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protect it with our competence*

# MULTI PHOSTRIP<sup>©</sup>

**Biological phosphorus  
removal from municipal  
waste-water in the side-  
stream process**

Description  
Application  
Advantages  
Operating results  
References

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## BIOLOGICAL PHOSPHORUS REMOVAL from municipal waste-waters in the sidestream process

The PHOSTRIP process benefits from the biochemical potential of microorganisms which are able to concentrate phosphorus in their biomass. In the sidestream a part of the return sludge will pass anaerobic milieu conditions. The biomass accumulates easily degradable organic matters and discharge phosphate into the water. Due to this reaction a sidestream with high phosphate concentration can be conditioned with several process steps to separate phosphorus in an economical way.

The patented PHOSTRIP process offers significant advantages over known precipitation processes as well as the mainstream biological phosphorus removal process.

### Advantages

- ✓ unaffected by fluctuations in treatment plant influent
- ✓ high dry solids content offers organisms a selective advantage
- ✓ enhanced fermentation of organic acids from the anaerobic zone
- ✓ extension of contact time by hydraulic separation of streams
- ✓ no additional heavy metals contamination of sludge
- ✓ substantially lower sludge production
- ✓ high sludge calorific value
- ✓ no negative effect on acid capacity
- ✓ no additional salinization of the receiving watercourse
- ✓ no scum problems
- ✓ same investment costs

### Simplified description of biological phosphorus removal

The principle of biological phosphorus removal is based upon the metabolism of those microorganisms (*Acinetobacter species*) in the treatment plant that are capable of incorporating increased amounts of phosphorus in their cells in the form of polyphosphate. To this end they must be given a selective advantage over other groups of microorganisms. These ambient conditions are created by briefly subjecting the treatment plant's biological community to strictly anaerobic conditions. In the PHOSTRIP process an anaerobic tank in an auxiliary stream is integrated in the sludge circuit for this purpose.

Polyphosphate-accumulating bacteria are able to absorb in the anaerobic phase small fractions of organic substances that have been broken down by extracellular enzymes, something other species cannot do. These organic substances, short-chain organic acids (e.g. acetic acid, propionic acid etc.), are stored in the form of carbon depots (poly- $\beta$ -hydroxybutyric acid [PHB]) and are immediately available again in the aerobic zone of the process for respiration and cell growth, whereas other organisms only begin to absorb and break down carbon-containing compounds in this phase. Organisms capable of storing polyphosphate thus have a selective advantage over those that are not, and enrichment of these species occurs within the system.

One positive side-effect is the fact that phosphate is used as an energy source or "space saver" for the carbon depots. That is, to permit the absorption of carbon and its conversion to PHB in the anaerobic phase, a polyphosphate store is created in the aerobic phase which is broken down for energy extraction in the anaerobic phase and replaced by carbon. Phosphate is therefore released in increasing amounts in the anaerobic phase and absorbed in the aerobic phase. As the cell also builds cellular substance (and grows) in the aerobic phase, P absorption in the cell is predominant, and the overall balance is positive.

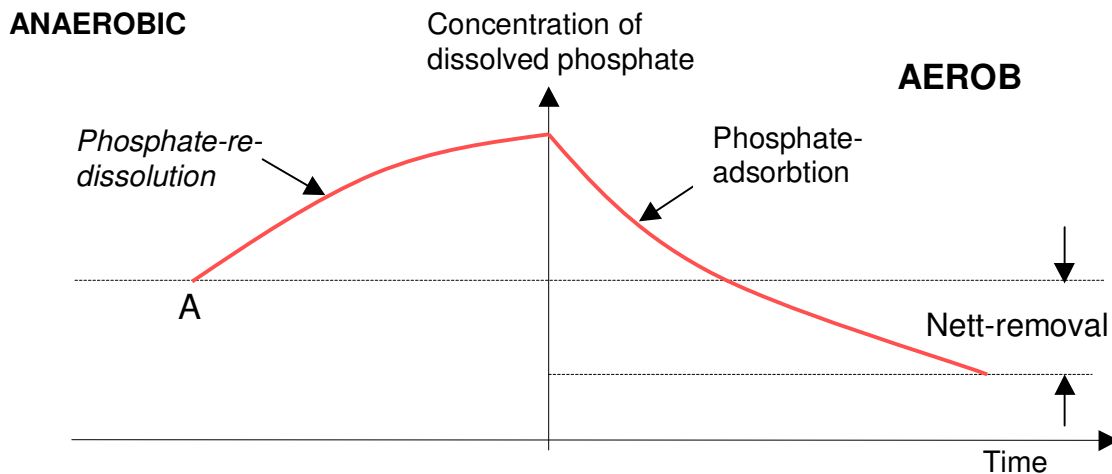


Figure: concentration curve

Compared to the phosphate contents of activated sludges from conventional type plants of 1-2% P with respect to the dry solids content, activated sludges with phosphate storage attain approx. 7-10%.

A close linear relationship exists between P re-dissolution and P absorption.

