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Author: Mr. Shengda Deng
School of Biological Science and Medical Engineering, Beihang University; Institute of Environmental Biology and Life Support Technology, Beihang University, China, dengshengda91@163.com

Dr. Beizhen Xie
School of Biological Science and Medical Engineering, Beihang University; Institute of Environmental Biology and Life Support Technology, Beihang University, China, xiebeizhen@buaa.edu.cn
Prof. Hong Liu
School of Biological Science and Medical Engineering, Beihang University; Institute of Environmental Biology and Life Support Technology, Beihang University, China, LH64@buaa.edu.cn

THE RECYCLE OF WATER AND NITROGEN FROM URINE IN LUNAR PALACE 1

Abstract

The recycle of the wastewater is one of the main factors for realizing a higher closure degree of bioregenerative life support system (BLSS), among which the treatment and recovery of the crew's urine are the most difficult and critical issues. Researchers have paid a lot of attention on the desalination of urine in the previous studies, however, if the nitrogen could be recycled simultaneously while desalting the urine, the substance circulation and the closure of BLSS could be improved more significantly. In this study, two-step method was conducted to treat the urine and recycle the water and nitrogen. The urine was hydrolyzed firstly, and then the water vapor and ammonia gas were cooled and collected by using reduced pressure distillation in alkaline condition. High temperature acidification method (HTAM) and immobilized urease catalysis method (IUCM) were investigated in the hydrolysis pretreatment of urine. The treatment conditions of both methods were optimized and the hydrolysis efficiencies were compared. The results showed that the optimum treatment temperature and acidity for HTAM were 99oC and [H+]=2 mol/L when the reaction time was 7 h, and the maximum nitrogen recycle efficiency was 39.7%. While, the optimum treatment conditions for IUCM were 60oC, pH=7.0 and 40 min, and the maximum nitrogen recycle efficiency could reach 52.2%. Therefore, compared with HTAM, IUCM has higher hydrolysis efficiency with milder reaction temperature and pH and shorter reaction time which means it could adapt to the heavy urine treatment workload in BLSS. This investigation has provided a promising method to recycle the urine in BLSS, and all the results will contribute to the further BLSS experiments conducted in the stage II of the "Lunar Palace 1".