

KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 1 www.phosphorusplatform.eu

Nutrient recovery from wastewater: opportunities & challenges of EU regulatory context

Kimo van Dijk, European Sustainable Phosphorus Platform (ESPP) kimovandijk@phosphorusplatform.eu





KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 2 <u>www.phosphorusplatform.eu</u>

The big picture of phosphorus - P

- Non-replaceable building block of life on earth
- Finite resource essential for global food security
- Major component of a Nutrient Circular Economy
- Critical Raw Material in leading edge industries
- Pollutant causing water quality failure





Nutrient challenges in Europe



Phosphorus use in the EU-27



Reuse of organic waste in EU-27



Based on Barth et al. 2008

Sludge destinations in EU-27 in 2010



Source: P-REX, FP7 project, <u>www.p-rex.eu</u>; based on a EUREAU study on sewage sludge handling & eurostat



Nutrient challenges in the Netherlands



Phosphorus flows in NL for 2011



Average phosphate surplus in Dutch agriculture 1880-2010



Ehlert et al., 2011

Phosphorus balance & losses in NL in 2011

Import Export Net balance

TOTAL	110.6	68.9	41.7
Waste		2.4	-2.4
Manure		16	-16
Animals	0.2		+0.2
Non-food	3.4	1.3	+2.1
Food	32.9	49.2	-16.3
Feed	67.1		+67.1
Fertilizer	7		+7



Potential losses	Gg P/year
Sequestered	23.2
Accumulation soils	11.8
Emissions to water	6.6
TOTAL	41.6

Smit et al. 2015. A substance flow analysis of phosphorus in the food production, processing and consumption system of the Netherlands. DOI 10.1007/s10705-015-9709-2

Transition towards sustainable P use (5xR)

Realign P inputs	 remove non-essential P inputs (e.g. detergents) match P requirements more closely (precision agriculture) utilise legacy P stores
Reduce P losses to water	 optimise input management minimise runoff and erosion strategic retention zones
Recycle P in bioresources	 avoid wastage improve utilization efficiency adopt integrated production systems
Recover P in wastes	 recover P in societies' wastes produce fertilizer substitutes
Redefine P in the food chain	 influence dietary choice define end-user P requirements re-connect crop and animal production systems

Withers, Van Dijk, et al. (2015): Stewardship to tackle global phosphorus inefficiency: the case of Europe

Availability of macro & micronutrients



Source: de Haes et al. 2012. Schaarste van micronutriënten in bodem, voedsel en minerale voorraden: Urgentie en opties voor beleid. Utrecht, Netherlands, Platform Landbouw, Innovatie & Samenleving. **AND** Chardon & Oenema, 2013. Verkenning mogelijke schaarste aan micronutriënten in het voedselsysteem, Wageningen: Alterra Wageningen UR.



KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 13 <u>www.phosphorusplatform.eu</u>

1991 – today: EU water policies (principal legislation)

- Urban Waste Water Treatment Directive 1991/271

- defines eutrophication "Sensitive Areas" = 'potentially' subject to eutrophication
- requires P removal of 80%P and/or down to 2 mgP/l for all wwtp > 10 000 pe (1 mgP/l wwtp > 100 000 pe) in these areas and in their upstream catchments
- requires "appropriate" treatment in wwtp < 10 000 pe

- Nitrates Directive 1991/676

- defines nitrate "Vulnerable Zones"
- requires action plans in these zones
- limits application of manure and fertiliser, obligations for manure storage, etc.

- Water Framework Directive 2000/2000

- all surface and ground waters must achieve Good Ecological Quality Status or (Potential) by 2015 / 2021/ 2027

- Groundwater Directive 2006/118

- Phosphorus on monitoring list (2014)



Phosphorus is first cause of EU Water Framework Directive quality status failure (other than morphology) 55% of UK rivers and 74% of lakes exceed P level for good ecological status



2014 EU Consultative Communication on Sustainable Use of Phosphorus

"the EU should prioritise reducing the use of mined phosphate in favour of recycled phosphates"

- Increasing knowledge and research
- Security of supply
- Risk of soil contamination by mineral or recycled fertilisers
- *P* recycling from wastewater, food waste and other biowastes
- P in agriculture: balanced fertilisation, manure processing
- Policy instruments
- Awareness raising and platforms

see www.phosphorusplatform.eu/scope107



Summary of the responses to the Consultative Communication on the Sustainable Use of Phosphorus [COM(2013) 517]



KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 15 <u>www.phosphorusplatform.eu</u>

2014

Supply risk

Phosphate rock added to EU list of 20 Critical Raw Materials

- List currently under revision
 Addition of P₄ proposed
 - (as well as phosphate rock)





EUROPEAN COMMISSION

PRESS RELEASE

Brussels, 26 May 2014

20 critical raw materials - major challenge for EU industry

The European Commission presented today a revised list of Critical Raw Materials. The 2014 list includes 13 of the 14 materials identified in the previous list of 2011, with only tantalum moving out of the list (due to a lower supply risk). Six new materials appear on the list: borates, chromium, coking coal, magnesite, phosphate rock and silicon metal bringing the number up to 20 raw materials which are now considered critical by the European Commission. The other 14 raw materials are: antimony, beryllium, cobalt, fluorspar, gallium, germanium, indium, magnesium, natural graphite, niobium, platinum group metals, heavy rare earths, light rare earths and tungsten (MEMO/14/377).

http://europa.eu/rapid/press-release MEMO-14-377 en.htm

Economic importance



KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 16 <u>www.phosphorusplatform.eu</u>

2015 EU Circular Economy Package

In responses to public consultation:

- > 30% of respondents identified bio-nutrients as "materials the EU should target first" (Q5, Q3)
- Overall, 54% cited bio-nutrients or phosphorus (all questions)





Public procurement (64)

Collection

Circular economy

Consumption Use, reuse, repair



March 2016 – ongoing EU Fertilisers Regulation

- currently in Council Parliament decision process
- EU criteria for all fertilisers & soil amendments
 - mineral fertilisers, composts, digestates, food industry wastes, ABPs animal by-products (but CMC11 still a "blank box") ...
- will open EU market for recycled nutrient products and also for nutrient recycling technologies
- but sewage biosolids excluded
- many issues remaining

See www.phosphorusplatform.eu/regulatory





EU Fertilisers Regulation – key issues outstanding

- ESPP amendment on traceability
 - for products containing organic materials
- STRUBIAS (JRC) process
 - struvite/phosphate salts (inc. from sewage) ash-based materials biochars
 - currently not in Regulation STRUBIAS = draft criteria proposed to add

→ see <u>www.phosphorusplatform.eu/regulatory</u> - comments to ESPP by end July latest

- should cover ash used directly on fields (e.g. chicken litter ash)
 - as well ash input to chemical processing (e.g. sewage sludge ash)
- other sewage-recovered products to add ?
- contaminant limits, by-products, low carbon mineral fertilisers, etc,

www.phosphorusplatform.eu/regulatory



EUROPEAN COMMISSION

European Commission > DocsRoom > Document detail

Proposal for a Regulation on the making available on the market of CE marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009



EU Fertilisers Regulation revision

A "CE" fertiliser can be sold anywhere in Europe ... but other products/materials can be used on fields
 J if authorised as a "national" fertiliser
 J under 'Waste' spreading authorisation

✤ A material which is recognised as a "CE" fertiliser …
→ is granted 'End-of-Waste' status

Article 18 End-of-waste status

A CE marked fertilising product that has undergone a recovery operation and complies with the requirements laid down in this Regulation shall be considered to comply with the conditions laid down in Article 6(1) of Directive 2008/98/EC and shall, therefore, be considered as having ceased to be waste.



National policies

Switzerland 2016 obligatory P-recovery from sewage sludge and animal waste ash (or separate storage pending recovery) Germany 2017: new sludge ordinance (AbfKlärV underway) will make P-recovery obligatory for all sewage works > 50 000 p.e. (see ESPP eNews n° 7 <u>http://www.phosphorusplatform.eu/scope-in-print/news/1408-enews7</u>)



Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra

Scope Newsletter n ° 118 http://www.phosphorusplatform.eu/scope118



Principales nouveautés dans l'ordonnance sur le traitement des déchets

L'ordonnance sur le traitement des déchets (OTD) est soumise à une révision totale. Voici en résumé les principales modifications :

- Des exigences sont formulées pour la valorisation de certains déchets, laquelle n'était pas encore réglementée dans le droit fédéral. Il s'agit notamment des biodéchets (y compris règlementation relative aux possibles installations de traitement) et des déchets riches en phosphore.
- Un plan d'élimination des déchets est exigé pour tout projet de construction. Le maître d'ouvrage est tenu de déterminer les déchets dangereux pour la santé et pour l'environnement (n. ex. amiante, déchets de chantier contenant des hiphényles)