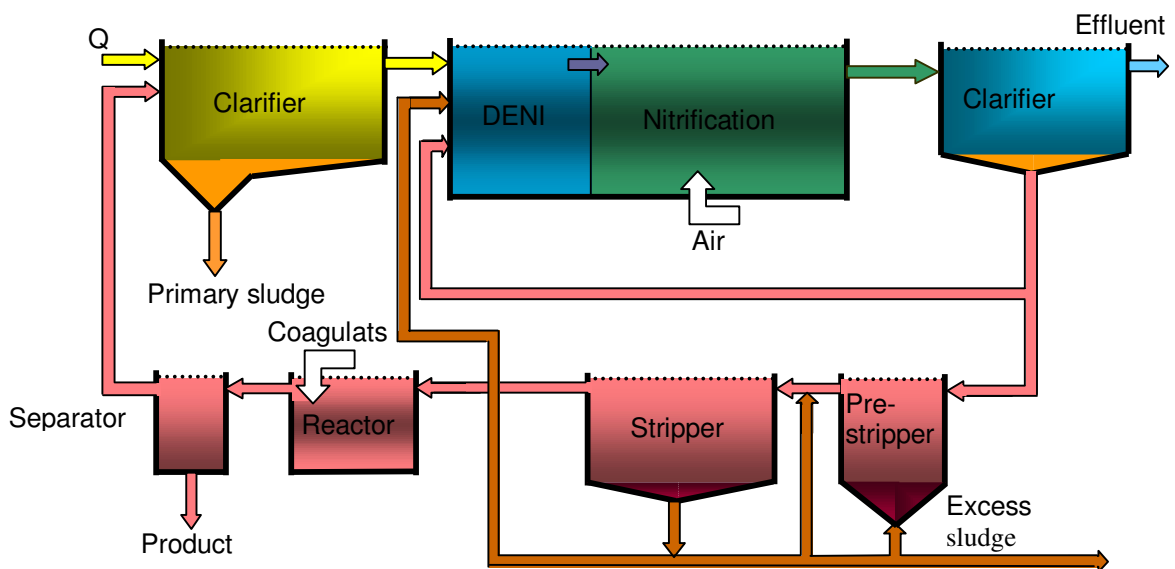


Figure: PHOSTRIP sidestream process

## Phosphorus recovery with PHOSTRIP

Owing to the depletion of the Earth's phosphate reserves and rising industrial demand (detergents, fertilizers), phosphate recovery is gaining in importance. Extracted mineral crude phosphates have to be treated in complex process steps for removal of radioactive elements and cadmium, making phosphate recovery from municipal treatment plants more economic and environment-friendly.

As a prerequisite for recovery it must be possible to remove the phosphate from the wastewater in concentrated dissolved form (> 50-100 mg/l) for subsequent separation in crystalline form.

The stripper overflow in the PHOSTRIP process satisfies these prerequisites!

Precipitation and crystallization can be done using calcium (lime precipitation) or in the form of struvite (ammonium-calcium-phosphate compounds).

## Implications of the PHOSTRIP process for the operation of a municipal wastewater treatment plant

The sludge index at reference plants using the PHOSTRIP process is substantially lower than 100 ml/l, peak values being 60-65 ml/l.

Filamentous bacteria with a tendency towards scum formation are suppressed.

Excellent activated sludge sedimentation qualities.

## Some PHOSTRIP<sup>®</sup> reference plants

Wastewater treatment plant	Capacity	Specifications
Darmstadt	240,000 PE	Stripper volume: 6,385 m <sup>3</sup> Preliminary stripper: 306 m <sup>3</sup>
Hofkirchen (Austria)	7,000 PE	Stripper volume: 285 m <sup>3</sup> Preliminary stripper: 13 m <sup>3</sup>
Darmstadt-Eberstadt	50,000 PE	Stripper volume: 110 m <sup>3</sup> Preliminary stripper: 44 m <sup>3</sup>
Schalchen (Austria)	50,000 PE	Stripper volume: 500 m <sup>3</sup> Preliminary stripper: 100 m <sup>3</sup>
Wallang (Austria)	70,000 PE	Stripper volume: 500 m <sup>3</sup> Preliminary stripper: 100 m <sup>3</sup>

## Further topics

Not only **phosphorus**, but also **nitrogen** and **excess sludge** represent an economic and environmental problem at municipal wastewater treatment plants. Specific return flow loads on plants by process water from sludge dewatering facilities can be put at 5-20% total phosphorus, 15-25% total nitrogen, and 4-6% COD.

To minimize the load on the treatment plant, split-stream process water treatment is expedient. To this end MUTAG markets a biological split-stream treatment system, operating as a flow-through and/or SBR process (nitrification/denitrification). The system can also be combined with the PHOSTRIP process.

The advantages:

- reduction of load on entire plant
- selective split-flow treatment
- increased activated sludge performance
- increased treatment plant effluent values

**Sewage sludge disposal** will gain in importance worldwide as more stringent waste disposal legislation is introduced. This is why MUTAG has developed and filed patents for a number of technologies utilizing oxidative processes for on-site sewage sludge reduction. These processes offer low-cost alternatives to conventional disposal methods.

MUTAG offers solutions with perfected combination processes that are tailored to your specific requirements.

Further essays are available on these topics.