



1. Introduction

The Lippeverband (LV) has commissioned the investigation of three wet chemical recovery processes within the framework of Phos4You to produce phosphoric acid.

- REMONDIS TetraPhos®
- Phos4Life™
- PARFORCE

2. P-recovery

The procedures are all based on the same principle (Figure 1). First, the phosphates are dissolved from the ash matrix using acid and the ash residue is separated. Since many undesirable accompanying or impurities (including iron, aluminum and calcium as well as heavy metals) are also transferred to the solution (raw phosphoric acid), the next step is the separation of impurities. Finally, the purified phosphoric acid is brought to the usual market concentration by evaporation.

3. P-rich product

The quality and purity of the phosphoric acid produced is quite variable, depending on the effectiveness of the purification processes applied, and carries small amounts of accompanying substances (Table 1) in accordance with the starting substance (SSA). However, it can be stated that the phosphoric acids produced in the "Phos4You" project are of marketable quality.

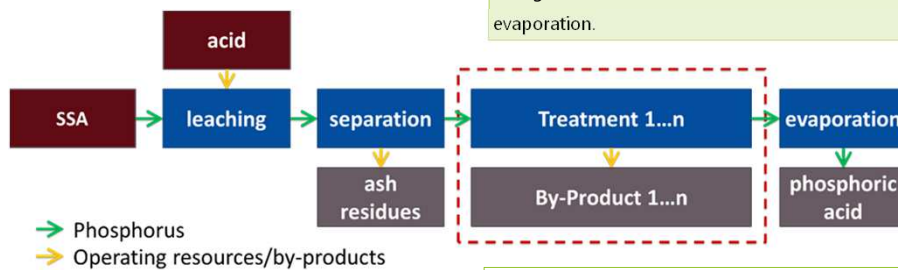


Figure 1: General scheme of wet chemical P-recovery processes (Blöhse 2021, modified)

Table 1: Overview of the main ingredients of the produced phosphoric acid shown in Figure 2

Elements	Concentration (in H ₃ PO ₄ 75 %)
Aluminium (Al)	0,3 %
Iron (Fe)	0,1 %
Calcium (Ca)	0,01 %
Magnesium (Mg)	0,02 %
Cadmium (Cd)	<5 ppm
Copper (Cu)	<5 ppm
Nickel (Ni)	<5 ppm

4. Discussion

The investigations carried out only provide a snapshot, since the composition of the SSAs used will change (seasonally) during the ongoing process. The resilience of the processes/procedures in continuous operation will only become apparent when they are implemented industrially over a longer period of time.

Particularly with regard to the quality and possible uses of the by-products and residual materials, there are still some uncertainties. Open questions about disposal routes or stable sales markets or recycling possibilities exist, but still need to be validated.

In the context of advancing technological implementation, the following points will play an essential role in the efficient design of phosphorus recovery from SSAs by wet-chemical processes:

- Process optimization/adaptations also in terms of operating chemical (including mineral acid - eluate) and energy requirement
- Process design in terms of by-product generation and quality



Figure 2: Example for phosphoric acids produced in the "Phos4You" project (© Dennis Blöhse, Lippeverband)

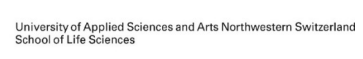
5. Conclusion

It can be stated that the technological solution of wet-chemical phosphorus recovery from SSAs is generally applicable and that the legal requirements, such as those of the German Sewage Sludge Ordinance (target: recovery rate > 80 %), can be met.

Further technological implementation will demonstrate feasibility and answer any remaining questions. The processes considered in Phos4You will be implemented on an industrial scale in further projects (Figure 3).



Figure 3: Outlook on technology implementation of the processes considered in Phos4You (Blöhse 2021, modified)



References:

Blöhse Dennis, Nafo Issa „Demonstrator I2: Acid extraction of P from SSA (REMONDIS TetraPhos®, PARFORCE, Phos4Life™)“ in Plateau Marie-Edith, Althoff Anke, Nafo Issa, Teichgräber Burkhard, „Technical report of the Phos4You partnership on processes to recover phosphorus from wastewater“, September 2021, edited by LIPPEVERBAND

Status as of: September 21

Acknowledgement: The Phos4You project receives ERDF-funding through the INTERREG V8 North-West Europe Programme (2014 – 2020). Match funding is provided by all the partner organisations listed above.