PLATFORM BSR WATER

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Policy brief on phosphorus recovery in industrial wastewater treatment plants

BSR WATER – Platform on Integrated Water Cooperation
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Imprint

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Project note

The EU co-funded project **BSR WATER – Platform on Integrated Water Cooperation** (2018–2021; www.bsrwater.eu) aims to enhance cross-sectoral cooperation in smart water management by providing a possibility for transnational experience exchange, sharing of good practices and solutions, as well as delivering comprehensive overview of the current and future regional policy. The platform brings together experts representing diverse projects that have generated through transnational cooperation many replicable and unique solutions, covering broad variety of water-related issues.

The platform cooperation is based on practical achievements and results of seven projects addressing a wide range of water management challenges. The outcomes and practical findings of the contributing projects (IWAMA, BEST, iWater, Manure Standards, Village Waters, Reviving Baltic Resilience, CliPLivE) support the long-term development of regional environmental policy and recommendations, which will further strengthen the policy-practice link in implementation of advanced water protection measures, including smart nutrient management and sludge handling, storm water management and the energy efficiency cycle at the national and municipal levels.

Policy Brief

Phosphorus recovery in industrial wastewater treatment plants

Pressure

Eutrophication is one of the main threats to the biodiversity of the Baltic Sea and is caused by excessive inputs of nutrients – particularly phosphorus - to the marine environment.

Objective

The present policy briefs provide recommendations contributing to the common goal of recreating a **Baltic Sea unaffected by eutrophication** by

- *By preventing phosphorus losses*
- *By closing phosphorus loops through recovery and recycling*

Scope

This policy brief addresses phosphorus (P) recovery in **industrial wastewater treatment plants (WWTP) with significant P loads, in particular wastewater from the milk and dairy-, potato processing- and juice industries.**

Status

HELCOM reported 1 814 industrial WWTP in the Baltic Sea catchment in 2014. Around half of these plants are located in Finland, while Poland accounts for 31%. However, Finnish plants tend to be small on average, as in total only 415 Mm³ industrial wastewater are generated, compared to 2 115 Mm³ in Sweden, 2 053 Mm³ in Germany and 1 161 Mm³ in Poland. Fig. 1 shows the percentage of industrial wastewater stemming from the food industry for the countries, where such information is available. Disposal of sewage sludge from industrial WWTP is only reported for Estonia, Germany and Poland and shown in Fig. 2.

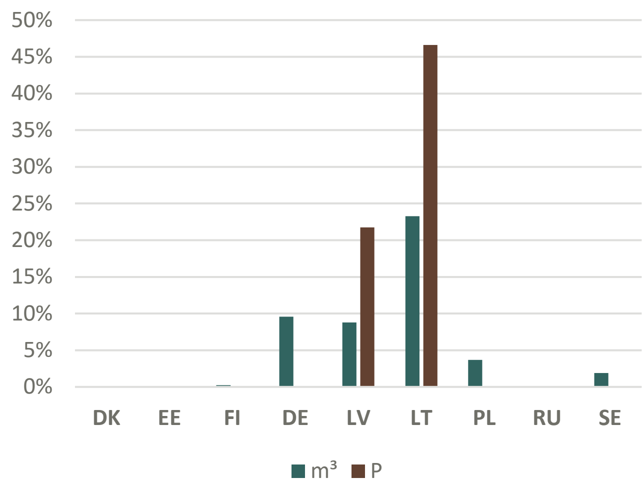

Figure 1: Percentage of wastewater stemming from the food industry based on volume and P load in 2014 (SE: 2015). Calculated as the amount generated by the food industry divided by the sum generated by all industries for which data is reported. Blanc fields: data not available [Eurostat 2020].

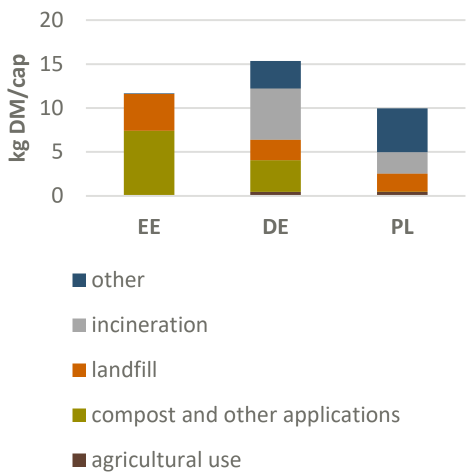

Figure 2: Treatment paths of industrial sewage sludge in EE (2013), DE (2016) and PL (2016) [Eurostat 2020].

