Challenges experienced while using MBR technology for biological sulphate reduction with synthesis gas

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Introduction

Sulphate rich waters represent an environmental risk originating from acid mine drainage. Neutralisation with lime or limestone is a preferred treatment method but cannot reduce sulphate concentrations to below 2500 mg/L. Biological sulphate reduction allows sulphate concentrations to be reduced to acceptable levels for environmental release. Most biological processes designed to reduce sulphate through anaerobic reduction suffers from a lack of sufficient and cost effective carbon and energy sources. Sewage, organic plant material and even abattoir waste have been used but these sources are often not sufficient. Sugars and alcohols represent excellent carbon and energy sources for these biological processes but are expensive. Synthesis gas, a mixture of mainly H_2, CO_2, N_2 and CO offers an affordable, alternative. Biological sulphate reducing processes prefers H_2 as electron donor and uses CO_2 as carbon source. Unfortunately CO and a by-product of sulphate reduction, H_2S, inhibit microbial sulphate reduction and limit the reaction rate of such bioreactors. Sulphate reducing bacteria (SRB) that tolerate high CO concentrations have been cultured. Other species of anaerobic bacteria can convert CO and water to H_2 and CO_2, *via* the so-called water-shift reaction.

These microbial populations can co-exist in bioreactors to allow synthesis gas as the only source of carbon and energy. MBR technology will be used to increase the MLSS concentration of the biological sulphate reducing reactor containing CO tolerant microbial populations while short hydraulic retention times (HRT) of the MBR system allows for the fast removal of H_2S, an inhibitory product for SRB activity.

Initial challenges involve poor hydrogen solubility, low sulphate reduction rates and adequate mixing of the sulphate-rich feed and other nutrients.

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