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Microbiologic Technique for Mine Methane Reuse

In cooperation with Institute of Biology and Inframicrobiology of the National Academy of Sciences of Ukraine, Institute of Geotechnical Mechanics of NAS of Ukraine has developed a technique of biomass obtaining with the help of methanotroph bacteria processing mine methane. Under favourable conditions the methanotroph microorganisms oxidize methane and reproduce themselves accumulating own cells; that is biomass.

Basic components of the technique are as follows: rock mass involving contiguous gas-bearing coal seams; a system for a mine degasifying involving vacuum pump unit, degasifying wells, and systems of major pipelines for methane-air mixture transportation; mine block of biostabilizers to generate suspension of methane-oxidizing bacteria being a part of degasifying plant of a mine.

The biomass of methane-oxidizing bacteria may be widely used. For example, to decrease concentration of methane in worked-out areas of longwalls, a number of Donbas mines took part in experiments by Institute of Geotechnical Mechanics and Institute of Biology and Inframicrobiology. In the context of the mines, methane concentration reduced radically. Distinctive aspect of the technique is the fact that it can use both low-concentrated (up to 15%) and high-concentrated (90% and more) methane-air mixtures. In addition, the biomass generated with the help of captured methane is its application as high-caloric feed supplement for farm livestock and fish. The biomass contains 60% of protein (for comparison: pea contains 22 % of protein, and soy contains 40% of it) rich in essential amino acids and vitamins. Its application as protein feed supplement provides substantial increase in animal productivity (more than 15%) as well as concentrated feedstuff saving (20% and more). If we take into consideration the fact that synthesis of a kilogram of the bacteria cells takes two to three cubic meters of methane it is quite understandable thing that in the context of 90 m³/min capture of methane-air mixture with 32% concentration of CH₄, application of fermenter (which volume is 187 cubic meters) will help generate 3100 tons of protein product per annum. As calculations have shown, generation of biomass with the use of captured methane-air mixture in the volume of 90 m³/min with average concentration of methane at the level of 32% is economically sound. If production profitability is about 30%, then payback time of fermentation plant construction is almost three years. Net cost of a ton of gaprin will be UAH 2472. In terms of market price, protein and vitamin concentrate will become equivalent to caloric value of crude protein which price is UAH 3622. Use of such quantities of feed supplement will help obtain extra 2,000 to 2,500 tons of meat (live weight basis).