THESIS TITLE: BIOLOGICAL SULFATE REDUCTION IN SULFATE-RICH INDUSTRIAL WASTEWATERS BY ANAEROBIC FLUIDIZED-BED REACTORS: EFFECTS OF ELECTRON DONORS

PRESENTED BY: ATOSA VAHDATI NIKZAD

ADVISOR: PROFESSOR MASSOUD PIRBAZARI

DATE: JUNE 29, 2007

TIME: 1-3 PM

LOCATION: KAP 203

ABSTRACT

BIOLOGICAL SULFATE REDUCTION IN SULFATE-RICH INDUSTRIAL WASTEWATERS BY ANAEROBIC FLUIDIZED-BED REACTORS: EFFECTS OF ELECTRON DONORS

High sulfate wastewaters are a major problem in industry because they increase the total dissolved solid content, and interfere with methanogenesis resulting in decrease in production of methane, which is a valuable fuel. A large variety of industries including: pulp and paper production, molasses fermentation, sea food processing, potato-starch factories, tannery which produce wastewaters with high concentration of sulfate have major problem in discharging their wastewaters. The reason is that the discharge of the industrial wastes into the water bodies is governed by NPDES program, which limits the amount of pollutants and specially COD received by the surface waters, and unfortunately, high sulfate content in the wastewater limits the usage of anaerobic methanogenesis for COD reduction.

Biological sulfate reduction is an effective mean of removing sulfate from wastewater. Sulfate reducing bacteria can adjust effectively to different environments, and production of the biofilm protects the bacteria from the toxic environment. Ability of the bacteria to acclimate to different

pHs, along with the possibility of toxic metal precipitation by hydrogen sulfide has made this method a very attractive treatment alternative for wastewaters containing heavy metals.

This research investigated the effectiveness of biological reduction in the removal of high concentrations of sulfate from wastewater. Anaerobic fluidized bed reactor (FBR) with recycle was chosen, and thermodynamic and kinetic parameters were used to evaluate best electron donors, and Completely Mixed Batch Reactor (CMBR) studies with different electron donors were conducted to investigate the feasibility of biological reduction with each electron donor. In addition, effects of pH, temperature and carbon to sulfur ratio on sulfate reduction have been evaluated in several CMBRs. The results of the batch biokinetic studies rationalized directly to the fluidized bed bioreactor studies to perform the biological sulfate reduction from wastewater with high level (2000 mg/L) of sulfate.

High sulfate removal efficiencies, as high as 96% observed, without any inhibition by produced H_2S. Production of hydrogen fuel from the byproducts of the experiment, proposed as a promising technology, and finally anaerobic biofilters have been introduced as an effective alternative for producing elemental sulfur from the produced H_2S.