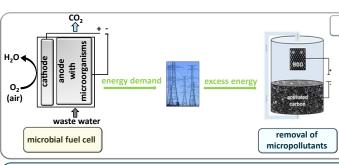# KEStro – Waste water treatment plants as stabilizers for power grids

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GEFÖRDERT VOM
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für Bildung
und Forschung

Objective

microbial fuel cell

removal of micropollutants

- Increasing amount of renewable energy.
- Innovative solutions for the balance of supply and demand in power grids are needed.
- Waste water treatment plants can be used for the stabilization of power supply systems.

- In a microbial fuel cell (MFC) microorganisms produce energy from organic substances in waste water. This can be used as a renewable and permanent available energy source.
- The MFC is combined with a novel process for the removal of micropollutants from waste water that can be operated in times of excess supply.

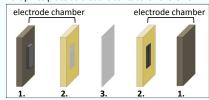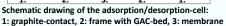→ Cells in laboratory- and pilot-plant-scale were designed and constructed for both systems.

Removal of micropollutants

Schematic drawing of the 3-step process for the removal of micropollutants.
- 1. step: adsorption of micropollutants from waste water effluent on granular activated carbon (GAC).
- 2. step: desorption via polarization of the GAC.
- 3. step: electrochemical degradation of the desorbed substances on boron-doped diamond electrodes (DIACHEM®) in a separate cell.
Experiments on electrochemical degradation are carried out at CONDIAS GmbH, Itzehoe.

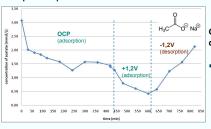**Adsorption/desorption cells**
- Two electrode chambers divided by a membrane.
- Each chamber is filled with a GAC packed bed.
- Graphite plate as electric contact for the GAC.

Schematic drawing of the adsorption/desorption-cell:
1: graphite-contact, 2: frame with GAC-bed, 3: membrane

Pilot plant for adsorption and desorption: 3 separate cells, 50 x 15cm², 360mL GAC/chamber

The pilot plant is operated in the waste water treatment plant Steinhof in Braunschweig.

1. step: adsorption on GAC

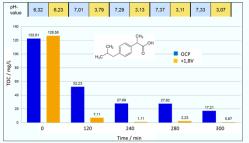**Change of acetate concentration during polarization of the GAC.**
- Enhanced adsorption on polarized GAC.

Adsorption of ibuprofen on polarized (yellow) and unpolarized (blue) GAC.

- Enhanced adsorption on polarized GAC.
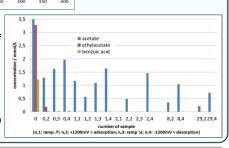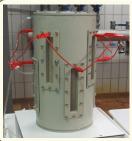- Influence of pH on adsorption performance.

2. step: electrochemical desorption

Concentration of ibuprofen in solution during polarization of GAC.
- Ibuprofen is desorbed at high voltage.
- Increase of pH by addition of NaOH also leads to desorption.

Cathodic and anodic polarization of GAC in the presence of different molecules.

- Various adsorption/desorption cycles are possible.
- Different molecules show different adsorption/desorption behaviour.

Microbial fuel cell

- Anode: biofilm grown on carbon felt.
- Cathode: gas-diffusion electrode as open-to-air cathode.
- Round body with 4 or 8 symmetrically distributed gas diffusion electrodes
- No membrane needed to separate anode and cathode compartment.
Microbial experiments are carried out at TZW, Karlsruhe (lab-scale) and at the waste water treatment plant Steinhof in Braunschweig (pilot plant).

Photograph of the microbial fuel cell (pilot plant).
Electrode area: working electrode: 2100cm², counter electrode: 480cm²; volume: 6L.

Project partner:

KEStro
„**K**läranlagen als **E**nergiepuffer für **Stro**mnetze"