International Biodeterioration and Biodegradation, vol. 102, 2015, pages 15-23

Characteristics of developed granules containing phototrophic aerobic bacteria for minimizing carbon dioxide emission

Abstract

Photosynthetic process compromises the most effective and natural way for carbon recycling, in which photosynthetic bacteria utilized carbon dioxide (CO_2) during the wastewater treatment processes. The aim of this study was to characterize phototrophic microbial granule in order to minimize CO_2. A 3-L bioreactor phototrophic Sequencing Batch Reactor (SBR_P) was applied to produce phototrophic aerobic granular sludge (AGS_P) and the biomass concentration increased from 3 to 14 g L^{-1}. Such growth has resulted in a maximum settling velocity of 40 mh^{-1} with granule average size of approximately 2.0 mm. The high settling velocity was found to be attributed by the smooth, compact, and regular characteristics of the aerobic granules. High magnification microscopic analysis revealed that AGS_P was dominated by cocci-shaped bacteria embedded within the extracellular polymeric substances (EPS). Detailed observation on the structure of the AGS_P showed the presence of 30 μm of cavity to allow nutrients and gas exchanges within the aerobic granule. Scanning Electron Microscope-Energy-Dispersive X-ray (SEM-EDX) examination showed AGS_P composed of different types of inorganic and organic compounds. AGS_P achieved 92% of CO_2 reduction, indicating that CO_2 biofixation can be performed facultatively by photosynthetic bacteria in an SBR based on the nomenclature of microbial species obtained.

Keywords

Carbon dioxide; Characterization; Phototrophic aerobic granular sludge (AGS_P); Scanning electron microscope-energy-dispersive X-ray spectroscopy (SEM-EDX)