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脉冲循环式渠槽厌氧反应器处理太湖腐熟蓝藻性能

Capability of pulse cycle corridor anaerobic reactor treating composted algae water

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作者	单位
余亚琴	1. 东南大学能源与环境学院，南京 210096； 2. 盐城工学院土木学院，盐城 224051
吕锡武	1. 东南大学能源与环境学院，南京 210096
吴义锋	1. 东南大学能源与环境学院，南京 210096
许丽娟	1. 东南大学能源与环境学院，南京 210096

中文摘要:

为实现太湖腐熟蓝藻的资源化处理，研究新型厌氧反应器——脉冲循环式渠槽厌氧反应器处理太湖腐熟蓝藻的效能及其运行特点。以城市污水处理厂剩余污泥为种污泥接种量混合液挥发性悬浮固体浓度（MLVSS）为20 g/L，进水化学需氧量（COD）质量浓度2 000 mg/L，水力停留时间（HRT）为5 d，中温(30～35 ℃)厌氧条件下，器可在30 d内成功启动并达到初步稳定运行，COD去除率达到60%左右，产气率为0.08 L/(L·d)；当进水COD容积负荷3.5 kg/(m3·d)时，仍能实现安全稳定运行，COD去可以稳定在80%左右，产气率在1.2 L/(L·d)，表明反应器抗冲击负荷能力较强，同时沼液中藻毒素（TMC-LR、EMC-LR）去除率为90%以上。稳定运行期间反应器厌氧污泥对腐熟蓝藻甲烷化的最大比基质降解速率为1.253 mg/(mg·d)，半饱和常数为11 770 mg/L，甲烷产率系数为0.256 mL/mg；电镜观测发现稳定运行期颗粒污泥以产甲烷八叠球菌为主，伴有丝状菌和杆菌等，同时发现其蛋白酶、TTC-脱氢酶和辅酶F420活性相对较高。研究发现脉冲循环式渠槽厌氧反应器能够有效地处理太湖蓝藻，这对资源化利用具有一定的指导意义。

英文摘要:

As a typical high organic concentration wastewater, composted algae water from the Taihu Lake could be treated with anaerobic biological treatment technology for clean ener biogas. During this process, Cyanobacteria are easy to float and crust in the reactor, thus affecting the efficiency of the gas production and reducing the processing effect of the reactor. Therefore, the design of an efficient anaerobic reactor suitable to the characteristics of cyanobacteria was the main task of the study.We designed a new type of anaerobic reactor, the pulse cycle corridor anaerobic reactor, and considered the performance of processing composted algae water from the Taihu Lake. Simultaneously, sequencing batch experiments on the methanation dynamics of the enriched granular sludge through the stable operation of the reactor was adopted to provide theoretical support on further promo of treating cyanobacteria. Main contents and results were as follows:With an inoculated aerobic activated sludge from municipal sewage treatment plant, the reactor started up at chemical oxygen demand (COD) concentration of 2000 mg/L, hydraulic retention time (HRT) of 5 d and temperature of (30-35)℃ for 30 d; the pulse cycle corridor anaerobic reactor achieved a stable state. The COD removal efficiency was above 60%, and biogas productivities of unit volume was 0.08 L/(L•d) at this level. When volumetric loading rate increas stage by stage from 0.8 kg/(m3•d) to 3.5 kg/(m3•d), the reactor could perform steadily with a COD removal efficiency as high as 80%. Meanwhile, biogas productivities of unit volu was 1.2 L/(L•d). The reactor had some advantages of quick start-up speed, tending to forming the particulate the sludge and enduring pulse load by shortening the pulse time, increasing the number of cycle of cyanobacteria in the reactor, extending the flowing time of cyanobacteria in the reactor channel, overcoming the phenomenon of cyanobacteria floating, and raising the probability of contact between the cyanobacteria and the sludge.The removal rate of microcystins (TMC-LR, EMC-LR) was over 90%, which indicated tha reactor had a good removal effect on microcystins of the composted cyanobacteria. The main reason for microcystins removal was the effective intercept of cyanobacteria by a lar number of cultivated anaerobic granular sludge and the enrichment of numerous indigenous bacteria in the reactor.The methanation kinetics of composted algae water substrated the granular sludge from the pulse cycle corridor anaerobic reactor was investigated. The maximum specific degradation rate, half saturation constant, and yield coefficient were 1. mg/(mg•d), 11 770 mg/L, and 0.256 mL /mg, respectively. Observed by a scanning electron microscope (SEM), the granular sludge was found in the stabilization stage with couple growing micro-organisms, including methanosarcina, filamentous bacteria, and rod-shaped bacteria. Proteinase, coenzyme F420 and TTC-dehydrogenase activity of granular sludg from pulse cycle corridor anaerobic reactor had been in high level during the duration of the experiment.Results indicated that the pulse cycle corridor anaerobic reactor could effectively deal with the algae-laden water from the Taihu Lake. It provided important value for the biogas fermentation of algae.

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