Focus on CSIR Research in Pollution and Waste

Biological sulphate removal technology

Background

Acid mine drainage (AMD) is formed when the mineral pyrite comes into contact with oxygen and water, producing elevated sulphate, metal and acidity concentrations. Biological sulphate removal technology can be used to treat AMD, using cost-effective carbon sources derived from the degradation products of grass-cellulose, the major constituent of plant biomass. Fermented cellulose produces volatile fatty acids (VFA): sustainable sources of energy. This treatment process relies on many species of degrading bacteria including the sulphate reducing bacteria (SRB).

Fermentation microorganisms using cattle rumen fluid

The rumen is a highly cellulytic ecosystem with a complex microbial population of bacteria, archaea, protozoa and fungi, that efficiently mediate the anaerobic degradation of plant material by producing fibre degrading enzymes.

At the laboratories of the CSIR, rumen fluid microorganisms are used in the fermentation of grass-cellulose at decreasing temperatures. Previous research results showed that rumen fluid microorganisms degraded grass-cellulose at temperatures of 36°C - 39°C, producing the carbon and energy sources for the biological sulphate removal process, resulting in an 86% sulphate removal efficiency. Decreasing the temperature stepwise by 1°C from 39°C - 33°C, showed that the higher temperature adapted microorganisms failed to produce enough VFA at temperatures below 33°C.

Current research focus

The current research being conducted by the CSIR focuses on adapting microorganisms from cattle rumen fluid to room temperature. The initial results are positive with a 100% sulphate removal using the carbon and energy sources produced from the degradation of grass-cellulose, using rumen fluid microorganisms.

In addition, the research will focus on the effect of the daily supplementation of substrate (grass), microorganisms, both the rumen fluid and the SRB. Furthermore, studies will focus on batch test operated reactors as well as on continuous fed reactors, using synthetic sulphate rich feed water and also pre-treated mine water, obtained from a closed mine in the Witbank mining area of South Africa.

Molecular studies

Molecular studies will be conducted to better understand the microbial population in the reactor systems and to acquire a 'picture' of the 'adapted to room temperature' rumen fluid microorganisms. The results are expected to enable the researchers to cultivate the adapted micro-organisms for the purpose of grass-cellulose degradation, thereby allowing for the continuous production of the energy sources for sustained sulphate reduction.

Passive and semi passive treatment systems

Biological sulphate removal using the grass-cellulose fermentation products can be applied on active and passive scale, e.g. anaerobic wetland systems.

Contact details:
CSIR Natural Resources and the Environment

Linda Godfrey
Manager: Pollution and Waste

Tel: +27 12 841-3675
Fax: +27 12 842-7687
Email: lgodfrey@csir.co.za

www.csir.co.za