

Hydrogen sulfide removal from fermentative biohydrogen process: Effect of ZSM-5 zeolite loading

Abstract

The production and consumption of biohydrogen is growing because it is a “green,” renewable energy that can be obtained in a relatively cost-effective manner through anaerobic digestion. Biohydrogen produced from biomass is a viable source of renewable energy; nevertheless, the presence of highly toxic and corrosive hydrogen sulfide (H_2S) in the process can hinder the quality of biohydrogen production and limit its application in energy conversion equipment. Consequently, the goal of the research was to assess the feasibility of using ZSM-5 zeolite for H_2S adsorption that function as activating agent to enhance biohydrogen quality under thermophilic conditions. The effect of ZMS-5 Zeolite loading (0.2–1.0 g) on biohydrogen production via dark fermentation from mixed fruit waste (MFW) was investigated using anaerobic sludge from a sewage treatment plant. The pH of the broth mixture was adjusted to 6.0, anaerobic conditions were created by purging it with nitrogen gas, and the temperature of the fermentative biohydrogen process was maintained at 60°C. Meanwhile, the H_2S adsorption test was run at ambient temperature with flow rates (100 ml/min) and an H_2S inlet concentration of 10000 ppm. The results indicate that the Z + H_2S exhibit spectral lines corresponding to the S-H asymmetric stretching vibration of H_2S at 2345.97 cm^{-1} . The ideal adsorption capacity is at 0.8 g with yet, increasing the dosage amount of adsorbents, increases the time required for the adsorbent to achieve 90% saturation. The non-linear curve fitting demonstrated that the adsorption kinetics of all dosages used followed those of the Avrami kinetic model. This approach of using ZSM-5 zeolite for H_2S removal provides an advantage in terms of minimizing environmental pollution and having great potential uses in industrial processes.

Keywords

Adsorption; Anaerobic digestion; Biohydrogen; Hydrogen sulfide; ZSM-5 zeolite