Decentralised wastewater treatment in Knittlingen and Heidelberg-Neurott

– concepts and results

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Summer school for environmental protection,
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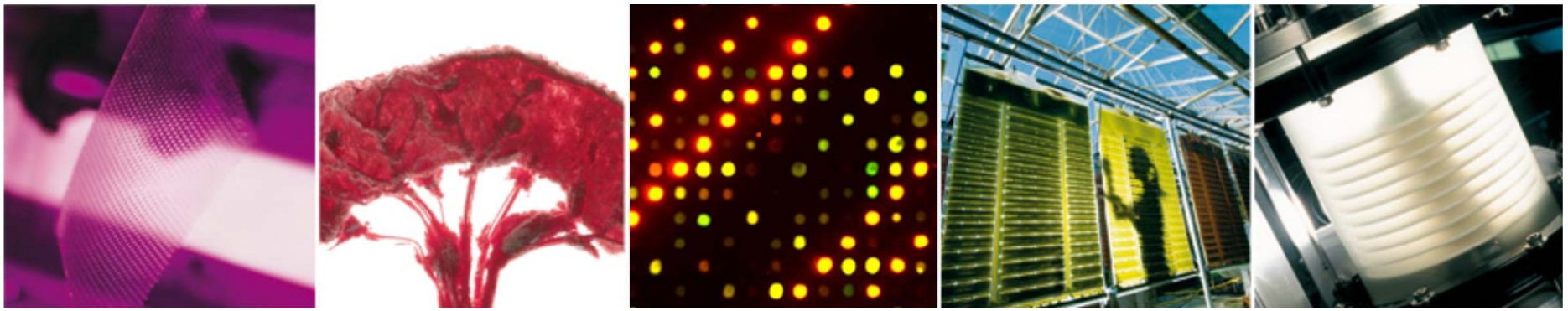

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Outline

1. MBR plant Heidelberg-Neurott
2. Rotating disk filter
3. Filtration of raw domestic wastewater (primary filtration)
4. Influent characteristics
5. Effluent water quality
6. Concept DEUS 21 in Knittlingen
7. Advantages of the new system

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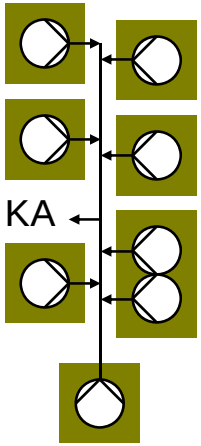
MBR plant Heidelberg-Neurott



- 60 inhabitants + 30 population equivalent (inn, farming)
- Average 6.6m³/d; max. 9.9m³/d
- Pressure sewer system with 7 immersion pumping stations
- Installed in the former equipment house of the local fire brigade
- Domestic wastewater and rainwater separated
- Only domestic wastewater collected and treated
- Mixing and equalizing tank cuts hydraulic and loading peaks

