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# Biogas Enhancement Using Iron Oxide Nanoparticles and Multi-Wall Carbon Nanotubes

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**Abstract :** Quick development and usage of nanotechnology have resulted to massive use of various nanoparticles, such as iron oxide nanoparticles (IONPs) and multi-wall carbon nanotubes (MWCNTs). Thus, this study investigated the role of IONPs and MWCNTs in enhancing bioenergy recovery. Results show that IONPs at a concentration of 750 mg/L and MWCNTs at a concentration of 1500 mg/L induced faster substrate utilization and biogas production rates than the control. IONPs exhibited higher carbon oxygen demand (COD) removal efficiency than MWCNTs while on the contrary, MWCNT performance on biogas generation was remarkable than IONPs. Furthermore, scanning electron microscopy (SEM) investigation revealed extracellular polymeric substances (EPS) excretion from AGS had an interaction with nanoparticles. This interaction created a protective barrier to microbial consortia hence reducing their cytotoxicity. Microbial community analyses revealed genus predominance of bacteria of Anaerolineaceae and Longilinea. Their role in biodegradation of the substrate could have highly been boosted by nanoparticles. The archaea predominance of the genus level of Methanosaeta and Methanobacterium enhanced methanation process. The presence of bacteria of genus Geobacter was also reported. Their presence might have significantly contributed to direct interspecies electron transfer in the system. Exposure of AGS to nanoparticles promoted direct interspecies electron transfer among the anaerobic fermenting bacteria and their counterpart methanogens during the anaerobic digestion process. This results provide useful insightful information in understanding the response of microorganisms to IONPs and MWCNTs in the complex natural environment.

**Keywords :** anaerobic granular sludge, extracellular polymeric substances, iron oxide nanoparticles, multi-wall carbon nanotubes
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