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系列混合碳源条件下颗粒化EBPR系统菌群结构变化规律研究

A study of microbial diversity of granule-based enhanced biological phosphorus removal systems cultivated with ratiometric propionate and acetate as mixed carbon sources

关键词：强化生物除磷 颗粒污泥 菌群结构 混合碳源 丙酸 乙酸

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摘要：在SBR反应器中接种富含聚磷菌的活性污泥,采用一系列不同丙酸/乙酸比例混合的碳源进行EBPR系统污泥的颗粒化培养,并考察了颗粒化进程中的系统菌群结构变化,以及不同混合碳源条件对系统功能菌种竞争的影响.结果表明,污泥颗粒化过程对EBPR系统菌群结构产生了较大的筛选作用.原本在系统中占优势的一类Uncultured bacterium被迅速淘汰;Uncultured *Rhodocyclaceae* bacterium、部分*Candidatus Competibacter phosphatis*、部分Denitrifying bacterium、*Acinetobacter*及部分Uncultured *alpha proteobacterium*分别逐渐被淘汰.在各个成熟的颗粒化EBPR系统中,除磷微生物主要为Uncultured *Chlorobi* bacterium与Uncultured *alpha proteobacterium*.不同混合碳源条件培养的颗粒化EBPR系统菌群结构差异主要表现为*Candidatus Competibacter phosphatis*(聚糖菌)与Uncultured *Chlorobi* bacterium(聚磷菌)菌群数量的不同.混合碳源中乙酸比例的提高可造成颗粒化EBPR系统中*Candidatus Competibacter phosphatis*的增长,使系统的除磷效率下降.而碳源中丙酸比例相对较高的条件有利于Uncultured *Chlorobi* bacterium增长,从而有助于颗粒化EBPR系统维持较好的除磷效率.

Abstract：A series of mixed carbon sources with different ratios of propionate and acetate was applied in granule-based enhanced biological phosphorus removal (EBPR) sludge in SBR reactor. Microbial diversity change during the granular process and functional bacteria competition under different carbon sources were studied. Significant microbial diversity change in EBPR system was exhibited during granulation. Uncultured bacteria previously dominated in the system disappeared rapidly, while uncultured *rhodocyclaceae* bacterium and portions of *candidatus competibacter phosphatis*, denitrifying bacterium, *acinetobacter* and uncultured *alpha proteobacterium* were gradually washed out. Uncultured *chlorobi* bacterium and uncultured *alpha proteobacterium* were the primary phosphorus removal bacteria in developed granular EBPR system. The change of bacteria population of *candidatus competibacter phosphatis* and uncultured *chlorobi* bacterium was evidenced as a result of microbial diversity under different ratios of mixed carbon sources. The population of *candidatus competibacter phosphatis* increased monotonically with acetate concentration, decreaseing the system phosphorus removal efficiency. Meanwhile, the population of uncultured *chlorobi* bacterium had a positive correlation with propionate concentration, which maintained good phosphorus removal efficiency of the EBPR system.

Key words：enhanced biological phosphorus removal (EBPR) granular sludge microbial diversity mixed carbon sources propionate acetate

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