Recommendations for P recovery

Biogas production

Wastewater from food processing companies is generally rich in easily degradable organic compounds, providing nutrients for the microorganisms in anaerobic digestion and thus showing a **high biogas yield**. Some municipal WWTP therefore encourage discharge of food processing industry wastewater to the public sewage system. **Centralisation enables the exploitation of economies of scale and generally allows for more effective treatment**. One example of a successful co-operation is the Słupsk Bioenergy Cluster in Poland, where 20 businesses and city facilities joint together. Wastewater of all participants is treated in the Słupsk WWTP and electricity and heat generated via biogas production distributed among the members through a separate grid.

On-site treatment, on the other hand, offers the advantage of a **tailored treatment** and provides **opportunities to recycle the treated wastewater and other recovered substances into the industrial process**.

To date, there are mainly two approaches for P recovery following anaerobic digestion:

Land application of digestate

Biogas digestate can – either directly or after composting – be **used in agriculture, gardening, landscaping, or (re)-cultivation.** This has the advantage of returning **not only P, but also carbon and other nutrients to the soil**. However, fertilising efficiencies are **less predictable** than for mineral fertilisers and **nutrient ratios cannot be adapted** to the plant's needs.

Due to the lower risk of contamination with pathogens, antimicrobial agents and other pollutants digestate from the food processing industry is **likely to face less problems with certification and to be more easily accepted as a co-substrate in other digestion processes** (see also Policy Brief 2 and 3).

Nevertheless, especially in regions with abundant organic waste streams the **market potential for biogas digestate is low**. It is therefore recommended to **further process and upgrade bigas digestate into a more valuable product** such as potting soil.

Struvite precipitation

Struvite can be precipitated from sludge liquor or matrix by adding a precipitation agent (typically magnesium chloride). Prerequisites are **biological P-removal** and **anaerobic sludge digestion** (For details see the Palette of solutions and Policy Brief 2). Economic viability generally increases with WWTP size and inflow P concentration, which is why **centralized treatment in municipal wastewater treatment plants or co-operative digestion with other forms of organic waste (see above) is usually recommendable**.

Although there is to date no reliable information on the market price of struvite, **active marketing of the recovered product as fertiliser**, is recommended and may be financially viable. **Struvite exhibits several advantages over conventional fertilisers**:

- The **low solubility** in natural conditions **reduces the chance of stormwater carry-off and leaching**
- The **higher magnesium concentrations** show **positive effects on plant P uptake and growth**
- **Cadmium concentrations in struvite are close to zero.**

Centralised sewage sludge incineration

Similar to municipal WWTP < 100 000 PE industrial WWTP can **transport their sewage sludge to plants with mono-incineration facilities**, provided such plants exists in a distance within which transport is economically viable. Several technologies for the recovery of P from the incineration ashes seem to be ready for large-scale implementation. See Policy Brief 1 for further information.

References:

Bonus Return (2017-2020). Available at: https://www.bonusreturn.eu/ [Accessed: 24.09.2020].

Eurostat (2020): Generation and discharge of wastewater by pollutant [env_ww_genp]. Available at: https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ww_genp&lang=en [Accessed: 24.09.2020].

Eurostat (2020): Sewage sludge production and disposal [env_ww_spd]. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ww_spd&lang=en [Accessed: 24.09.2020].

Kraus, F.; Zamzow, M.; Conzelmann, L.; Remy, C.; Kleyböcker, A.; Seis, W.; Miehe, U.; Hermann, L.; Hermann, R. and Kabbe, C. (2019): Ökobilanzieller Vergleich der P-Rückgewinnung aus dem Abwasserstrom mit der Düngemittelproduktion aus Rohphosphaten unter Einbeziehung von Umweltfolgeschäden und deren Vermeidung. Umweltbundesamt, Dessau-Roßlau, Germany.

Räike, A.; Oblomkova, N.; Svendsen, L.M.; Kaspersson, R.; Haapaniemi, J.; Eklund, K.; Brynska, W.; Hytteborn, J.; Tornbjerg, H.; Kotilainen, P.; Ennet, P.; Kokorite, I.; Sonesten, L.; Plunge, S.; Koch, D.; Andresmaa, E.; Frank-Kamenetsky, D.; Pecio, A.; Sokolov, A. and Ejhed, H. (2019): Background information on the Baltic Sea catchment area for the Sixth Baltic Sea Pollution load compilation (PLC-6). Baltic Marine Environment Protection Commission (HELCOM).

State of Green and Danish Water Forum (2016): Unlocking the Potential of Wastewater. Using wastewater as a resource while protecting people and ecosystems. Think Denmark white papers for a green transition.

Systemic – Circular solutions for biowaste (2017 – 2021). Available at: https://systemicproject.eu/about/ [Accessed: 24.09.2020].

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