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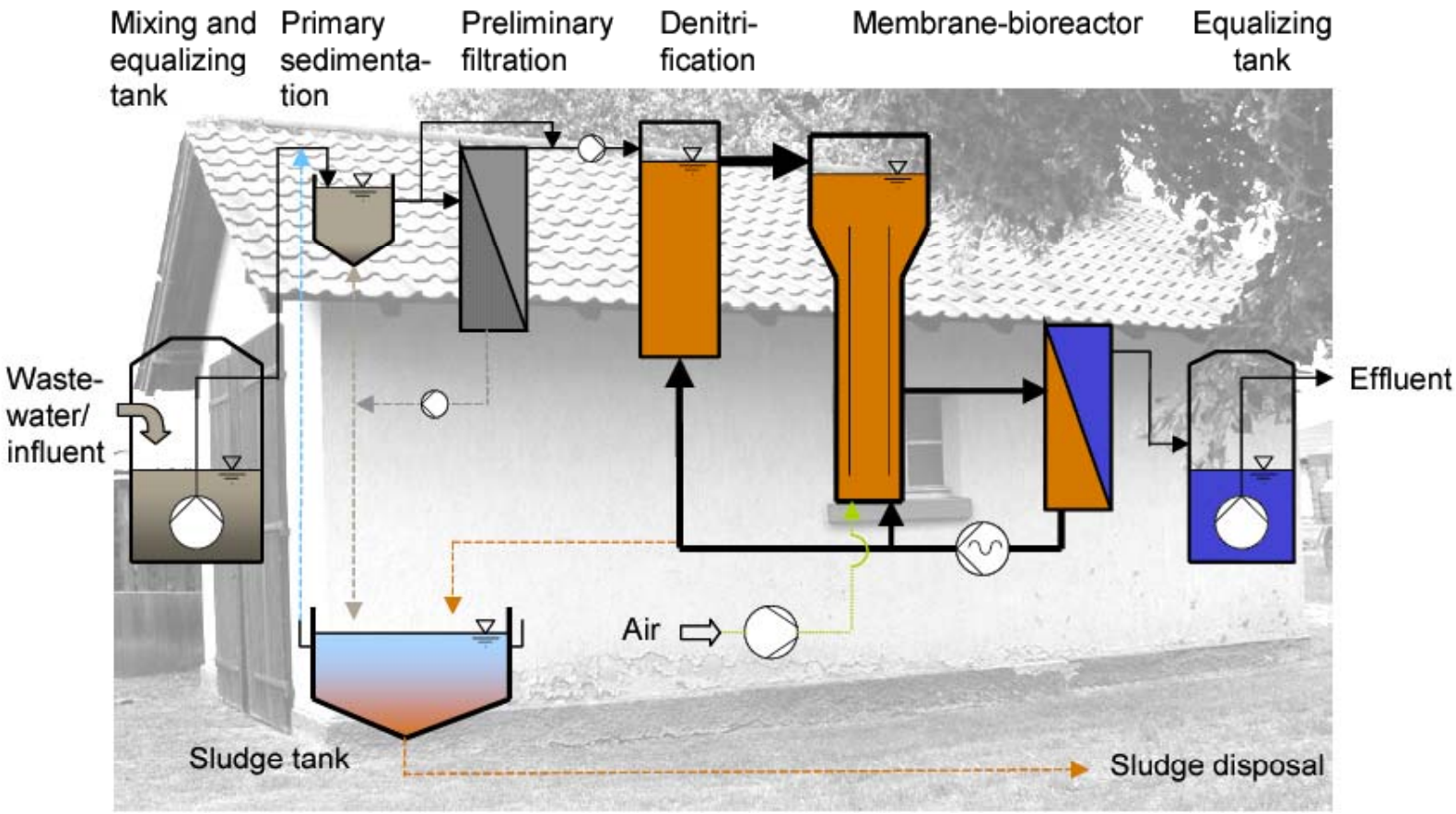
Process of the MBR plant Heidelberg-Neurott



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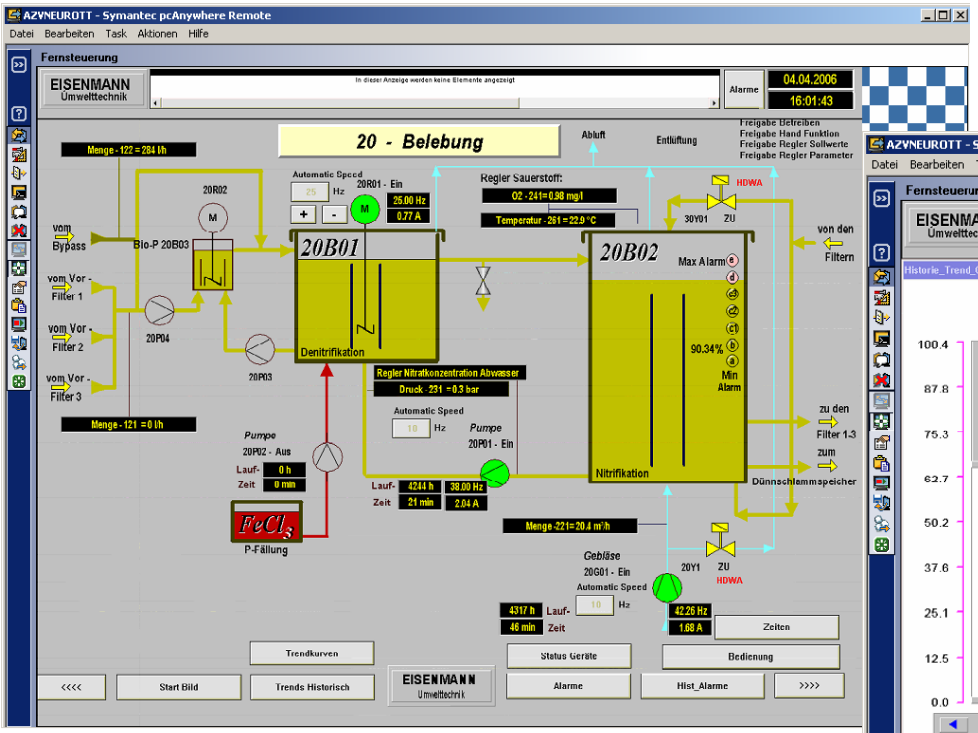
Operation and maintenance



