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P95

IMMOBILIZATION OF PHOTOFERMENTATIVE BACTERIA IN LENTIKATS® FOR BIOHYDROGEN PRODUCTION

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Abstract

Biological hydrogen production by photofermentation with suspended cell-culture systems has been extensively studied. Suspended cell culture systems have the advantage of good mass transfer between microorganisms and substrates but the disadvantage of not being able to maintain sufficient concentrations of hydrogen producing bacteria in the reactor at low HRT conditions since at sufficiently high flow rates, cell wash-out can occur. Immobilization techniques can generally be divided into three main categories; adsorption (biofilm formation), encapsulation, and entrapment. Developing an effective immobilized system is probably the best option for increasing the biomass concentration which also might increase the light utilization efficiencies in photobioreactors. One of the most investigated immobilization techniques is cell entrapment, which seems to be a promising immobilization technique because it is relatively low cost and easily performed. Moreover, it provides a greater biomass content in the bioreactor and can create a local anaerobic environment. The main disadvantages of gel entrapment systems are low hydrogen production rates, insufficient supply of light, weak mechanical strength, and poor stability over long-term operation. Agar, agarose, alginate, carrageenan and chitosan are the most widely used entrapment materials.
In this study in order to eliminate the negative effects of the entrapment methods a novel non-aggressive method (called Lentikat ®) of PVA- gel preparation at room temperature by means of controlled partial drying was used for photofermentative biohydrogen production. Due to the lenticular shape, Lentikats® have the beneficial properties of both, small and large carriers, namely good diffusion properties as a result of small lens thickness and good mechanicalproperties and simple separation, typical for large carriers. *Rhodobacter capsulatus* JP91 was kingly provided from Prof. Hallenbeck's Lab at Montreal University, Canada was entrapped in Lentikats®. The lens shaped entrapped immobilized *Rhodobacter Capsulatus* was transferred into an upflow glass reactor with a working volume of 50 mL. the light intensity and the temperature were kept constant at 6000 lux and 28±2°C by a halogen lamp light source. The biohydrogen production potential by using increasing concentrations of lactate (2-5-10 g/L) was examined in 3 days HRT (Hydraulic Retention Time) conditions. The best volumetric hydrogen production rate as 324±28 mL H_2/L reactor.day and 1.8±0.4 mol H_2/mol lactate yield was obtained for inlet lactate concentration of 5 g/l. Immobilization by Lentikats® positively affect the biomass concentration in the reactor and this system is ready for the development for biohydrogen production from different organic substrates.