

FULL-TEXT

Effects of Co and Ni nanoparticles on biogas and methane production from anaerobic digestion of slurry

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ABSTRACT

Nanoparticles (NPs) were hypothesized to enhance the anaerobic process and to accelerate the slurry digestion, which increases the biogas and methane production. The effects of NPs on biogas and methane production were investigated using a specially designed batch anaerobic system. For this purpose, a series of 2 L biodigesters were manufactured and implemented to study the effects of Cobalt (Co) and Nickel (Ni) nanoparticles with different concentrations on biogas and methane production. The best results of NPs additives were determined based on the statistical analysis (Least Significant Difference using M-Stat) of biogas and methane production, which were 1 mg/L Co NPs and 2 mg/L Ni NPs ($p < 0.05$). These NPs additives delivered the highest biogas and methane yields in comparison with their other concentrations (0.5, 1, and 2 mg/L), their salts (CoCl_2 , and NiCl_2) and the control. Furthermore, the addition of 1 mg/L Co NPs and 2 mg/L Ni NPs significantly increased the biogas volume ($p < 0.05$) by 1.64 and 1.74 times the biogas volume produced by the control, respectively. Moreover, the aforementioned additives significantly increased the methane volume ($p < 0.05$) by 1.86 and 2.01 times the methane volume produced by the control, respectively. The highest specific biogas and methane production were attained with 2 mg/L Ni NPs ($p < 0.05$), and were 614.5 ml Biogas g^{-1} VS and 361.6 ml CH_4 g^{-1} VS, respectively compared with the control which yielded only 352.6 ml Biogas g^{-1} VS and 179.6 ml CH_4 g^{-1} VS.

Keywords: nanotechnology, nanoparticles, anaerobic digestion, biogas, methane production, trace metals, chemical additives, manure management, slurry treatment.

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