- Monitoring of parameters online
- Alarm signal management

- Fully automated plant
- Reduced manpower by remote monitoring

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MBR plant Heidelberg-Neurott

Opening in December 2005 aroused political interest

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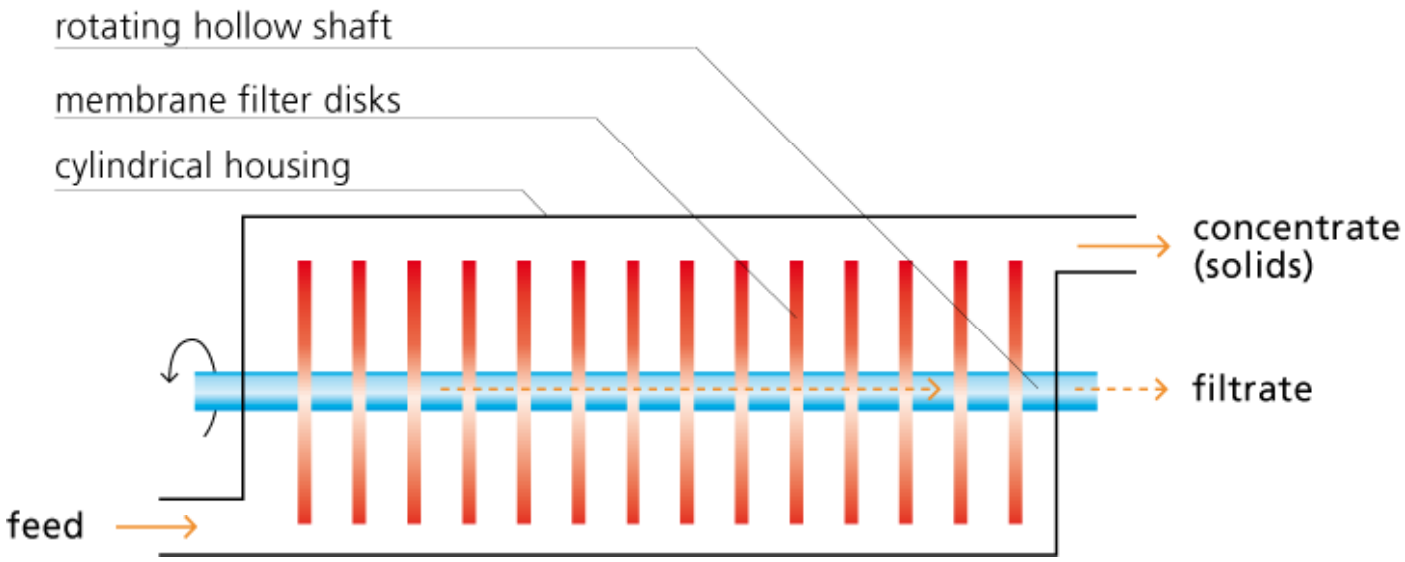
Principle of the rotating disk filter



- Dynamic membrane filter with ceramic membrane disks
- Typical pressure of 0.2–1.5 bar applied
- Filtration direction: inside out
- Rotation of disks with 200–800 min^{-1}
- Covering layer controlled by centrifugal force
- Different pore sizes available: 0,2 µm, 60 nm

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Filtration of raw domestic wastewater

- Experiments in pilot plants reveal:
  - Retention of COD 70–80 %
  - Retention of TN 10 %
  - No retention of ammonia and nitrate
  - Retention of TP 15 %
- Reduction of microorganisms: no faecal bacteria found
- Water reuse for irrigation appropriate
- Specific flux of 20–30 $l/m^2 \cdot h$ without adding any chemicals
- Cleaning intervals: several months
- Energy consumption: 1 kW/m^3 for non-optimized prototype

