

Advanced wastewater treatment based on electro chemical processes – Development of the process “electro accumulation” for the treatment of urban and industrial wastewater for the removal of remaining solid particles, powdered activated carbon and microconstituents

In past few years the topic microconstituents became a center of interest in the treatment of wastewater, especially in Germany and Switzerland. Due to improved analytical measurement methods microconstituents can be detected in the range of nanograms ubiquitously in the aquatic environment. Source of these endocrine substances are industrial and communal wastewater treatment plants (WWTP) as they typically do not eliminate many manmade microconstituents. Mainly these substances get into the wastewater by human and animal excretion as well as by effluents of industrial plants. Microconstituents can be pharmaceuticals, x-ray contrast agents, pesticides, personal care products and industrial chemicals like flame-retardants, chelation agents and plasticizers. By dosing powdered activated carbon (PAC) to the effluent streams of WWTPs, microconstituents can be removed with a high efficiency. Past studies showed that concentrations of 10-20 mg PAC per liter wastewater and average retention times of 15-30 min are needed. Also inert chemical oxygen demand (COD) and other remaining wastewater substances can be removed in addition. The subsequent essential separation of loaded PAC is quite challenging due to the very low particle sizes (1-100 µm, D50=20-25 µm) in combination with high flow rates. Typically, the sedimentation of PAC containing wastewater solids is only possible by adding coagulants and flocculation agents such as metallic salts (e.g. FeCl, AlCl, etc.) and organic polymers. Besides being cost intensive these additives can have the negative side effect of lowering the adsorption capacity. Also filtration processes are difficult in their operation. Due to the small particle sizes of typical PAC products the sieve openings need to be very fine consequently. Facing the process related difficulties of the separation of loaded PAC, the project team identified the urgent need to look out for new treatment methods for the removal of in effluent

streams remaining wastewater particles, powdered activated carbon and microconstituents. The so-called process “electro accumulation” has been development. Basically electrochemical processes such as electro coagulation, electrophoretic deposition and electro flotation as well as magnetism have be used to separate wastewater particles such as activated sludge and powdered activated carbon. Depending on the applied current and voltage and the chosen electrode materials the different process take place in a certain order. Two test plants (laboratory and semi-industrial scale) have been tested for that purpose. Mainly iron, steel and aluminum electrodes have been tested. Contrary to expectations, given by zeta potential measurements of wastewater and PAC, the electrophoretic deposition almost did not occur. Instead electro coagulation and electro flotation seemed to be more promising. The magnetic separation was very week as the PAC products only contain a very small amount of ferromagnetic substances such iron, nickel and cobalt.

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| Funding Institution: |
| Institute for Manufacturing Technologies of Ceramic Components and Composites (IFKB), University of Stuttgart |
| Contact: |
| Prof. / Universidade Regional de Blumenau Dr.-Ing. Uwe Menzel Dr.-Ing. Sebastian Platz, M.Sc. |
| Project partner: |
| Institut für Fertigungstechnologie (IFKB) der Universität Stuttgart Novoflow GmbH Umwelt- und Filtertechnik |
| Duration: |
| 07/2012 - 07/2014 |

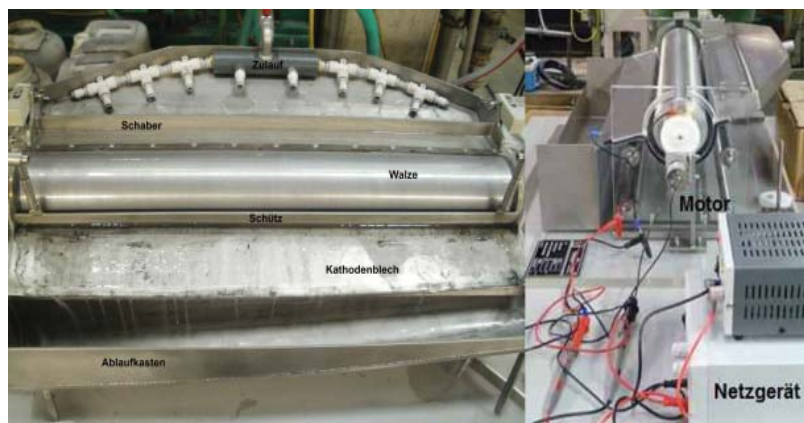


Figure: Start-up phase of the laboratory scale test plant „electro accumulator“