

## Abstract

Sludge management has been and increasingly becoming a dilemma in recent decades due to increasing population and accumulation of toxins in wastewater sludge, caused by complex toxins in industrial, hospital, residential, agricultural and other effluents. Various sludge management options have been researched, ranging from incineration, thermochemical liquefaction, to pyrolysis and gasification.

This work proposes syngas, bio-oil and bio-char or char production through gasification of a mixture of sludge and screenings at different ratios of 75/25, 25/75 and 50/50. Triplicate samples of each ratio were produced from sludge and screenings that were collected from Olifantsfontein, Gauteng, South Africa. The analysis to find the toxins, metals resources in sludge, approximate analysis, CHNS and functional group analysis were aimed at finding if sludge is a good high energy matter, from a thermogravimetric analysis (TGA), the sampling and stopping temperatures during gasification were established.

The overall best results of high syngas quality (high LHV, H<sub>2</sub>, CO and CH<sub>4</sub> contents) and high quality bio-oil (i.e. cleanest, with high crude oil equivalent bonds such as C<sub>1</sub> up to C<sub>36</sub> and higher applicable bio-oil contents) was achieved by a 75/25 ratio, followed by a 50/50 ratio. The results also showed some possibility of biological and chlorinated hydrocarbon toxins (PCBs and PAHs) break down as well reduction of sludge and screenings to about 32% of the initial mass.

The application of these results range from syngas application in power generation, to liquid fuel production through the Fischer-Tropsch synthesis (FTS). Char toxicity can be further analysed for its application in agriculture and as an adsorbent in other processes. Char can also be further analysed for metal extraction.