Kinetic Modeling and Virtual Sensor for Renewable Hydrogen Estimation in an Anaerobic Reactor

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ABSTRACT

In this study, the kinetics of hydrogen production was discussed from the point of view of energetic sustainability based in the reusing of toxic residues in effluents contaminated by cadmium and sulfate in a batch bioreactor under anaerobic conditions, whereas the products of bacterial metabolism such as the sulfide (H_2S) and cadmium sulfide (CdS) in the presence of light allowed the hydrogen production. The proposed mathematical model was suitable for predicting concentrations of sulfate, sulfide, biomass, cadmium, CdS and production hydrogen. The model was subsequently calibrated with experimental data from the bioreactor. The experiments showed that the concentrations of hydrogen production increased with increasing sulfide hydrogen concentration. The proposed virtual sensor demonstrated monitoring the concentrations in the hydrogen production process. The sensor consists of a model-based state observer (nonlinear) to infer the (unmeasured) hydrogen, cadmium, cadmium sulfide and biomass concentrations, considering only on-line measurements of sulfate and sulfide concentrations. The software sensor performance is showed with experimental data from a real process and it is compared versus an others observers, obtaining good estimated concentrations of the proposed virtual sensor. The solution of using a virtual sensor gives promising guidelines to tackle in the future the problem of real time control of hydrogen production

Keywords: Nonlinear observer; Photocatalytic; kinetics