The inhibitory impacts of nano-graphene oxide on methane production from waste activated sludge in anaerobic digestion

The wide application of graphene oxide nanoparticles inevitably leads to their discharge into wastewater treatment plants and combination with the activated sludge. However, to date, it is largely unknown if the nano-graphene oxide (NGO) has potential impacts on the anaerobic digestion of waste activated sludge (WAS). Therefore, this work aims to fill the knowledge gap through comprehensively investigating the effects of NGO on carbon transformation and methane production in the anaerobic digestion of WAS. Biochemical methane potential tests demonstrated the methane production dropped with increasing NGO additions, the cumulative methane production decreasing by 7.6% and 12.6% at the NGO dosing rates of 0.054 mg/mg-VS and 0.108 mg/mg-VS, respectively. Model-based analysis indicated NGO significantly reduced biochemical methane potential, with the highest biochemical methane potential decrease being approximately 10% at the highest NGO dosing rate. Further experimental analysis suggested that the decreased methane production was firstly related to a decrease in soluble organic substrates availability during the process of sludge disintegration, potentially attributing to the strong absorption of organic substrates by NGO. Secondly, NGO significantly inhibited the methanogenesis by negatively affecting the corresponding enzyme activity (i.e. coenzyme F420), which could also resulted in a decreased methane production.

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