**Quantitative analysis of gasification of Botswana coal using a 5kg/h auger reactor**

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***Highlights***

* To perform gasification of three different coals in Botswana
* Comparison of the product gas in terms of the amount of gas produced.
* To determine which coal field produces most product gas

**1. Introduction**

Botswana has approximately 212 Billion tons of coal of which less than a quarter of a billion tons is mined annually forming a part of the Karoo supergroup. It is in the region of what is called the Karoo Supergroup which is the most widespread stratigraphic area in Africa south of the Sahara Desert [1]. These reserves have been found to have high ash, medium calorific value, and low-medium quality bituminous coal [2]. Despite these coal riches, Botswana has only one power plant that generates and supplies electricity to the whole country being able to meet only 30% of the demand in the country. Botswana is developing at a high rate with a lot of infrastructure being erected which calls for more power supply that can be done through the process of coal gasification.

Gasification is the thermochemical conversion of carbonaceous material into valuable synthetic gas. The process takes place in the presence of steam and oxygen. An auger type reactor is a mechanically forced reactor with a screw driven by a motor to control its residence time. This feature allows for agitation which allows for contact with metallic surface and therefore more efficient heat transfer rate.

The auger reactor housed in BIUST is specifically 400 mm long with capabilities of up to 1050 °C temperature, up to 5 kg/h feed rate and residence time of at least 5s.

**2. Methods**

The samples were first taken through a TGA to determine physical properties. The feeder was then set to run at the required feed rate and the reactor to the required residence time. Heater duty was put to 10 kW. Main parameters for this process were oxygen and steam at 1 atm pressure and temperatures up to 1323 K. All parameters and measurements were recorded during the test. The results were then analyzed and concluded.

**3. Results and discussion**

Minergy coal shows to be the highest quality coal with lowest ash content and highest volatile matter and fixed carbon as shown by Table 1 and Figure 1. This coal field also produced more gas due to the highest percentage of volatiles.

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| --- | --- | --- | --- | --- | --- |
| **Coal Fields (Composites)** | **Characteristics of Composite Coal** | | | | **Quantitative analysis (per kg)** |
| **Moisture** | **Volatile Dry** | **Ash Dry** | **FC Dry** |
| Mabesekwa | 7.55 | 23.91 | 43.66 | 32.43 | 115 litres |
| Minergy | 8.49 | 27.34 | 33.34 | 39.32 | 135 litres |
| Morupule | 8.78 | 19.2 | 52.94 | 28.23 | 95 litres |

**Figure 1.** Proximate analysis of three coal fields in Botswana

**4. Conclusions**

Comparing coals from three different mines across the country, Minergy coal field shows to have the most valuable coal followed by Mabesekwa coal field and then Morupule coal field according to the amount of product gas collected compared under the similar conditions. Coal in Botswana differs across the belt.

**References**

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[2] R. Grynberg, *Coal Exports and the Diversification of Botswana ’ s The Coal Export Industry Diversification of Botswana ’ s Economy*. 2012.