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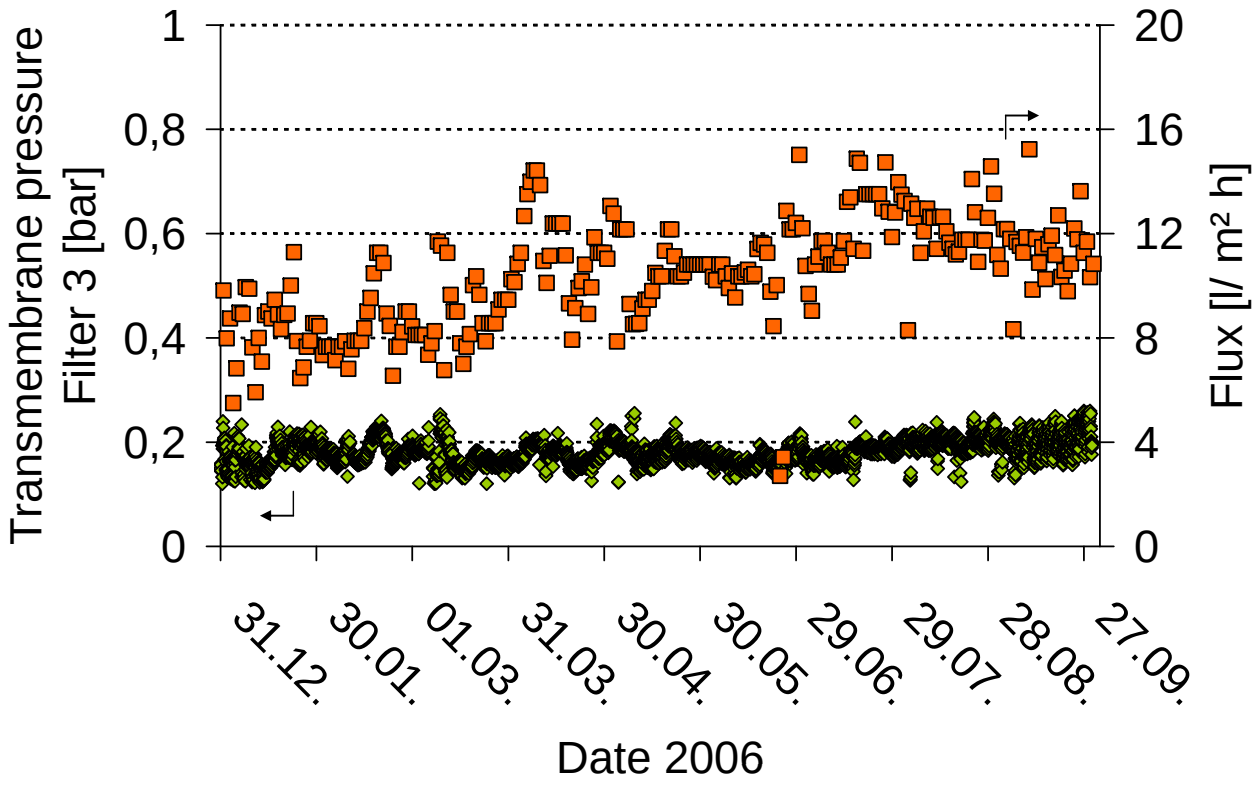
Membrane Performance



- Average flux 12 l/m²·h
- Design flux 20 l/m²·h
- TMP between 0.1 and 0.3 bar
- No chemical maintainance or recovery cleaning in the first year of operation
- Only one chemical cleaning per year in the first three years of operation

