Session: Biofilm application

Scalable biofilm reactors as key component of a reaction cascade for the production of 2,3-Butanediol from food waste

Johannes Eberhard Reiner

Karlsruhe Institute for Technology - Engler-Bunte-Institute - Water Chemistry and Water Technology, Germany

Valorization of biomass waste streams into platform chemicals is considered one of the cornerstones towards a sustainable circular economy. This project aims for the development of a lab-scale reaction cascade for the directed degradation of complex organic matter into 2,3-Butanediol. After an initial acidic dark fermentation of biomass into carboxylic acids, hydrogen and carbon dioxide, two different biofilm processes are employed to convert the hydrolysate of the dark fermentation into 2,3-Butanediol: First, a microbial electrolysis cell serves as purification step in which an anodic biofilm oxidizes non-essential organic acids into carbon dioxide leading to an accumulation of propionate. For this purpose, a scalable bioelectrochemical rotating disk reactor with an anode surface of 1 m2 was constructed. Early experiments employing the model organisms Shewanella oneidensis and Geobacter sulfurreducens prove a significant influence of the working electrodes rotation speed on the degradation rate of the organic acids as well as on the achieved current densities. In order to follow the reaction cascade, the propionate-rich effluent from the bioelectrochemical system is then to be fed into a membrane biofilm reactor. A bioengineered Cupriavidus necator strain serves as the biocatalyst for an aerobic, mixotrophic conversion of propionate into 2,3-Butanediol. Whereby hydrogen and carbon dioxide, produced in the previous reaction steps, is expended in order to increase the overall efficiency of the reaction cascade.