

PHOSPAQ and ANAMMOX®

Case Study Aviko Steenderen (Potato Processing Industry)
Sustainable effluent treatment at low total cost of ownership



FACTS & FIGURES

AVIKO Potato Processing

- 100 tons/h potatoes
- Wastewater stream = 160,000 p.e.

Anaerobic pre-treatment

- 85% reduction of COD
- Biogas conversion into heat & electricity (600 kWe)

UASB effluent contains

- 1,600 kg COD/day
- 1,000 kg NH₄-N/day
- 200 kg PO₄-P/day

PHOSPAQ process

- 80% PO₄-P reduction
- 400 tons/year struvite suitable as fertilizer
- 70% COD removal

ANAMMOX® process

- 90% NH₄-N reduction

The challenge

The AVIKO Potato Processing Plant in Steenderen, the Netherlands, produces a wide variety of potato products. As a consequence wastewater containing proteins, starch and phosphate is produced equaling an amount of 160,000 population equivalent. Already since 1982 this wastewater is treated in a dedicated treatment plant, based on anaerobic UASB technology, located on the premises of the municipal STW Olburgen. In the UASB reactors the organic components (COD) are converted into biogas that is reused by conversion into electricity and heat. The effluent coming from the UASB reactors is discharged to the sewage treatment plant. Although most of the COD-load has been removed by the anaerobic treatment plant, this effluent still contains considerable amounts of COD, NH₄ and PO₄ which represents discharge costs of over € 1,5 million per year.

The owner and operator of this dedicated treatment plant for AVIKO's wastewater is the operating company Waterstromen. Due to new regulations (EWFD), the municipal STW Olburgen had to reduce the nitrogen and phosphate discharge in their final effluent. Since the major part of the nitrogen and phosphate load of the sewage treatment originates from the UASB reactors, it was decided in 2003 to give Waterstromen the task to reduce the phosphate and nitrogen content of the anaerobic effluent. Therefore the challenge was to find a suitable process to remove these high amounts of phosphate and nitrogen at the lowest total cost of ownership while maximizing sustainability.

The challenge

- Compliance to new regulations for N and P according to EWFD
- Minimize total cost of ownership
- Maximize sustainability



The solution

A comprehensive feasibility study by Waterstromen resulted in the selection of the PHOSPAQ-process in combination with the ANAMMOX®-process to achieve their goals instead of using a conventional activated sludge process in combination with iron dosing.

Phosphate removal with PHOSPAQ

Effluent from the UASB reactors combined with a small reject water stream coming from sludge dewatering on the STW are introduced in the PHOSPAQ reactor. The PHOSPAQ reactor can be described as an aerated crystallization reactor where phosphorous and residual COD removal is combined. Under addition of MgO, phosphate is removed by precipitation as struvite.

Synergetic advantages are obtained by combining P- and COD-removal in the PHOSPAQ reactor.

Simultaneous aeration of the reactor allows the additional biological conversion of residual COD, but also provides for the mixing required to obtain a good struvite quality. In addition, it provides for stripping of CO₂ that raises the pH and stimulates the struvite formation. The struvite produced, is harvested from the bottom of the reactor.

The struvite complies with EU standards for fertilizer and can be used as slow-release fertilizer.

Ammonium removal with ANAMMOX®

Next step is the ANAMMOX® reactor where in one single stage ammonium is directly converted into nitrogen-gas by a combination of nitrification and anammox bacteria. Compared to conventional nitrification-denitrification, the conversion of ammonium does not require organic carbon. Therefore a bypass of the UASB reactors to supply COD is avoided and thus a maximum generation of biogas is secured. Furthermore, approximately 40% energy is saved because relatively little aeration is required.

After the ANAMMOX® reactor water is discharged to the sewage works where the wastewater is further treated to reach surface water discharge quality. The construction of the plant was completed early 2006.

The solution

- PHOSPAQ process removes phosphate as struvite, which is suitable as fertilizer
- ANAMMOX® process removes ammonium without the use of an electron donor and at reduced power consumption

The benefits

This plant with both PHOSPAQ and ANAMMOX® processes is in operation since spring 2006. The plant provides Waterstromen a yearly saving on discharge costs of over € 1,5 million. Removal of phosphorous and ammonium is over 80% and over 90% respectively. As a consequence, STW Olburgen complies with the stricter discharge limits for N and P.

Compared to conventional activated sludge process where iron-salts are dosed for phosphate removal, the combination of PHOSPAQ and ANAMMOX® processes provides the following advantages:

- Annual saving on discharge costs of over € 1,5 million
- Comply with stricter EU regulations for N and P
- Extra production of 1,5 GWh net electric power per year
- Production of 400 ton/year suitable fertilizer
- Compact process, more than 5 times less reactor volume needed (1,200 m³ instead of 7,000 m³)
- 600 tons less sludge production per year

Customer statement

Richard Haarhuis, Operational Manager of Waterstromen: "We have chosen the PHOSPAQ - ANAMMOX® combination because of the lowest total cost of ownership and it's sustainability.



We were convinced by the low power consumption, the recovery of resources and the limited space required. The performance of the plant shows we have made the right decision".



For more information

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