

MOISTURE IN COAL.

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That coal has been derived by the chemical decomposition of vegetable debris that existed during an earlier geological age is agreed at least by the vast majority of scientific workers. And although we are still very much in the dark as regards the exact chemical constitution of the resultant coaly matter certain facts regarding the nature of the processes that led to the conversion of the vegetable debris into peat, brown coals and lignites, bituminous coals, and into anthracites are at least apparent. In the very earlier stages, following the deposition of sediments over the vegetable debris, the rapid de-watering of the debris was undoubtedly the principal feature. With the increase of pressure and a rise in the temperature as a result of the increasing thickness of the overburden, chemical changes undoubtedly set in rapidly within the much-compacted mass of vegetable matter. Whether one accepts the peat—brown coal—lignite—bituminous coal—anthracite theory or not, one must at least admit that the changes involved included (1) the further gradual elimination of water as a result of both physical and chemical reactions, and (2) the elimination of oxygen, possibly as CO_2 and H_2O during chemical decomposition.

The above-mentioned changes are exemplified in the following analyses of the various members of the peat-anthracite series quoted below:—

	Irish Peat.	Morwell Brown coal.	Malayan Lignite.	Bituminous coal (Dishegarh seam).	Welsh anthracite.
Percentage H_2O in raw material	90	55	20	2.5	1.0
Percentage O_2 in dry, ashless material ..	32	29	20	10	4.0

The above-mentioned moisture, which is 'residual' to the original vegetable debris or the result of chemical changes taking place during the maturing of the coal, may be regarded as inherent in the coaly matter and in the mineral matter that is included in the coal. This inherent moisture, with the exception of that combined with the mineral matter, is eliminated when the coal is heated for a short period at about 105°C .

In addition to the above-mentioned 'inherent' moisture, coal is known to absorb appreciable quantities of water when exposed to a humid atmosphere, especially if the coal is in a finely divided state. Such additional moisture is likely to be absorbed in the mines, during transportation in open wagons, or

during washing. Moisture of this type is, however, at least largely eliminated by air-drying.

In view of the above chemical and physical changes during coalification it would, therefore, not be surprising to find a close relationship between the proportion of 'inherent' moisture and the degree of maturity of a coal. This appears to be the case in at least many Indian coals. The well-matured coking coals of the Jharia, Giridih and Raniganj fields are all low in moisture—not more than 2 per cent and very often less than one per cent (calculated on an ash-free basis). In the case of the non-caking and semi-caking coals of the Barakar measures of other fields and of the Raniganj coal measures, the moisture usually varies from about 3 to as much as 10 per cent.

A study of the composition of the coals of the Raniganj field and of certain of the Barakar coals of Jharia and Giridih shows that the caking properties of these coals are also definitely related to their oxygen contents, calculated on a moisture-free basis. This relationship has been recognised in the case of other countries.

It is found that the hard-caking coals of the Barakar measures, which are, as above-mentioned, low in moisture, are relatively low in oxygen—less than 8 per cent calculated on the dry, ash-free basis. The Sanctoria and Dishergarh seams of the Lower Raniganj measures, which yield a fairly hard, vesicular coke on carbonisation, usually contain from 1.75 to 3.0 per cent moisture and an oxygen content of about 9.5 to 11 per cent, whilst the poorly-caking and non-caking seams contain higher percentages of moisture and oxygen percentages of about 11.5 to 14. This relationship is well-illustrated when we trace the change in the Sanctoria-Ponitati seam across the Raniganj field, from the relatively low moisture, caking coal of the Sanctoria-Sitalpur area to the less strongly caking coal of the Charanpur-Shripur area, into the non-caking or very poorly caking, high moisture coal of the Damodarpar-Akholpur area. This seam, and also others in the field, affords an excellent example of a coal seam showing considerable change in chemical composition, laterally.

It appears therefore that the moisture content of at least a number of Indian coals is closely related to the rank of the coal—that is, to its degree of maturity. As the coal increasingly matured giving rise to low oxygen caking constituents, so at the same time the inherent moisture was being gradually eliminated as a result of the chemical changes that took place.

In addition to the moisture present in the combustible element of coal, there is also the water of combination that occurs in the various hydrated minerals which comprise the mineral matter. This water of hydration is usually not eliminated at the temperature of 105°C. to which the sample is normally heated in order to determine the 'proximate moisture'. In some cases it is necessary to heat the mineral matter to temperatures of 300°–500°C. before this water is driven off. The amount of H₂O in question is obviously not sufficient to make any appreciable difference to the total 'proximate

moisture' of a particular sample but in the case of accurate ultimate analytical work, when dealing with inferior coals containing say over 20 per cent of mineral matter, this water of hydration may well affect the determination of hydrogen (and oxygen). It might, therefore, be necessary to de-ash such coal samples as far as possible by dissolving out the mineral matter with acid (hydrochloric and hydro-fluoric) prior to determining the carbon and hydrogen.

There is one other point I would like to mention, namely the percentage of moisture that is absorbed by smokeless fuel in India during the monsoon period. When burning smokeless fuel in England, the difference between its ignition temperature during the dry months as compared with the wet winter periods was very marked. During the former, the fuel ignited without difficulty whilst during the latter it was necessary to mix it with coal or wood in order to get it to burn satisfactorily. Possibly, the question has been investigated in India. It is, I think, a point of some practical importance in connection with the question of increasing the popularity of such fuel in this country, for during the monsoon season there is the possibility of these soft cokes absorbing appreciable quantities of water, during transport and delivery, and so becoming very difficult to ignite.

