A review on the impact of conductive nanoparticles (CNPs) in anaerobic digestion: Applications and limitations

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ABSTRACT

The development of the anaerobic digestion (AD) process and its mild operating conditions of complex organic carbon distinguish it from conventional energy technologies and make it highly desirable to meet a sustainable green energy technology. Although, the effectiveness of this AD method is often constructed by few issues such as surface heterogeneity, ammonia inhibition, poor methane production, slow microbe growing rates, and slow mass transfer which needs rectification. Conductive nanoparticles (CNPs) helps to increase anaerobic digestion rates as nano-sized structures with specific physicochemical properties interact with the substrate and microorganisms. CNPs as additive have resulted in high efficiency for the AD process because of their unique physicochemical characteristics, i.e. high surface area, high active sites, high reactivity levels, high specificity, self-assembly, increased mobility, and AD media transmission. This review concentrates on the recent attempts to examine the impact of CNPs, pro and cons on biogas production while using a metal oxide, zero-valent metals, and nano-carbon materials. The traditional view of binding CNPs to living organisms and the current view of mechanisms for improving aerobic digestive performance with metal CNPs. Furthermore, the effect of the physical parameter and kinetic limitations has discussed by the mathematical modeling that essential to observe, optimize simulate, and predict the behavior of microbes at different conditions in the AD process. Later the methanogenic activity and chemical content inhibition of CNPs on the AD system was discussed. Finally, future prospects and other recommendations discussed as conclusive remarks, which help in the substantial use of CNPs to the AD process.

KEYWORDS: Anaerobic digestion, Conductive nanoparticles, Kinetic limitations, Physicochemical parameters, Methanogenesis

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