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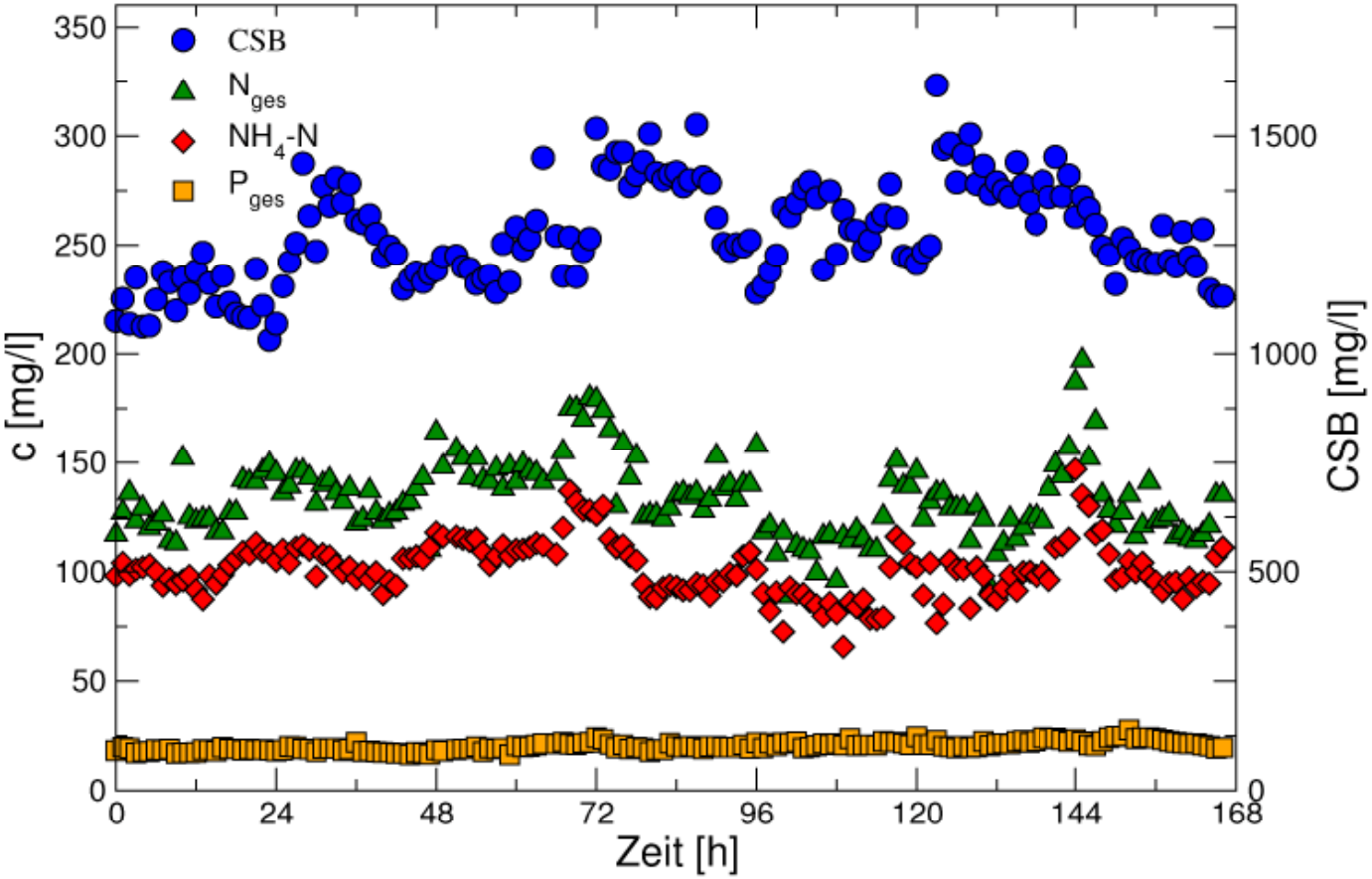
Influent concentration and degradation



- High influent concentrations compared to standard wastewater
- Good performance of mixing and equalising tank
- Basis for high removal efficiency of plant

