Compact and high-performance activated carbon incorporated membrane bioreactor with the addition of biofilm carriers

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Abstract:

The global fertiliser market price has soared in recent years along with the increasing world population and the agricultural demand. This continuous production of synthetic fertilisers would affect the resource availability due to the phosphorous extraction from mines as well as the fixation of atmospheric nitrogen. Source separation of urine can be an effective solution for nutrient recovery as a fertiliser, as well as a reduction of the burden on conventional wastewater treatment plant as a considerable quantity of nutrients in wastewater is derived from urine. However, malodour, high organic contents and pH, and the presence of pathogens and pharmaceuticals in urine remain a barrier limiting its direct agricultural use. The biological oxidation of stored urine in the membrane bioreactor (MBR) can be a promising technology in reducing odorous organics and pH as well as stabilising by partial conversion of NH_3/NH_4^+ into NO_3^-. However, the high hydraulic retention time (HRT) due to the high nitrogen concentration of urine, and the presence of micropollutants in urine, as well as the occurrence of nitrite accumulation owing to the imbalanced growth of slow-growing nitrifying bacteria remain to be challenges. This study aims to investigate the effects of biofilm carrier addition and the subsequent support for nitrifying bacterial growth on the nitrification of source-separated urine and the HRT of MBR, in comparison with a conventional MBR. Moreover, powdered activated carbon (PAC), which has been demonstrated as an effective additive for micropollutants removal, will also be added to explore the effects on nitrification along with carriers, and organics removal.

Keywords: Urine nitrification; Membrane bioreactor; Powdered activated carbon; Biofilm carriers; Nutrient recovery

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