National policies

Finland government 2017: objective to process 50% of manure and sewage sludge for nutrient recycling Sweden EPA proposed objectives: 2002 = 60% of sewage P to agriculture inc. in biosolids

2015 = 40% of sewage *P* and 10% of manure *N*

- Denmark waste strategy 2013
- **2018** = 80% reuse of sewage P to farmland

And 55-60% of household organic waste to biogas production





Standards

CEN (European standards organisation):

- CEN/TC 308, /TS 13714, /TR 13097 sludge management
- CEN/TC 165 WG40 wwtp > 50 PT
- CEN/TC 223 & 260 Soil improvers, fertiliser, etc
- 2017: CEN/SABE position on standards needs to support P-recovery online at <u>www.phosphorusplatform.eu/regulatory</u>

2017 CEN/CLC/BT/JWG 11 standards needs for sustainable chemicals

for the circular economy (underway)

ISO (International Standards Organisation)

- ISO 275 sludge recovery, recycling, treatment and disposal

Etc ...





This Position Paper aims to provide a basis for recommendations to CEN/SABE for CEN/BT further to the conclusions of the CEN/SABE ENV Team (Environmental Monitoring Strategy Team) meeting of 25 March 2015 on "Phosphorus recycling ¹from wastewater treatment processes: available technologies, applicability and standardization needs".

Organic contaminants in sewage biosolids *Priority challenge for ESPP: more than half of EU sewage sludge is today recycled to land*

- ESPP workshop on pharmaceuticals in sewage biosolids Malmö 27/11/16 <u>www.phosphorusplatform.eu/scope123</u>
- EU consultation on pharmaceuticals in the environment May 2017 <u>http://www.phosphorusplatform.eu/organic-contaminants</u>
- ESPP & Eureau position on need for R&D

into pharmaceuticals in biosolids:

- risks assessment
- fate in treatments
- EU consultation on microplastics

http://www.eumicroplastics.com/



"Answers to the Sewage Sludge Questionnaire", EurEau 4.10.2016 <u>www.eureau.org</u> under Positions/Reports



KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 24 <u>www.phosphorusplatform.eu</u>

Obstacles for nutrient recycling in Dutch Legislation

Heavy metals legislation:

- More strict legislation in the Netherlands than obliged by EU
- For example: it is impossible to apply sewage sludge direcly on the land, or other heavy metals issues for waste streams such as sugar beets

Struvite:

• Discussions about the pathogens and medical wastes in struvite, no clear framework yet, this is in progress, but still not in place

Manure products:

 Products from manure depend on EU legislation (Nitrates directive, Fertilisers Regulation), once manure always manure situation, hopefully new development in 2018 with EU guidelines on products from manure treatment ("End-of-Manure-status")



KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 25 <u>www.phosphorusplatform.eu</u>

Obstacles for nutrient recycling in Dutch Legislation

End-of-waste:

• Still definition of waste, end-of-waste, by-products create difficulty

Manure market disturbed:

• Difficulties with the market which is disturbed because of the large surplus of manure, creating obstecales for other fertiliser products



KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 26 www.phosphorusplatform.eu

Positive developments in the Netherlands

2015 recovered phosphate catagory in Dutch fertilisers law

6th Action Programme Nitrates creates exception rule for products that have a positive effect on the soil

Living lab regions with space for experimenting – fertiliser free 'Achterhoek'

Policy programme: Netherlands circular 2050 -> transition agenda's

Global nutrient recycling example

Dutch recovered struvite sailed back to south America to be used as fertiliser to grow cacao beans for chocolate factory in Amsterdam (www.treshombresreep.nl)



Regional nutrient recycling example

Festival collected urine used for growing barley for the production of beer in Denmark (<u>Pisner</u> made by local brewery Norrebro Bryghus, Copenhagen)





KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 29 www.phosphorusplatform.eu

Dutch Success Stories in nutrient recycling





KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 30 www.phosphorusplatform.eu

Wastewater nutrient recycling

Waste water treatment as an Energy and Resource Factory





KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 31 www.phosphorusplatform.eu

Manure nutrient recycling

Sustainable manure management





Energy















Water



KNW Waternetwerk symposium "Resource recovery, just do it?", Wageningen, 9th November 2017 - 32 www.phosphorusplatform.eu

