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Prediction of spontaneous combustion in coal by use of thermogravimetry
MSc (50:50) Research Project
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Abstract

The self-heating of coals is a complex problem which has been occurring for centuries. This problem has been fatal to coal miners, an economical challenge to coal mines and a health risk in a release of greenhouse gases to the public in general. Therefore, everyone is affected by the self-heating of coal, which leads to spontaneous combustion when the ignition temperature is reached.

There are many test methods that have been used to test spontaneous combustion in coal, but all have one common factor or disadvantage of requiring long periods of time before a conclusion can be deduced. This then creates a need for a rapid and reliable method to test the liability of coal to self-heat in the coal industry and thus the motivation for this project.

The thermogravimetry analysis (TGA) method was selected to test the liability of coal to self-heat due to its short analytical duration. The Smith-Glasser oxidation test was selected to validate the TGA results obtained. The main aim of this project is to investigate the reliability of the TGA method to predict the propensity of coal to self-heat.

29 samples from different regions of South Africa were used, prepared to 250 µm for all the analyses and self-heating tests. All samples were analysed for proximate, calorific value, sulphur and petrographic properties before the spontaneous combustion liability tests began.

The TGA method followed two tests: 1) the O_2 adsorption and 2) the ignition test. Five different heating rates (3, 5, 7, 10, and 20) °C/min were run in order to obtain five derivative slopes which would be used to obtain the TG_{spc} index. The oxygen adsorption test studies the mass increase at low temperature under exposure of air between the temperature ranges of 100 – 300°C.

The Smith-Glasser oxidation test method studies the reaction of coal with O_2 and calculates the O_2 absorbed per amount of coal tested. The Smith-Glasser test results collaborated with most of the other analytical results, and with the TGA results to a certain extent.

The TGA spontaneous combustion liability test requires additional analytical work to back up its results because the results do not appear as accurate as the Smith-Glasser oxidation test. It also requires repeatability tests to ensure the integrity of the results.