within a decade.

http://easymining.se/ and ESPP – DPP – NNP P-recovery Technology Catalogue http://www.phosphorusplatform.eu/p-recovery-technology-inventory

Glatt PHOS4green

Jan Kirchhof, Glatt Ingenieurtechnik GmbH, presented this process which is based on suspension and granulation technologies. Ash is mixed with phosphoric or other acid or additives in a batch reactor, then buffered, then goes to a continuous spray granulation process. The processing is flexible, and other acids or solid or liquid raw materials can be used. At present, the process transfers all contaminants, inert materials such a silica, and iron and aluminium, present in the ash, into the final product. This means that at present only ashes which themselves fulfil fertiliser regulation requirements can be used. Glatt indicate that they are currently at the design phase for a process for heavy metal removal. A first full-scale plant is currently under commissioning in Haldensleben, Germany, with capacity to intake c. 30 000 t-ash per year and produce c. 60 000 t/y fertiliser.

https://phos4green.glatt.com/ and ESPP – DPP – NNP P-recovery Technology Catalogue http://www.phosphorusplatform.eu/p-recovery-technology-inventory

Phosphoric acid from low-grade phosphate rock

Marc Sonveaux and Hadrien Leruth, Prayon, presented Prayon's phosphoric acid production processes, including from low-grade phosphate rock and for phosphorus recycling. The **Ecophos / Technophos process** produces feed grade DCP (di calcium phosphate) from low-grade phosphate rock with high magnesium content (P content

Recycled nutrients in Organic Farming

RELACS: recycled nutrients in Organic Farming

The final two RELACS webinars on potential and risks of use of recycled nutrient products in Organic Farming considered contaminants, recycling routes and Life Cycle Analysis (following on from the first three webinars already summarised in ESPP eNews n°53) and concluded with discussion of how use of recycled nutrients is considered in the EU Organic Farming Regulation and perspectives for using recycled nutrients as Organic Farming inputs in the future.

Environment and health

Robin Harder, SLU (Swedish University of Agricultural Sciences), presented possibilities of recycling nutrients from human faeces and urine and from municipal sewage. When excreta are collected separately at the source (to date only marginal in Europe), this can provide nutrients in a more concentrated form and with less contaminants than in municipal sewage, though pharmaceuticals and hormones are still potentially present. Technically, it should be possible to obtain clean and safe recycling fertilisers from both source-separated urine and faeces and from municipal sewage. In case of recovery from municipal sewage, the focus is often on phosphorus, whereas with recovery from source-separated excreta, a broader focus on more nutrient elements is more common.

Kristian Koefoed Brandt, University of Copenhagen, summarised knowledge on antibiotic resistance genes (ARGs) in organic waste streams and in soils. Farmland application of organic fertilizers typically leads to a transient increase in abundance and diversity of antibiotic resistance genes (ARGs). Metals such as copper and zinc may constitute persistent selection pressures for antibiotic resistance (co-selection) in some agricultural soils, whereas antibiotic residues tend to be quickly biodegraded or inactivated in soil (Song et al., 2017). Results from a recent Swedish agricultural field trial indicated that 40 years of sewage sludge application did not have any clear effects on ARGs most likely due to competitive exclusion of sludge-derived bacteria (Rutgersson et al., 2020).

Lukas Egle, Vienna Municipality, presented the City's objective to recover phosphorus from ash from mono-incineration of sewage sludge, and maybe in the future, also animal by-products. The incineration route ensures elimination of organic contaminants and microplastics, and heavy metals are removed in the ash processing. In Austria, sewage contains around 1 kgP/person per year, and phosphorus in animal by-products is a further 0.5 – 0.6 kgP/person/year. If this were fully recovered, it would represent nearly half of Austria's mineral phosphate fertiliser use.

Ludwig Hermann, Proman and ESPP President, summarised conclusions of LCA comparisons between mineral fertilisers and recycled nutrient products under the Phorwärts (see ESPP eNews n°28), Systemic and Lex4Bio projects. Greenhouse gas emissions from mineral phosphate fertiliser production are relatively limited, 1 – 1.5 kgCO_2-eq./kgP_2O_5, compared to 9 -11 kgCO_2-eq./kgN for mineral nitrogen fertilisers. Environmental impacts of most recycled P-fertilisers are lower than those of mineral P-fertilisers, particularly if heavy metals are removed. However, the lower impact is not guaranteed due to high chemicals consumption for some recovery processes or relevant heavy metal concentrations (Zn, Cu, Pb, Cr) compensating the advantage of lower cadmium concentrations. LCA analysis suggests that the most important environmental impacts are freshwater eutrophication (in the use phase), cadmium toxicity (depending on the source of rock used) and risk of accidental pollution from phosphogypsum waste stocks (generally around historic production sites, see article on Tampa, Florida, below). Difficulties are that various different LCA methodologies are not compatible, results depend very strongly on definition of boundaries and allocation of impacts to different outputs, non-coverage of accidental pollution risks in LCAs and need for probabilistic risk assessment for pollutants.

