
REUSE OF WATER AND NUTRIENTS IN HYDROPONIC SYSTEMS

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HypoWave - Reuse in hydroponic systems

- Hydroponic systems for a resource efficient agricultural reuse of wastewater
- System with multiple barriers and protection of water and soil from contaminants
- BMBF (German research ministry) funding: 2016 – 2019
- 13 partners from Germany: research, industry, utilities



Challenges

- Use of nutrients in wastewater
- No contamination of product with heavy metals, pathogenic or antibiotic-resistant microorganisms, micro-pollutants
- Discharge of effluent into environment without further treatment
- Economically feasible system solution



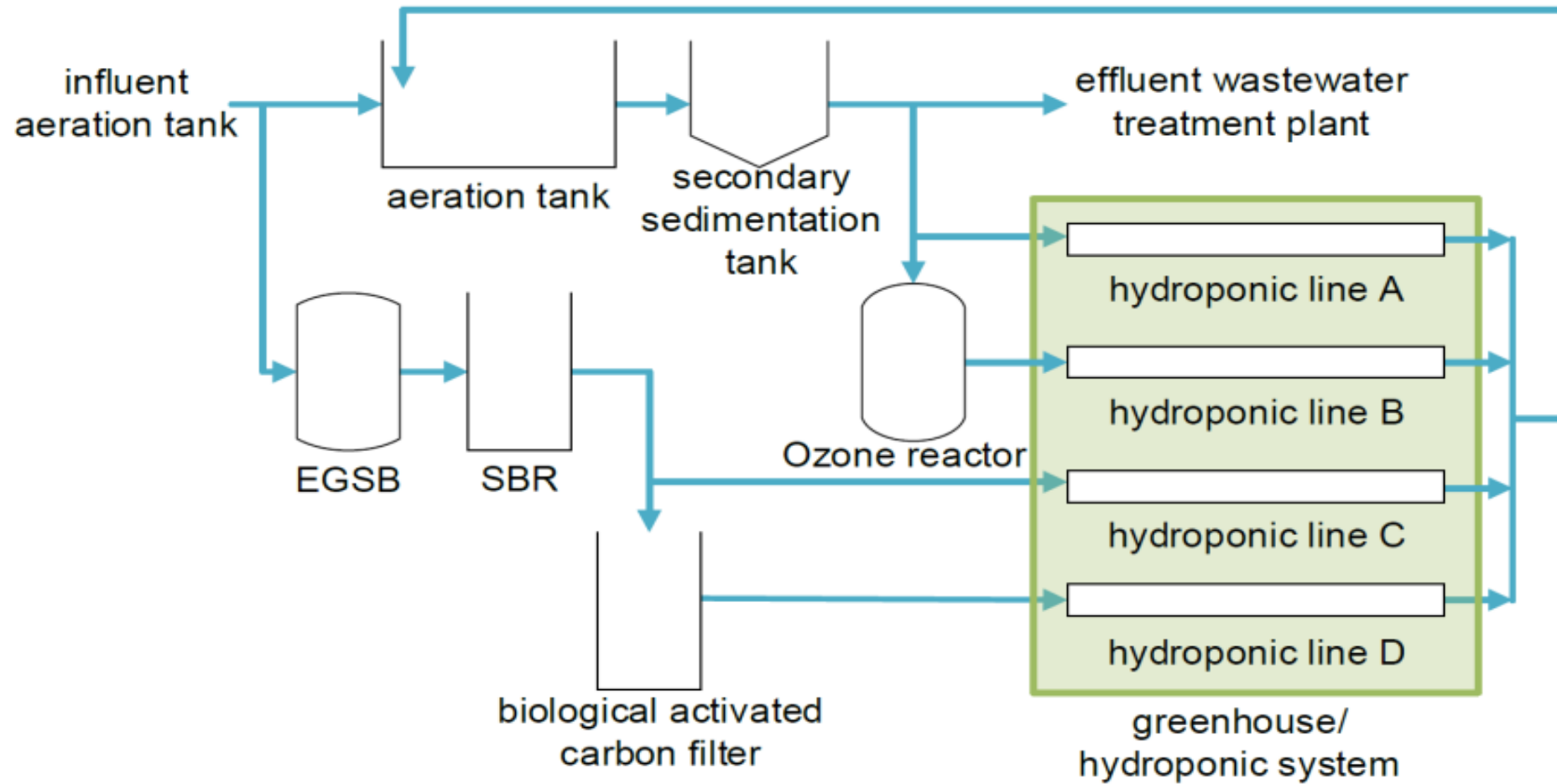
Source: Aquitectura

Pilot plant in Wolfsburg-Hattorf

- Operation between April 2017 and November 2019 at municipal WWTP Wolfsburg-Hattorf
- Different wastewater treatment processes in parallel
- Growing lettuce in hydroponic greenhouse in parallel lines



Processes in pilot plant



Pilot plant – wastewater treatment



Pilot plant – hydroponic greenhouse

- Nutrient Flow System (NFS)
 - Cultivation of lettuce (*Lactuca sativa* L.)
 - Seedlings were nursed over 20 days, 68 plants per line
 - Operation of four main lines as a flow through system



