Paper Number: 99

Coal quality estimation from routinely acquired geophysical logs

Zhou, B.[1] and O'Brien, G.[1]

[1]Mine Site Characterisation and Imaging, CSIRO Energy, 1 Technology Court, Pullenvale QLD 4069, Australia, Binzhong.Zhou@csiro.au

---

Coal quality parameters such as ash content, density, volatile matter and specific energy are important to the coal mining industry from mine planning, design, extraction and beneficiation through to utilisation. These parameters are traditionally obtained through laboratory analysis conducted on drill-core samples. Currently, obtaining coal quality information requires the collection of borecores, which are then subjected to pre-treatment to simulate the size reduction and liberation that can be expected during the mining process. This process is expensive and time consuming. In addition to this, most boreholes are drilled without or with limited coring due to costs. Therefore, only a limited number of coal samples can be tested and analysed and this largely limits the ability to appropriately map the spatial variability of the coal quality in both horizontal and vertical directions. Obtaining estimates of these coal quality parameters from non-cored holes would complement this information and thus provide a better estimate of the resource.

Geophysical logs are routinely acquired in boreholes by coal mines to measure various in-situ petrophysical parameters such as the acoustic, radiometric and electric properties of the rocks. These logging parameters can be correlated with rock types and are used for rock mass characterisation, lithostratigraphic interpretation, orebody delineation and grade estimation. They can also be used for estimating coal quality parameters (such as ash content, fixed carbon and volatile matter) which, when combined with the information obtained from treated bore cores, significantly improve geological models of coal quality and hence enhance estimates of the *in-situ* resource.

The commonly-used approach for determining coal quality from the geophysical logs is mainly based on simple cross-plots. However, the relationships between coal quality parameters and geophysical logs are not always best represented by simple equations (straight lines) and may instead be curved lines generated by complex equations. This suggests that instead of using a simple correlation approach, a multi-variable data analysis approach has a better chance of dealing with the complexity of coal quality parameter estimation and thus will improve the estimation accuracy of the these parameters.

To perform coal quality parameter estimations using multiple geophysical logs, we used a multi-variable data analysis algorithm based on the Radial Basis Function (RBF) neural network. To do so we also developed data pre-processing algorithms to extract the geophysical logging data corresponding to the coal samples. The RBF-based algorithms were tested by using the data sets provided by two different mines. In both cases, routinely-acquired geophysical logs such as density, gamma ray and sonic logs have been used to estimate the coal quality parameters such as relative density, ash content, fixed carbon and volatile matters. The performance of this approach has been demonstrated using both selfcontrolled training data sets and an independent data set. It was observed that although the density logs play a key role in coal parameter estimation, the use of multiple types of geophysical logs, including logs with different resolutions such as short spaced density log DENB and long spaced density log DENL, improves the estimation accuracy. It is therefore expected that more accurate coal quality parameters can be estimated if more geophysical logs such as photoelectric factor (PEF), SIROLOG and PGNAA which provide geochemical constituents are acquired.