

Coal Grain Analysis

Managing, Visualising, and Understanding Data for Coal Characterisation

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Introduction



Figure 1: Sample preparation

Characterisation of the microscopic structure of coal is fundamental to understanding its chemical and physical behaviour. The highly heterogeneous nature of coal and the fact that the characteristics and relative distributions of the different material constituents of this resource will determine its rank and quality, make a deep understanding of the composition of each grain critical. Analysis of coal samples allows benchmarking of potential

yield and ash content during the exploration stage, estimation of washability during processing including fine coal recovery via flotation processes, and estimation of fusible content to improve coal utilisation for coke making or power generation.

The software we developed allows the automatic analysis of large coal images which provide reliable statistics on the distribution of coal types and impurities. It has been successfully used to analyse hundreds of coal samples and is now commercially available.

Software features

Unique features of our software include:

- Single grain characterisation
- Enhanced particle separation
- Support for large images
- Statistical analysis of 100,000+ particles, as compared with approximately 500 particles in standard coal petrography methods.

Image acquisition and segmentation

After careful preparation of the sample a high resolution image is acquired. The image segmentation stage is summarised in the following steps:

- Identification and removal of background, polishing and imaging artefacts
- Automatic separation of touching grains based on shape
- Removal of shades on the edge of the grains that are due to a difference of hardness between coal grains and the mounting resin
- Computation of grain structural statistics such as Feret diameters, grain volumes and size distributions for the total sample.



Figure 2: The system being operated and the optical microscope

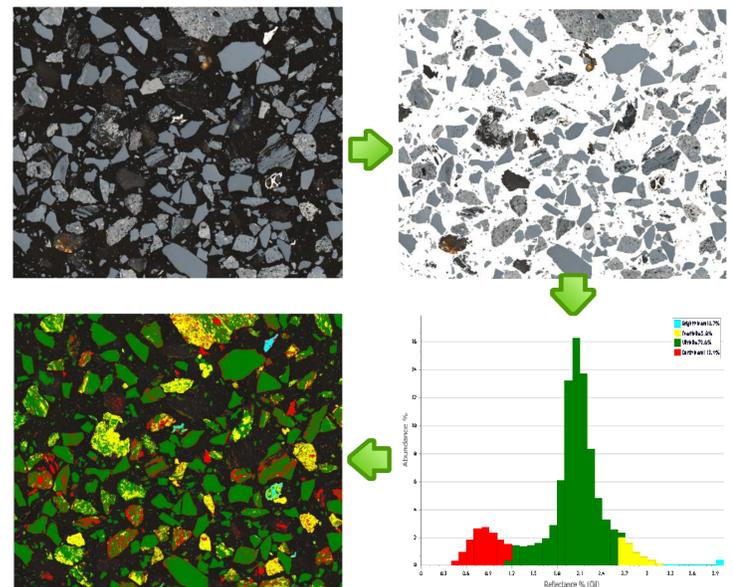


Figure 3: Top Left: microscopy image; Top Right: post-segmentation; Lower Right: reflectance histogram; Lower Left: characterised image

Characterisation of Coal components

Characterisation requires identification of the different components in the coal grains. Due to the mixing of blends and difference in cutting angles during sample preparation, there is a significant benefit in estimating the distribution on a per-grain basis.

We employ a non-linear least square algorithm (Levenberg–Marquardt) to robustly fit the underlying distribution components on each grain and then use the data obtained from this algorithm to accurately characterise the grain.

Future Work includes..

- Continued commercialisation of the software
- Getting additional support from industry
- Working directly with various microscope file formats
- Handling of larger image files up to 40GB (tile-based processing)
- Extending the use of colour information for characterisation
- Intra-component characterisation for individual particles
- Enhanced automation of image analysis with the help of machine learning algorithms
- Machine learning characterisation of dust particles using Optical dust markers
- Blend partitioning
- SEM integration
- SaaS features
- Ongoing optimisation:
 - GPU processing
 - Distributed processing
 - Improvements to core algorithms

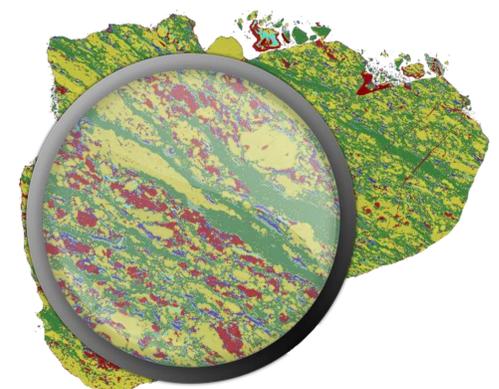


Figure 4: Intra-component characterisation (concept)

FOR FURTHER INFORMATION

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