Perspectives for acceptance of recycled nutrients in Organic Farming

Bernhard Speiser, FiBL, outlined key points of the EU Organic Farming Regulation relevant to use of secondary nutrient materials. A material can only be used as an input (e.g. fertiliser) in Organic Farming if it is specifically listed in the Regulation annex. At present, a number of secondary nutrient materials are listed (with various specific conditions, in particular "not from factory farming"): manure, dejecta of insects and worms, composted/digested household biowaste, biogas digestate, mushroom culture waste, slaughterhouse wastes, alcohol industry stillage, mollusc waste, egg shells, industrial lime from sugar or salt production. The Regulation also fixes some general principles: input materials must be from plants, algae, animals, microbes or minerals (i.e. not chemically processed) unless such materials are not available in sufficient quantity or quality. Also (art. 5) mineral fertilisers must be "low solubility".

Frank Oudshoorn, SEGES Denmark and member of EGTOP (the EU expert group on Organic Farming) explained that this group examines proposals to add additional input materials to the Regulation annex, when a dossier is submitted with support of a Member State. EGTOP examines whether the proposed material is needed for Organic Farming, safety, and assesses conformity to the overall principles of Organic Farming: natural or Organic origins of the material, low solubility, principle for fertilisers of feeding the soil not the plant. However, Member States may sometimes interpret differently. For example, Denmark has, in advance, accepted use in Organic Farming of ammonium sulphate recovered from digestate by combining stripped ammonia with stripped sulphur – because it was considered the production process was a "mechanical" concentration of digestate. The process has however not been used yet.

Anne-Kristin Løes, NORSØK (Norwegian Centre for Organic Agriculture), underlined the need for a scientific approach to defining terminology used in the Organic Farming Regulation, such as "natural", "low solubility", "physical processing". This is explored in Løes and Adler, 2019 which discusses the dilemmas between "natural" and sustainability and recycling; between "low solubility" and clean, low contaminant products, between "non-chemical processing" and efficient use of natural resources. The concept of "natural" in Organic Farming is explored in Verhoog 2003 and 2007.

Jakob Magid, University of Copenhagen, summarised a study underway in Denmark on opinions of committed Organic consumers on the use of recycled materials as inputs to Organic production. This suggests that there are two types of committed Organic consumers, at present of similar proportions: those who see Organic products as "pure and clean" and find abhorrent recycling of wastes to Organic farming, and those who favour "sustainability" and consider recycling as an important path towards a more sustainable food system.

In discussions with webinar participants and from the presentations at the five webinars, the following possible conclusions were proposed and will be elaborated in a synthesis document:

- Many contaminants have decreased in both sewage sludge and manure
- Organic contaminants in sewage are not a significant risk, but do generate fear and uncertainty
- Sustainability and recycling are core objectives of Organic Farming
- Multi-criteria assessments of recycling options are needed, including sustainability aspects
- Work is needed on defining terms used in the Organic Farming Regulation, such as "low solubility" or "processing.
- In particular, a definition of "factory farming" is needed (the European Commission has started discussions on this).
- The Organic Farming movement should have a voice on societal questions such as livestock production localisation, separative sewage collection

RELACS (Improving Inputs for Organic Farming), Horizon 2020 https://relacs-project.eu/

Research

Eutrophication significantly increases greenhouse emissions

A review of around 100 scientific publications concludes that eutrophication significantly increases greenhouse gas emissions from freshwaters (CO_2, methane, N_2O). An increase of 5 µg/l of chlorophyll-$_a$ in lakes and reservoirs worldwide would result in an increase of GHG emissions equivalent to >6% of fossil fuel CO_2.

The current GHG emissions from freshwaters worldwide are estimated to be equivalent to >30% of global fossil fuel CO_2 emissions (56% from freshwater CO_2 release, 40% from methane, 4% from N_2O).

Eutrophic shallow lakes are estimated to emit nearly 50% more methane than comparable non-eutrophic lakes. Eutrophication increases organic matter production in fresh waters, but it is unclear whether the resulting net CO_2 uptake will compensate for increased methane production, because the organic matter produced is readily degradable. Increased nitrogen loading to surface waters can cause them to shift from being N_2O sinks to net N_2O emitters. Eutrophication also increases freshwater GHG emissions indirectly, for example, by shifting from vegetation dominated by macrophytes to algae, whereas macrophyte roots tend to reduce methane production by moving oxygen to sediments. Also, cyanobacteria readily produce methane even in the oxic water zone, both at day and at night.