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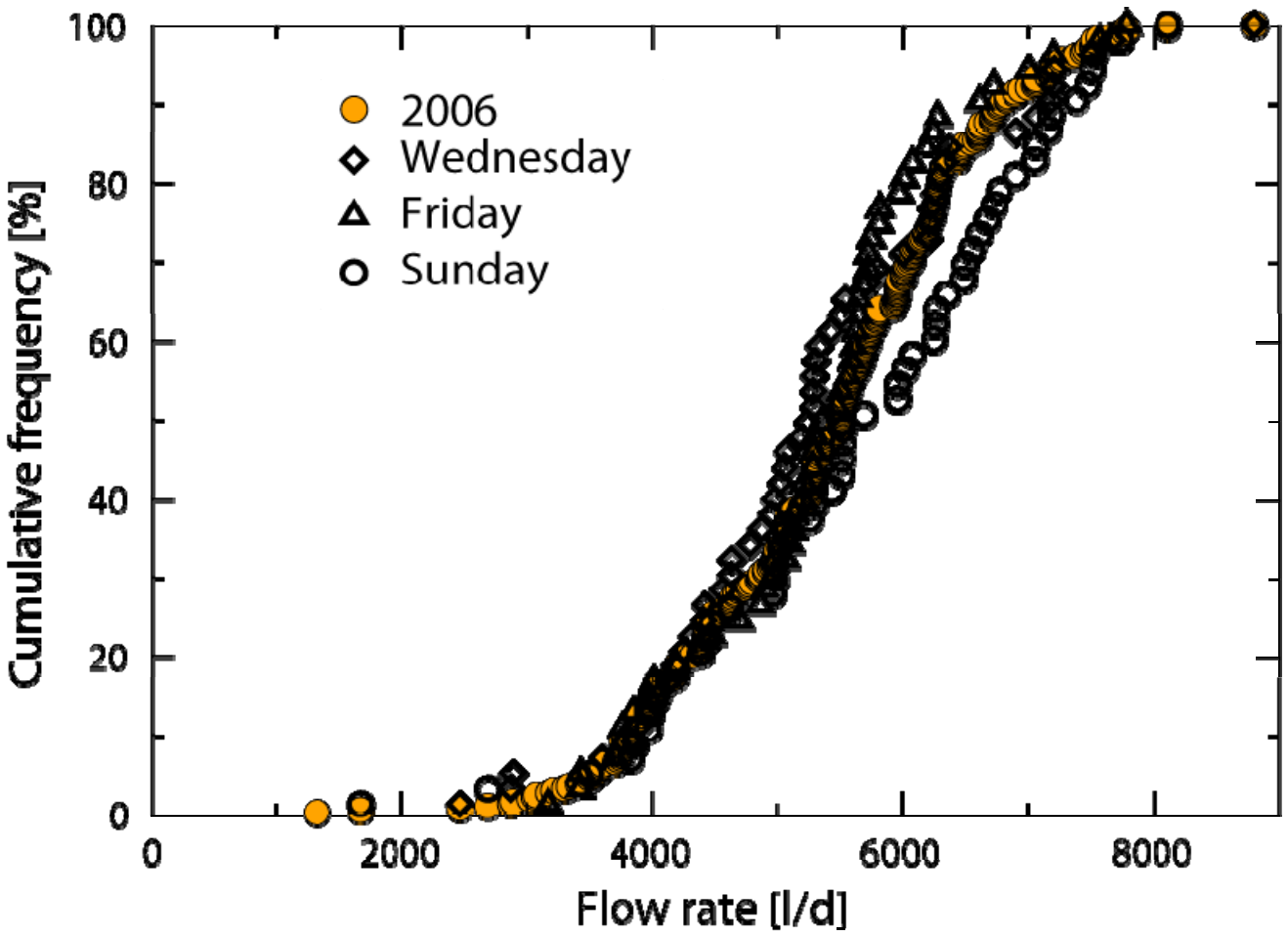
Influent characterisation



- 85% of days: flow rate below 6600 l/d
- Max. flow rate not yet occurred
- Very close estimation
- Narrow distribution: no user patterns

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Influent values, effluent limitations and discharge values 2006

Parameter	Median influent value mg/l	Median discharge value mg/l	Legal limit mg/l	Elimination %
COD	1074	36	75	97
NH_4-N	109	0.2	10	99.8
NO_3-N		9.2		
TN	131	11.3	18	91.7
PO_4-P	17	8.31	-	

- Excellent discharge values and Elimination
- Meets the European standard of the council directive concerning the quality of bathing water
- Nitrogen load 30% higher than expected

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Conclusion MBR plant Heidelberg-Neurott

- New type of WWTP based on membrane filtration demonstrated in full scale application
- First large scale application of the rotating disk filter
- Primary filtration opens new fields of application
- High effluent water quality
- Pressure sewer system + MBR plant is cheaper than a sewer to the central WWTP of Heidelberg
- System suggested for existing settlements