Results of piloting

- The hydroponic system can be operated efficiently with irrigation water with low concentrations (N,P)*
- Concentrations of heavy metals in lettuce were very low
- Ozonation and activated carbon filtration achieved removal efficiencies of > 90% also for persistent micropollutants
- Main focus should be on microbiological parameters – microbial risk assessment and quality management of whole chain is recommended**

More details:

*Alexa Bliedung, Thomas Dockhorn, Jörn Germer, Claudia Mayerl, Marius Mohr; Experiences of running a hydroponic system in a pilot scale for resource-efficient water reuse. *Journal of Water Reuse and Desalination* (2020)

**Marius Mohr, Thomas Dockhorn, Jörg E. Drewes, Sybille Karwat, Susanne Lackner, Bryan Lotz, Andreas Nahrstedt, Andreas Nocker, Engelbert Schramm, Martin Zimmermann; Assuring water quality along multi-barrier treatment systems for agricultural water reuse. *Journal of Water Reuse and Desalination* (2020)

Feasibility studies

- Identification of framework conditions, barriers and drivers for realization of water reuse in hydroponic systems
- Development of concepts for implementation for different regions with local stakeholders
- First step for implementation of analyzed innovation



Methodology of feasibility study

- Formation of interdisciplinary team, representing expertise in urban water management, crop production, social sciences
- Desktop research, literature analysis and site visits: local conditions, supporting / limiting factors for water reuse in hydroponic systems
- Semi-structured interviews with relevant stakeholders
- Discussion of resulting concept with local stakeholders for validation
- Publication of results in a brochure: www.hypowave.de

Feasibility study Gifhorn

- Seasonal water scarcity in agriculture
- Market for regional products
- Share of costs for water and nutrients relatively low: economical feasibility of water reuse challenging
- More than 30 wastewater ponds to be connected to WWTPs in coming years



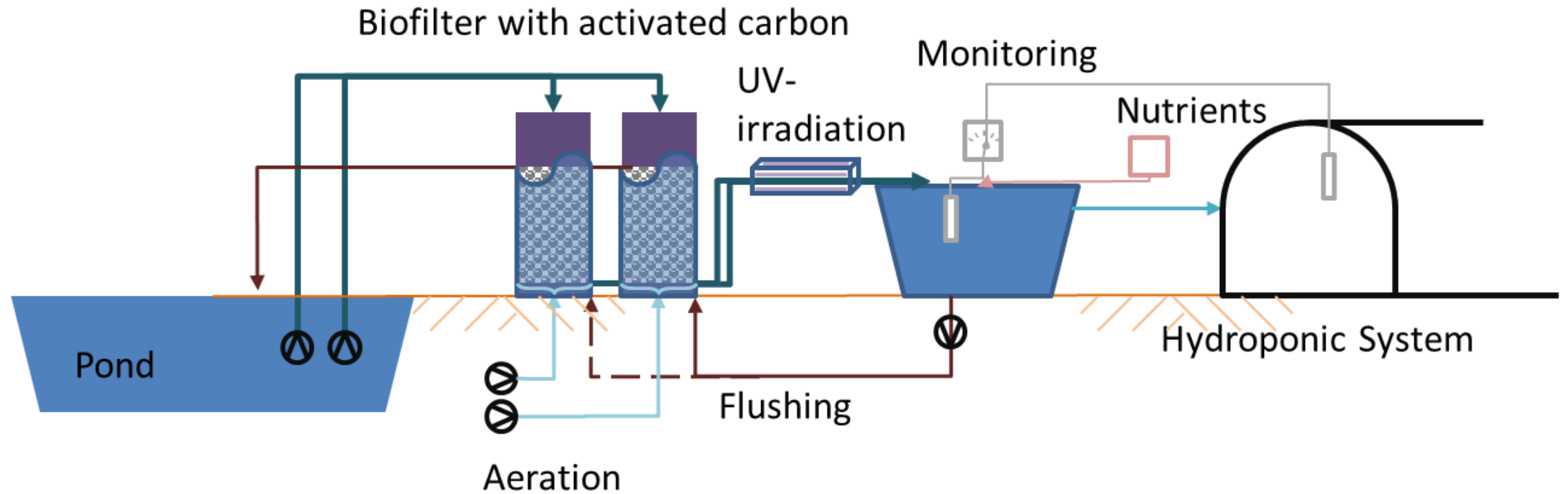
Wastewater disposal in Gifhorn county



Potential application in Weißenberge

- Weißenberge: 500 inh. connected to pond system
- Economically feasible if connection to WWTP not necessary due to post-treatment in hydroponic system
- Pre-treatment of effluent of ponds necessary, as nitrogen present as ammonium
- Continuous operation necessary: heating and lighting
- Contract between operator of hydroponic system and utility needed

Proposed treatment process in Gifhorn county



General findings of case studies

- Main drivers:
 - Water scarcity
 - Insufficient wastewater infrastructure
 - Innovative local actors (first movers)
- Main barriers:
 - Complex system, difficult to integrate into existing infrastructure
 - Low prices for water and nutrients
 - Perception of risks

Acknowledgement



HypoWave

Use of hydroponic systems for resource efficient water reuse in agriculture

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