The review also shows that climate change is expected to significantly increase freshwater GHG emissions and eutrophication (see also ESPP SCOPE Newsletter n°137 on climate change and eutrophication), with positive feedback loops. Increasing temperatures will increase release of nutrients from sediments (accelerated mineralisation), as will extreme climate events (remobilisation of sediments). Both will also lead to increased nutrient losses from land to freshwaters. Increased temperatures may also favour methane production in freshwaters, rather than methane consumption.

This review confirms that policy makers need to further reduce nutrient inputs to surface waters, both because climate change will increase eutrophication risks, and because freshwater eutrophication contributes significantly to greenhouse gas emissions.

"The role of freshwater eutrophication in greenhouse gas emissions: A review", Y. Li et al., Science of the Total Environment 768 (2021) 144582 https://doi.org/10.1016/j.scitotenv.2020.144582

Biochar pyrolysis removes antibiotic resistance genes

Pot trials in China using pakchoi (*Brassica chinensis*) suggest that pyrolysis at 400 – 450°C for 30 minutes reduces ARGs (antibiotic resistance genes) to levels comparable to those in control soil. The tests compared composted pig manure ("high temperature" composting for several weeks) from two different farms to control soil (collected from farmland) and to pyrolysed composted manures (biochar). Compost was added to the pots at 4% dw/dw, and the biochar at 1.2% (equivalent because biochar yield was c. 30% of compost input dw/dw). The pots to which compost was added showed much higher levels of ARGs and of MGEs (mobile genetic elements) on the day of application than the control and biochar pots, between which there was no significant different in number of ARGs. Levels of ARGs were still higher in the compost pots after 40 days. The authors conclude that pyrolysis to produce biochar mitigates ARGs in manure.

In a paper cited, H. Liao et al. compared impacts of two composting systems, large scale (c. 20 tonnes), on levels of ARGs in sewage sludge: hyperthermophilic composting (total time 25 days, of which 15 days > 70°C), conventional composting (total time 45 days, 5 days > 55°C). The hyperthermophilic composting showed significantly better reduction of ARGs and MGEs, and shorter half-lives, compared to conventional composting. Hyperthermophilic composting reduced resistance to different antibiotics by 60 – 85 %, whereas conventional composting reduced resistance by 30 – 40%.

"Turning pig manure into biochar can effectively mitigate antibiotic resistance genes as organic fertilizer", X. Zhou et al., Science of the Total Environment 649 (2019) 902–908 https://doi.org/10.1016/j.scitotenv.2018.08.368

Differing positions on sewage sludge use in agriculture

A paper based on literature and 17 stakeholder interviews concludes that attitudes to agricultural use of sewage sludge in Sweden (after treatment such as composting or anaerobic digestion) are highly polarised. Fear of contamination, in particular "unknown or unfamiliar" risks, and "feelings of disgust" are obstacles to acceptance, despite the benefits of recycling nutrients and organic matter. Stakeholders interviewed were 5 famers or farmers' cooperatives, one food retailer, one NGO, sewage works operators, regulators and consultants. An identified need is better monitoring and risk assessment of emerging contaminants such as PFAS or microplastics. The study concludes that use of sewage sludge in agriculture brings important benefits but that the priority should be better understanding and control of risks.

"Resources and Risks: Perceptions on the Application of Sewage Sludge on Agricultural Land in Sweden, a Case Study", N. Ekane et al., Front. Sustain. Food Syst. 5:647780, https://doi.org/10.3389/fsufs.2021.647780

Phosphate fertiliser value of dairy processing sludges

Dairy industry wastewater phosphate removal sludges, resulting from use of aluminium or calcium to precipitate phosphate to sludge, were compared to superphosphate for P-fertiliser effectiveness, on grassland in a field trial in Ireland on P-deficient soil. The P was applied on 12th April and grass was harvested on 24th May, 17th July, 26th September and 6th February of the following year. Differences in grass biomass yield were not significant compared to control, neither for the superphosphate nor for the dairy sludges. Differences in grass P concentration were not significant compared to control for any treatment in the second and third harvest, but were significantly higher with superphosphate in the first harvest, and significantly higher with both of the dairy sludges in the fourth harvest. The authors calculate that the fertiliser replacement value for the first harvest was 50% for the aluminium sludge and only 16% for the calcium sludge, but increasing to around 100% over time (one year, fourth harvest) for the aluminium sludge. They conclude that P fertiliser replacement value of dairy sludges varies significantly depending on the P-removal process and that appropriate information should be supplied to farmer to enable appropriate P management.

"Differing Phosphorus Crop Availability of Aluminium and Calcium Precipitated Dairy Processing Sludge Potential Recycled Alternatives to Mineral Phosphorus Fertiliser", S. Ashekuzzaman, Fertiliser. Agronomy 2021, 11, 427 https://doi.org/10.3390/agronomy11030427

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