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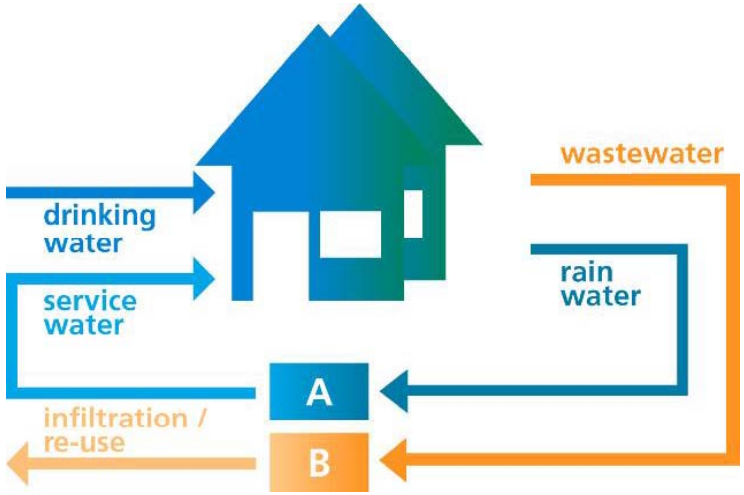
Concept DEUS 21 in Knittlingen

- Demonstration project in development area with 100 properties
- City of Knittlingen near Pforzheim, Germany
- DEcentral Urban InfrastructurSystem – DEUS 21 funded by the German Ministry of Education and Research (BMBF)
  - Utilization of Rainwater/Stormwater
  - Vakuum sewer system
  - Semidecentralized wastewater treatment



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Rainwater utilisation

- Collection of rainwater from roofs and paved areas
- 3 Storage tanks (300 m³)
- Treatment by ultrafiltration: Bellmer Fine Filter with ceramic disks (pore size 60 nm)
- Distributed in separate piping network – drinking water quality
- Closed circular pipeline – UV-lamp against microbial re-contamination
- Advantage: soft water




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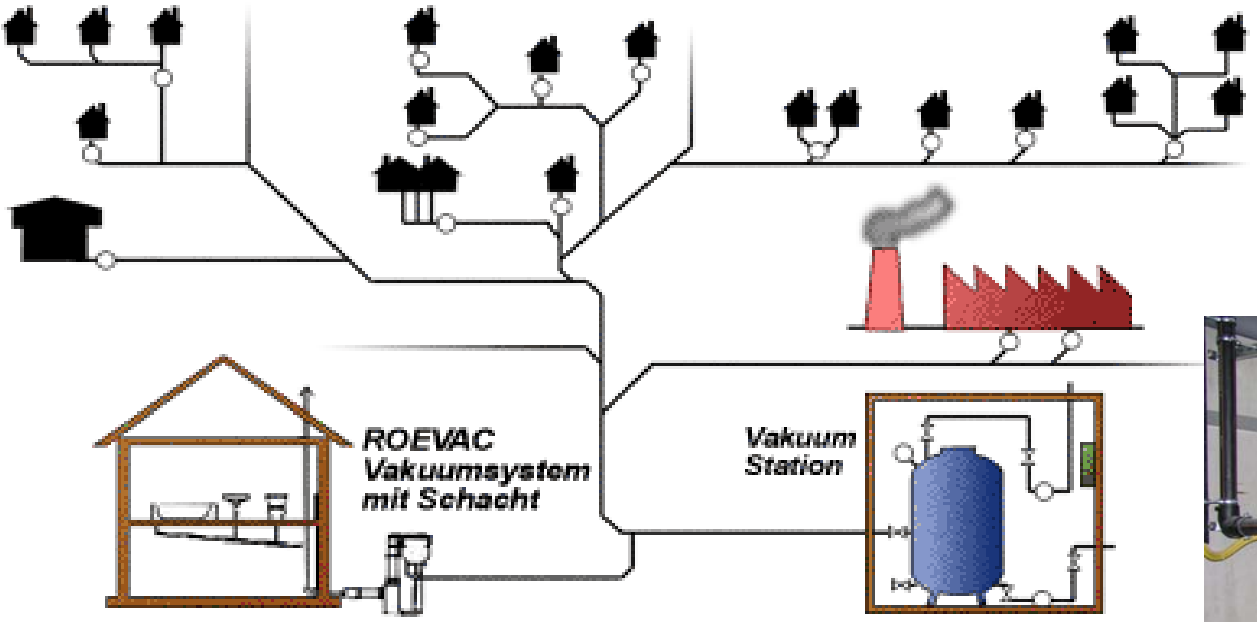
Scheme of a vacuum sewer system



- Domestic wastewater and organic waste from kitchens collected
- Vacuum station in the water house
- Vacuum pumps work between -0.5 and -0.7 bar

