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沼液中悬浮物对乙醇发酵的影响及其絮凝处理的研究

Effect of suspended solids in digestate on ethanol fermentation and flocculation treatment

关键词: [沼液](#) [乙醇发酵](#) [悬浮物](#) [絮凝剂](#) [浊度](#) [色度](#)

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摘要: 乙醇-沼气双发酵耦联工艺的应用有望实现乙醇工业工艺废水“零排放”的目标.本研究对该耦联工艺的回用配料水--中温沼液中的悬浮物对乙醇发酵的影响进行了考察,并对其去除方法进行了确定.结果表明,沼液中悬浮物的存在会促进酵母细胞的繁殖,提高发酵速率,但副产物甘油及小分子有机酸的量大幅上升,而主产物乙醇的生成量减少,悬浮物对乙醇合成的临界抑制浓度为 $0.35 \text{ g} \cdot \text{L}^{-1}$ (干重).采用不同的絮凝剂及絮凝方式对沼液中的悬浮物进行去除,发现絮凝剂聚合氯化铝(PAC, $300 \text{ mg} \cdot \text{L}^{-1}$)与阳离子聚丙烯酰胺(CPAM, $2 \text{ mg} \cdot \text{L}^{-1}$)协同处理时效果最佳,对沼液浊度、色度的去除率分别为92.4%、23.7%,所得上清液的悬浮物粒径小于 $2 \mu\text{m}$,PAC、CPAM的残留量分别为 0.82 、 $0.03 \text{ mg} \cdot \text{L}^{-1}$.絮凝处理后消除了悬浮物对乙醇合成的抑制作用,且絮凝处理后沼液回用的发酵性能略优于离心所得沼液回用的发酵水平,达到了预期的目的.

Abstract: Application of the integrated ethanol-methane fermentation technology is expected to achieve the goal of "zero discharge" in ethanol industry. This work investigated the effect of suspended solids in mesophilic digestate on ethanol fermentation and the removal method. Results showed that the presence of suspended solids in fermentation promoted yeast propagation and improved the rate of fermentation. Concentrations of by-products (glycerol and organic acids) increased significantly while the ethanol synthesis was inhibited with the critical inhibitory concentration of $0.35 \text{ g} \cdot \text{L}^{-1}$. Different flocculants and flocculation methods were then used to remove the suspended solids from the digestate. $300 \text{ mg} \cdot \text{L}^{-1}$ of aluminium polychlorid (PAC) and $2 \text{ mg} \cdot \text{L}^{-1}$ of cationic polyacrylamide (CPAM) were the optimum combination of flocculation, under which the turbidity and color removal rates were 92.4% and 23.7%, respectively. The particle size of suspended solids was below $2 \mu\text{m}$ and the residual concentrations of PAC and CPAM were 0.82 and $0.03 \text{ mg} \cdot \text{L}^{-1}$, respectively, in the resulted supernatant. Besides, ethanol synthesis in the fermentation with the above supernatant as process water was not inhibited. The performance of fermentation with flocculation-treated digestate was better than that with the digestate treated by centrifugation.

Key words: [digestate](#) [ethanol fermentation](#) [suspended solids](#) [flocculants](#) [turbidity](#) [color](#)

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