Environment and water

Effect of zeolite nanomaterials in methanogenic communities

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Recently, the application of zeolite structures in methanogenic communities has attracted significant attention, since they may enhance the anaerobic digestion process, by affecting specifically the methanogenic activity of the sludges[1]. Zeolites are solid inorganic crystalline materials comprised of silicon, aluminum and oxygen in the three-dimensional structure. The building blocks become arranged in a periodic way to form channels and cages on a nano- and subnanometer scale of strictly regular dimensions, named micropores. The presence of the aluminum in the zeolite framework create a negative charge in the lattice, which can be balanced by the exchangeable cations, as sodium or metal ions.[2] In this study, commercial zeolite structures (ZSM5, USY, NaX and NaY) with different particle sizes and different exchangeable cations (Co, Cu, Zn, Fe) were used in order to investigate their effect towards the specific methanogenic activity, both acetoclastic and hydrogenotrophic, of anaerobic sludge. In the acetoclastic methanogenic activity, NaY modified with Cobalt (CoY) decreased the activity in comparison with the control (without zeolite). The remaining zeolites (ZSM5, USY, NaX and NaY), even when modified with metal ions (Zn, Fe, Cu), seems to have no effect on this methanogenic pathway. On the other hand, the hydrogenotrophic methanogenesis was improved by the presence of NaY (109 %), which did not happen in the presence of ZSM5 and USY zeolites. Additionally, the effect of different zeolite concentration was accessed. Overall, the increase of zeolite concentration from 1 g/L to 5 g/L resulted in a higher inhibition towards the methanogenic activity. In addition, the application of these nanomaterials can be evaluated in pure cultures of methanogens, in order to understand and fine-tune the best zeolite nanomaterial concentration that may improve the specific methanogenic activity.

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