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Generation of Reduced Sulfur Compounds in Tailings

Background

Biodegradation of residual hydrocarbons in oil sands tailings leads to generation of greenhouse gases (GHG) such as methane (CH_4) and carbon dioxide (CO_2) as well as a range of reduced sulfur compounds [1]. While all types of tailings support such microbial activities to some extent, froth treatment tailings (FTT) that include bioavailable naphthenic or paraffinic solvents are known to be the major source of such emissions. The n-alkanes and BTEX compounds found in naphtha, for example, stimulate the biological production of GHGs as reported extensively in the literature ([2], [3]). Different microbial communities are present in the tailing ponds including but not limited to methanogens, iron reducing bacteria (IRB), and sulfate reducing bacteria (SRB) each producing a specific product with a certain kinetics. SRBs, for example, consume sulfate and produce HS^- that could escape as H_2S [4]. In some tailings treatment options, sulfate is added either as gypsum or a coagulant (Alum or Ferric sulfate) leading to an increase of sulfate concentration in tailings. Presence of sulfate and hydrocarbons in tailings provides the SRBs with the substrates needed for H_2S production. The kinetics of CH_4 , CO_2 , and H_2S generation in tailings at presence of different electron acceptors have been studied extensively in the past as summarized in [5] and references therein. One aspect that is not yet studied in detail in tailings is the generation of reduced sulphur compounds (RSCs). RSCs are a group of compounds generated from natural and anthropogenic sources with sulfur atoms in their lowest oxidation state. The most common RSCs in the environment include H_2S , carbonyl sulphide (COS), methane thiol, dimethyl sulphide, carbon disulphide, and dimethyl disulphide [6]. Some past studies have shown that RSCs could be originated from the light hydrocarbons in tailings [7], although the results are not conclusive. As such, the origin of RSCs and the variables that would impact their generation and kinetics require additional investigation.

Statement of Research Opportunity

Funding opportunities are available for fundamental research focused on understanding the RSCs generation in tailings and FTT affected tailings. The impact of various treatments on the generation and kinetics of the RSCs and particularly carbonyl sulfides is of interest.

Desired Results

The research project should provide an understanding of the origins and kinetics of RSCs generation in tailings. Particularly, understanding if light hydrocarbons (naphtha or paraffinic solvents), HPAM polymers used for flocculation, sulphate concentration, and presence of nutrients could have an impact on the generation of RSCs.

Works Cited

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