Nutrient recovery from wastewater: opportunities & challenges of EU regulatory context

Kimo van Dijk, European Sustainable Phosphorus Platform (ESPP) kimovandijk@phosphorusplatform.eu





ESPP: a coalition for action

- Objectives: sustainable phosphorus use & recycling
 - global food security
 - circular economy
 - environmental protection
 - healthy diet and food safety

Bringing together:

- wide range of industries
- national & regional governments,
- knowledge institutes
- not for profit Platform
- funded by Members



Participate Collaborate Innovate

• Actions:

- vision & awareness
- stakeholders & networking
- dissemination
- policy and regulation dialogue

Success story:

Waternet Amsterdam West sewage works

- AirPrex struvite precipitation
- Upstream of sludge digesters
- Operational savings: 150 000 € / year
- Improved sludge dewatering:
 250 000 € / year
- Increased methane production
- Achievement of 1 mgP/l discharge





Success story:

Ecophos P-recycling from sewage sludge ash

- Pilot plant operational Varna, Bulgaria
- Produce DCP (Di Calcium Phosphate) for fertilisers, animal feed
- Full-scale plant under construction Dunkerque, France capacity: 200 000 t/y DCP from low grade P-rock and ash
- Contract to treat 60 000 t/y ash from Netherlands (SNB HVC Groep) = 4 000 t/y P

See SCOPE Newsletter 111 and <u>www.ecophos.com</u>



A big step for Phosphorus recycling!

The Dutch companies HVC and SNB have signed a contract with EcoPhos (Belgium) for the recycling of Phosphorus from the fly ash of the Sewage Sludge Incineration Plants in Dordrecht and Moerdijk in the Netherlands. With this agreement HVC and SNB have made a big step for the Waterboards in the Netherlands in recycling Phosphorus, an increasingly scarce very important resource.

Unique process

Ecophos has developed a unique process to valorise. Phosphorus from the fly ash of sewage sludge incineration plants into high quality fartilizers. The Ecophos process leads to well-known existing.



35

Success story:

Timac: struvite as maize starter fertiliser

- Fertiliser industry added-value for recycled nutrients
- NuReSys recovered struvite from potato processing
- Non-burning, enabling "ultra localisation" next to roots

NuResy

- Micro-granulation
- Ammonium addition for nutrient balance



Success story: Recophos – ICL

- Electrothermal production of white phosphorus (P4) from sewage sludge / ashes
- High-value raw material for chemicals: fire safety, electronics, ...
- Recophos FP7 pilot project
- Technology acquired by ICL March 2016

<u>www.icl-group.com</u>

http://www.prnewswire.com/news-releases/icl---next-step-towardssustainable-innovation-571973381.html



Recha



Success story:

REVAQ sewage treatment Certification

- > 50% Sweden's sewage goes to REVAQ Certified sewage works
- Sludge digestate quality, monitoring, information transparency criteria
- 3000 t/year phosphorus recycled to agriculture

http://www.iea-biogas.net/case-studies.html?file=files/daten-redaktion/download/case-studies/REVAQ_CAse_study_A4_1.pdf



Success story:

Friesland Campina milk cooperative, NL

- Biogas production and P-recovery from manure
- Bonus/malus in milk purchase prices
- Funding support for farmers' manure treatment investments

www.frieslandcampina.com

<section-header><section-header><text><text><text>

Success story:

ICL fertilisers Amsterdam & Ludwigshaven

- Use of secondary materials in fertiliser production:
 - meat and bone meal ashstruvite
- Objective: 100% by 2025
- Pilot testing successful
- Industrial installations (storage, handling) planned
 <u>www.icl-group.com</u>



Success story: SARIA UK – Kalfos

- P-fertiliser and soil conditioner from combustion of animal by-products (MBM)
- Authorised for arable and grazing land
- 12 000 tonnes/year

http://www.kalfos.co.uk/











Success story: NutriTrade Baltic local fish

- Local fisherman incited to catch cyprinids
 - restore food web (algal grazing zooplankton)
 - remove nutrients from the sea
- Promote new markets for local fish products:
 - recipes, chefs, new processing routes & consumer products
- Biogas production from processing by-products
- Cost: c. 66 €/ kgP removed (not inc. sales) Launched 2015. John Nurminen Foundation / NutriTrade http://nutritradebaltic.eu/pilots/pilot-fish/



