The Energetic Models of PHB Products by Alcaligenes eutrophus

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ABSTRACT

The Alcaligenes eutrophus were cultured at various temperatures (26 °C, 30 °C, and 33 °C) to study the growth rate of the bacteria, the PHB accumulation, the change in concentration of carbon and nitrogen during fermentation, and pyruvic acid exhausting due to metabolism. Results show that under 26 °C for 64 hr, the culture obtains 5.82 g microorganism/L, in which 3.81 g are PHB. In other words, there is a 2.01 g/L net microorganism. There is 20 g/L concentration of glucose in the beginning of fermentation, dwindling down to 6.65 g/L after 64 hr. The consumption of glucose was 13.36 g/L. The nitrogen supply exhausted after 52 hr. The microorganism growth rate was 0.1282 g/hr, and the yield of PHB is 0.29 g/g glucose. Under 30 °C for 78 hrs, the culture obtains 9.10 g microorganism/L, in which 4.24 g are PHB. In other words, there is a 4.86 g/L net microorganism. There is a 25 g/L glucose concentration in the beginning of fermentation, which dwindles down to 2.41 g/L after 78 hrs. The consumption of glucose was 22.59 g/L. The nitrogen supply exhausted after 56 hr. The microorganism growth rate was 0.1027 g/hr, and the yield of PHB is 0.19 g/g glucose. Under 33 °C for 62 hrs, the culture obtains 10.72 g microorganism/L, in which 5.81 g are PHB. In other words, there is a 4.91 g/L net microorganism. There is 25 g/L glucose concentration the beginning of fermentation, dwindling down to 0.13 g/L after 62 hrs. The consumption of glucose was 24.87 g/L, the nitrogen supply exhausted after 33 hr. The microorganism growth rate was 0.0572 g/hr and the yield of PHB is 0.22 g/g glucose. HPLC analyzing found that increasing the reaction time and the culture temperature during fermentation will increase the pyruvic acid count. However, the amount of pyruvic acid was so slight that it did not affect the growth rate of the microorganism or the production rate of PHB. Experimental results show that the more PHB accumulated in microorganism presents, the slower PHB accumulation rate will be. The accumulation rate would reduce to zero, if intracellular PHB has reduced its saturation level. Thus, the intracellular PHB may inhibit the PHB accumulation. Many kinetic models have been proposed by researchers. However, these models all have more than six parameters. In this study, a model with five parameters has been proposed. Besides, this model is not affected by the starting concentration of microorganism and thenitrogen/carbon ratio, and experimental results are compared with model values satisfactorily.

Keywords : 聚羥丁酸酯 動力式 抑制作用 丙酮酸 生長速率 發酵