

Bioconversion of synthesis gas to ethanol in a CSTR

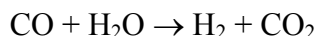
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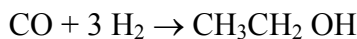
Abstract

The depletion sources of fossil fuels and chemical feedstock, also the oil crisis in 70's had drawn the world to find alternative clean renewable resources. The production of fuel by microbial culture was considered as an alternative source. In this research, synthesized gas would be used as gaseous substrate of anaerobic bacteria for production of hydrogen in first stage of bioreactor, then in second stage with adjustment of hydrogen and CO ethanol is obtained in presence of biocatalysts. The synthesis gas can be obtained from the gasification process of biomass and municipal solid wastes. The synthesis gas, which consists of CO, H₂ and CO₂, is a major building block in the production of fuels and chemical. Currently most of the synthesis gas is produced commercially by catalytic reforming of natural gas. These gases may also be produced through gasification of biomass, coal, sewage sludge and municipal solid wastes. However the synthesized gases are not rich in hydrogen. Synthesized gas must have a H₂: CO ratio of at least 3:1 to produce liquid fuel such as ethanol.

Microbial production of hydrogen is carried out by adjustment of molar ratio of hydrogen to CO equal to 3 in the first stage of fermentation, then the second stage of fermentation would be carried out in a CSTR bioreactor for ethanol production using *Clostridium ljungdahllii*. The hydrogen production for molar adjustment is carried out by *Rhodospirillum rubrum*. The desired water gas shift reaction is presented by the following stoichiometry:



The stoichiometry for ethanol production using *C. ljungdahllii* is shown the suitable H₂/CO ratio:



Finally a packed column fermentator is used instead of conventional bioreactor. The combination of two stages using mixed culture is required to find out possible use of single bioreactor. The maximum yield of productivity of ethanol from synthesis gas would be obtained based on use of various bioreactor and microbial cell densities.