Application of humic substances in intensification of anaerobic biotransformation of oxidized sulfur compounds

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The specificities of the functioning of some natural biosystems with the participation of microorganisms and humic substances (HS) are increasingly attracting the attention of researchers [1-3]. The effect of HS on the activity of different bacteria and consortia of microorganisms was studied separately [4-5]. It was found that potassium humate and chemically modified HS are inhibit the metabolic activity of bacterial cells, while the fulvic acids and sapropel are stimulate the metabolic activity of natural methanogenic consortia [4-5].

Anaerobic methanogenic consortia are widely used not only for the production of biogas, but also for the decomposition of various wastes and for wastewater treatment. In this work, we used HS for stimulating metabolic activity of anaerobic cells during the biocatalytic stage of the hybrid chemical-biological process of oil desulfurization [6-7]. This process is a sequential combination of chemical stages (oxidation of sulfur-containing substances and their extraction) and a biocatalytic stage (transformation of an extract containing oxidized sulfur compounds under anaerobic conditions with simultaneous production of biogas and inorganic sulfide). Sapropel (Ruskiyi ogorod) and fulvic acids (Greenway) were introduced in methane tank. The liquid phase of the methane tank also was contained ethanol and dibenzothiophenesulfone (Table 1).

Table 1. Process characteristics of ethanol extract containing dibenzothiophenesulfone transformation by anaerobic consortium

HS	Methanogenesis efficiently, %	Methane content in biogas, %	Transformation of sulfur into inorganic sulfide, %
-	64.3±2.6	49.7±2.2	72.5±3.7
Fulvic acids	64.5±2.6	72.5±2.8	92.8±5.2
Sapropel	65.8±2.8	62.8±2.7	87.9±4.3

It was shown that the efficiency of methanogenesis in this process practically did not change with the introduction of different HS into the medium. Increasing the methane proportion in the biogas composition and the degree of sulfur conversion into inorganic sulfide in the process was significant (by 15-20%). It is possible that these HS stimulate the metabolism of methanogenic archaea and sulfate-reducing bacteria being components of anaerobic consortium. The work was supported by the RFBR (grant number 18-29-05064).

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