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P-RoC-technology – field of application

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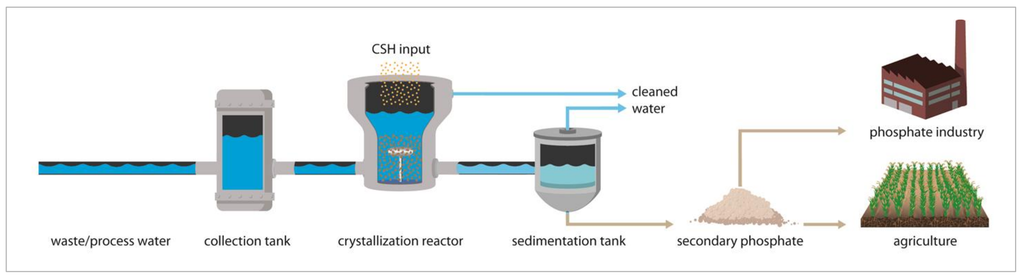
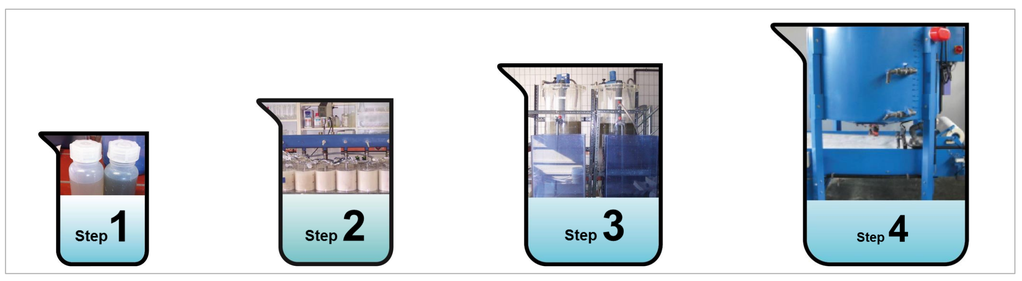
1. P-RoC-technology

P-RoC-technology (Phosphorus Recovery by Crystallization from waste- and process water) is a patented technique which was developed by Karlsruhe Institute of Technology, which enables to recover phosphorus from fluids without chemicals except for a reactive substrate and it is implemented in semi-continuous stirred reactor. P-RoC-technology is a simple technology, easy to handle and easy to adopt in the consisting wastewater treatment. The generated secondary phosphate can be processed in P-industry or used as fertilizer without further treatment. The content of the pollutants is much below the limiting values of the fertilizer regulations.



2. Methods

P-elimination depends on some influencing factors. Therefore a bottom-up approach has been developed and proved. Initially the fluid that should be treated has to be characterized concerning the parameters like concentration of cations, pH-value, solids content etc. After that, reaction kinetics is investigated in short-term experiments in lab scale. If reaction kinetics is tested positively in a next step long-term experiments in semi-technical scale are conducted. A further upscale of factor 10 enables to validate the efficiency of P-RoC-technology in pilot-scale. Also parameters for the estimation of economic feasibility can be investigated in this status.

