# Impact of Diluent in Terrestrial Landscape Closure

## Background

Froth treatment tailings (FTT) are a relatively minor waste stream compared to the extraction tailings generated during the mineable bitumen extraction process; however, they contain constituents of particular concern that oil sands operators consider during the development of closure plans for deposits and structures containing these tailings. Constituents of concern include residual hydrocarbons and certain fine mineral solids that, depending on operational and tailings management constraints, can potentially lead to specific geochemical circumstances (e.g., ARD, NORMs) that must be appropriately managed [9].

Froth treatment tailings are somewhat unique compared to other extraction tailings because they contain not only residual bitumen, but also residual quantities of light hydrocarbons such as naphtha or paraffinic diluent which are employed during the froth treatment process. Hydrocarbons in general can impact tailings dewatering and subsequent settling although they may not have as large an effect on long-term consolidation [1]. Residual naphtha and paraffinic diluent, however, are also degraded through complex microbial processes, resulting in the generation of gas and its subsequent evolution from fluid tailings even for many years following deposition (see [1], [3], [4], [10], [11]). Besides contributing to GHGs at oil sands operations, the evolved gas (mostly methane) may also have the potential to result in disturbance of deposits and landforms containing FTT affected tailings [5].

The degradation of light hydrocarbons in FTT affected tailings through microbial activity has been investigated in several studies (see, [6], [7], [8]). Recent work completed by COSIA [4] has established a regional picture of some relevant mechanisms and involved microorganisms and biological processes. The rate and ultimate amount of gas generated is still under investigation.

The impact of gas generation and evolution on the stability of aquatically capped deposits containing froth treatment tailings was recently addressed by Suncor [5], in which gas evolution mechanisms (single bubble vs. bulk gas release, etc.,) and potential disturbance phenomena in subaqueous deposits was investigated. A similar study has not yet been completed for the oil sands context for the mechanisms associated with gas generation, release, and potential landform disturbance in FTT containing deposits that have a terrestrial (rather than aquatic) closure landscape in mind. However, bubble growth and rise in sediments is known in other contexts (see, [14], [13]).

## Statement of Research Opportunity

It is of general interest to investigate the fate of residual light hydrocarbons contained within deposits that are closed terrestrially. Specifically, there is an opportunity to understand the mechanisms of gas generation and the potential of long-term release from within terrestrially closed structures containing FTT affected deposits. There is an opportunity to understand both similarities and differences between this scenario and one in which FTT affected deposits are closed aquatically,

particularly with regards to similarities/differences in potential long-term failure mechanisms of said deposits.

The impact of gas generation, accumulation, and potential release on the geotechnical stability of the deposit is sought. An understanding of the interactions between the gas (and its potential evolution) and other constituents (water, bitumen) within the deposit which may affect its performance or the performance of neighboring/overlying deposits is also sought.

## Desired Results

Ideally, an understanding of the previously mentioned phenomena is sought in order to better plan for the closure and reclamation of deposits containing FTT, such that long-term performance (stability, release water quality) of a terrestrial landscape containing FTT is known.

An understanding of the implications of gas generation and/or gas release on deposit stability and overlying capping materials (as well as potential considerations with regards to capping strategies for terrestrial structures) is one goal. Another goal relates to an understanding of the relationship between the quantity and concentration of residual diluent contained within the materials at the time of deposition, and the severity and longevity of gas generation/release/failure phenomena. This knowledge is sought for both naphthenic and paraffinic diluent containing deposits.

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