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Anaerobic wastewater treatment

- Microorganisms treat organic compounds under anaerobic conditions
- Production of biogas
- Sludge reduction by reduced growing rate
- High sludge conctentrations necessary: Microfiltration
- No heating necessary (psychrophile degradation)
- Almost no removal of nutriens
- Pilot plant (50 p.e.) in operation since September 2006

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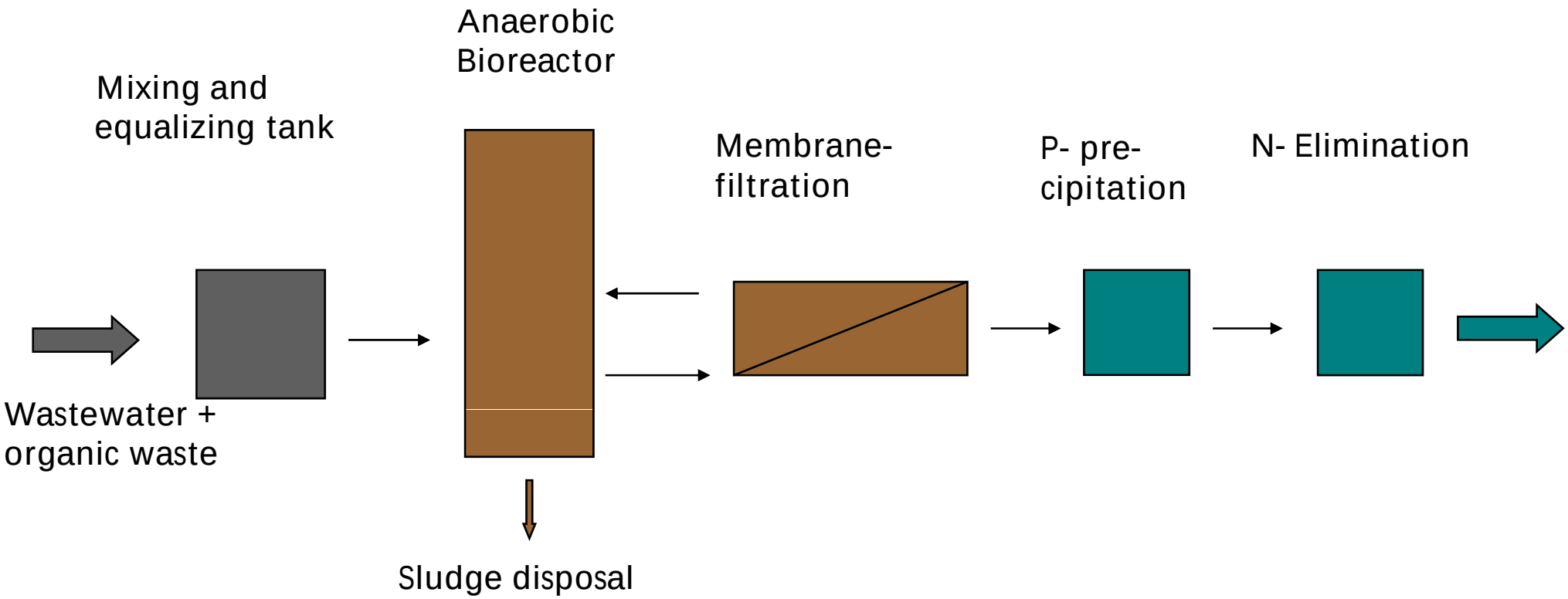
Wastewater treatment



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Advantages of the new system in Knittlingen

- No expensive sewage system, but small pipes for transport of wastewater
- No storage of kitchen waste necessary
- Less water consumption due to vacuum toilets and utilisation of rainwater
- Storage of rainwater decreases risk of floods
- Wastewater treatment close to origin might raise awareness for environmental issues
- Wastewater treatment method recycles energy (biogas) and nutrients (phosphorus and nitrogen)
- Discharge is free of bacteria and solids (filtration)

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Conclusion

- Semi-decentralized wastewater-management system integrated in existing settlement successfully demonstrated for over two years
- Rotating disk filter successfully demonstrated in full scale applications
- DEUS 21 concept for development areas developed and under investigation
- Opens field for sustainable solutions of water and nutrients use

Thank you for your attention

Questions are welcome!

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