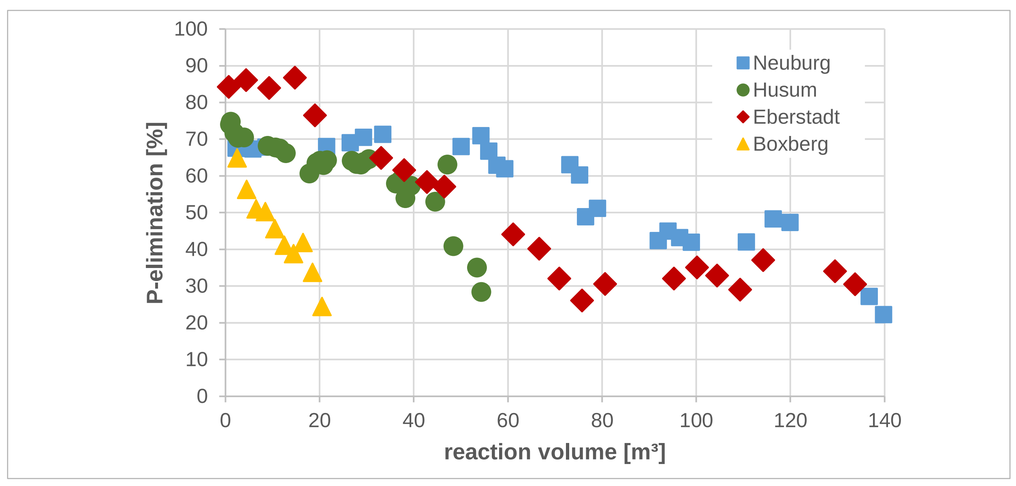


3. Results

P-elimination by P-RoC-technology depends on several factors like concentration of soluble phosphorus, pH-value of the waste or process water as well as the amount and the quality of the organic substance. The following table shows the characteristics of different fluids.

	Husum	Neuburg	Eberstadt	Boxberg
origin	anaerobic tank of a biological P-elimination with lime precipitation	centrate of a WWTP with ferric chloride precipitation	centrate of a WWTP with aluminium sulfate precipitation	liquid pig manure
pH-value	7,8	7,8	7,9	8
soluble phosphate	30 mg/L	40 mg/L	60 mg/L	50 mg/L
organic load	10 mg/L DOC	80 mg/L DOC	80 mg/L DOC	1150 mg/L DOC

Three different fluids of a WWTP and liquid pig manure have been investigated in pilot-scale by P-RoC-technology. The waste water were from WWTP with different treatment: In Husum the WWTP works with biological P-elimination and lime-milk and in Neuburg and Eberstadt phosphorus precipitation occurs with ferrochloride and aluminiumsulfate, resp. The organic load was the uppermost in the pig manure.



It is shown in the diagram which informs about the efficiency of P-RoC-technology that 50 % to 60 % soluble phosphorus can be recovered by this technique. The difference between the fluids is the volume that has been treated: This is due to the influencing factors – the amount of organic load (see Boxberg and Eberstadt) as well as a lower concentration of soluble phosphate (see Husum). Both minimizes the efficiency of P-RoC-technology. The difference in P-elimination of the centrates (Neuburg and Eberstadt) indicates the influence of the organic load onto the efficiency. The quality of the generated secondary phosphate is exemplarily shown at the product generated in Neuburg. The secondary phosphate is a mineral phosphate fertilizer according to the German Fertilizer Regulation[1]:

parameter	secondary phosphate	mineral phosphate fertilizer [1]
P_2O_5	10.3 %	> 10 %
Mg	1%	duty of declaration > 5 %
Ca	17.6 %	duty of declaration > 5 %
Na	0.08 %	duty of declaration > 5 %
K	1%	duty of declaration > 5 %
Al	0.1 %	k. A.
Co	n.n.	duty of declaration > 0.002 %
Zn	0.0006 %	duty of declaration > 0.003 %
Ni	3.4 mg/kg	< 100 mg/kg
Mn	0.01 %	duty of declaration > 0.01 %
Cu	0.0001 %	duty of declaration > 0.1 %
Cr	1 mg/kg	< 2500 mg/kg
Fe	0.18 %	duty of declaration > 0.5 %

[1] German Fertilizer Regulation, 2004, version of 13.11.2014

The P-content of the generated secondary phosphate is appraised as soluble in neutral-ammonium-citrate and therefore of good plant availability. It couldn´t be any organic contaminants like polycyclic aromatic hydrocarbons, organic chlorinated pesticides and polychlorinated biphenyl as well as radioactivity concerning from uranium or caesuim detected. Also the investigation on hygienic parameters like E. coli, Salmonella, Yersinia and Clostridia was negative.

4. Acknowledgement

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5. References

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