ESTIMATION OF SURFACE MOISTURE IN A COMPOSITE COAL STOCKPILE

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Declaration

I, Kyle Enslin, declare that this dissertation is my own, unaided work. It is being submitted to the Degree of Masters of Science to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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Abstract

This dissertation, through a literature survey, investigated the different types of moisture in coal, what parameters affect coal moisture content as well as technologies and methods for drying coal. It was found that the parameter that affects surface moisture the greatest was particle size and in particular, the -500µm size fraction. Based on this knowledge a hypothesis was developed.

The hypothesis states that each size fraction contributes to the total surface moisture content relative to the size fractions equilibrium surface moisture content and weighting within the overall size distribution. The total surface moisture content is then the sum of these individual contributions.

$$SM_{EST} = \sum_{i=1}^{n} SM_i * f_i = (SM_1 * f_1) + \ldots + (SM_n * f_n) \qquad 1\text{-}1$$

Where,

SM_i = relationship (equation) between the equilibrium surface moisture content and the geometric mean of the individual size fraction (%)

f_i= weighting of size fraction in particle size distribution (%)

In order to test this hypothesis the relationship between equilibrium surface moisture and size fraction had to be established first. This was done by performing drainage tests on nine different size fractions and determining the equilibrium surface moisture content for each.

Tests were then done in two stages on composite coal samples to determine the equilibrium surface moisture content. The size distribution for stage one (PSD1) was different to stage two (PSD2). The samples had a fixed +500µm size distribution while the fines fraction (-500µm) increased by 1% for each test from 0% to 10%. Tests were done using a

25L drum and 2m drainage pipe to determine the consistency of the results when scaled up.

Increasing the fines content resulted in a direct linear relationship between the fines fraction and surface moisture content. This was found to be true for the test data as well as the estimated data. Both the test and estimated data showed that for every 1% increase in fines content there was about 0.25% increase in equilibrium surface moisture content. This was true for both size distributions. Although the relationship was consistent, the size distribution did make a difference to the overall result. The finer size distribution resulted in a higher overall surface moisture content.

Finally the model (equation 1.1) was used to estimate the surface moistures of 90 Eskom mill feed samples from five different power stations. Between the 25L drum, drainage pipe tests and Eskom data, the model estimated the Eskom data the best. The Eskom data also showed that in order to reach a minimum surface moisture of 6% the fines content should be kept below 9%.