INFLUENCE OF MACERAL COMPOSITION IN THE COMBUSTIBILITY OF SOME COLOMBIAN COALS.

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The increase of international coal market has created new power operational problems and the need to reduce the carbon levels in ash below around 6% in order to render the pulverized fuel ash saleable as well as mantain the combustion efficieny (1).

Compared with the Northern hemisphere coals, many Gondwana coals contain high levels of maceral of the inertinite group. The inertinite maceral group is commonly regarde as the main source of unfused chars (2) and this can increase problems with carbon carryy-over in the fly ash, leading to less overall efficience and cost are incurred in its disposal.

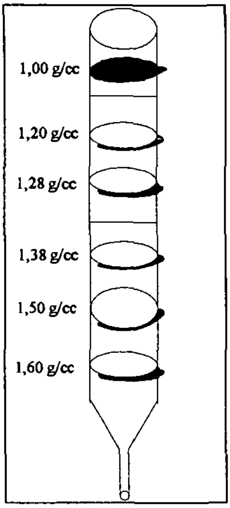
Since coal is a very heterogeneous material consisting of different organic substances (macerals) and mineral matter to know the behavior of the different macerals in the combustion is important. The propose of the present work was to investigate the influence of maceral association in the burning profile of coal.

EXPERIMENTAL

Three samples of coal were crushed and analized by conventional ASTM method. The elemental analysis were carried out using Leco CHN-600 equipment and sulfur determinator Leco SC-132 equipment.

The demineralization of the coals were done by HF/HCl digestion as described by Radovic et al, (3). The demineralized sample were separated into different fractions using density gradient separation. The coal was placed in a vessel filled with density-gradient aquous CsCl ranging from 1.0-1.6 g/ml at 25°C. The density gradient method was developed using a glass colum of 1.5cm of id by 50 cm long. as show in the Figure 1. The solution was added into the column handly with care to avoid mixture. The order of addition was first the solution with the higher density in the sequence shown in the Figure 1.

Sample of 0.1-0.3 g of the demineralized coal was mixed with 0.5ml of Brij-35, a non ionic surfactant, as described by Dyrakacz and co-workers (4). The mixed sampled is fixed at the top of the colum with care and left for 90 minutes to permit the diffusion of the coal macerals according to their specific density. After the maceral separation the samples were filtered and the solution density was measured by refractometry index. Finally the coal sample were washed with destillated water and the maceral concentration was essesed using a microscop Leitz MPV-SP.



The combustiblity profile of the coals and macerals concentrated were done according to the method described in previous work (5). About 5mg of pulverized sample, less than 75μm was spread into the crucible and the system was heated at a heating rate of 20 °C min^{-1} until 900 °C. A residence time at 120 °C for 5 minutes was fixed to permit the release of moisture.Three points can be clearly define; the initial temperature (IT) is defined as the temperature at which the rate of weigt loss excess 0.1% after the moisture peak., the peak temperature (TP) is defined as the temperature at which the rate of weight loss was a maximun and the burnout temperature (BP) is the temperature at which the rate loss decreased less than 1.0% min^{-1}.

Figure 1: Sequence and density of the solution used.

RESULTS AND DISCUSSION

The analytical data of the coal used is presented in table 1. The samples belong to

Table 1. Analytical date of the coal used

Sample	H_20	Ash a)	V.M (a)	%C (b)	%H (b)	%S (b)	%V (a)	%E	%I	R_o
GB-093	3.07	11.98	39.80	82.28	5.88	1.81	58.7	21.0	18.3	0.64
GB-148	3.24	18.50	37.21	82.46	6.97	1.59	61.1	18.3	8.2	0.68
Cerrejon	8.30	1.51	41.38	81.40	6.01	0.87	78.6	6.8	11.7	0.60

Where:(a), as determined; (b), moisture ash free basis, V, vitrinite, E, exinite, I, inertinite; R_o, reflectance.

bituminous coals.The density of the solution can be estimated by the refractive index, the straight line equation that relates density (X) with the refractive index (Y) was Y=0.079747X + 1.2384 with a correlation factor of 0.9996 The exinite was concentrate in the lower density solution while the inertinite concentrate in the higher density solution, Table 2. For all the samples vitrinite was the easier maceral to concentrate and in Cerrejon the vitrinite concentrated was +99%. Exinite and inertinite were difficult to separate indicating that the agregate of this macerals are presented in very fine particle.

The combustibility as measured by the burning profile method and using the IT index (6) shows (Table 3) that the mineral matter content has a negative effect upon combustion for the first two samples but in Cerrejón sample the mineral matter present a positive influence indicating that the mineral matter in this coal acts as catalyst during the combustion process.

Table 2: Maceral concentration in the dfferent density gradient .

Sample No	Density	Maceral concentration			
		%V	%E	%I	%MM
DGB-093	1.19	44.0	**48.0**	7.5	0.5
	1.27	**88.0**	8.0	4.0	--
	1.33	47.8	2.1	**49.5**	0.6
DGB-148	1.13	74.5	**23.5**	1.5	0.5
	1.26	**95.8**	2.1	1.6	0.5
	1.31	78.5	0.9	**20.0**	0.6
Dcerrejon	1.16	54.0	**39.0**	6.9	0.1
	1.23	**99.4**	0.3	0.2	0.1
	1.36	50.6	1.0	**48.2**	0.2

Where: D, demineralized; % in volumetric; V, vitrinite; E, exinite
I, Inertinite.

Table 3 shows that exinite is the maceral easer to burn as shown by the burning profile peak index. The inertinite peacks shows that the burnout temperature is allways higher that the other two macerals and in the IT is also at higher temperature. According to this results the order for the combustibility facility of the macerals is: exinite>vitrinite>inertinite. The relative high concentration of inertinite in the Cerrejon coal may explain the operational problems that have been presented when using this coal directly in the utility it also conclude that some mineral matter is needed in this coal for better combustion.

Table 3. Combustion profile peaks of the origi coals, demineralized coals and their maceral concentrates.

Sample	IT	PT	BT
GB-093	293.6	673.4	787.6
DGB-093	261.5	619.3	782.1
GB-148	311.1	685.1	815.0
DBG-148	275.7	629.9	821.1
Cerrejon	306.0	591.4	758.8
Dcerrejon	334.5	620.6	819.5
Exinite concentrate GB-093	221.5	578.2	737.1
Vitrinite conentrate GB-093	294.4	651.9	750.0
Inertinite concentrate GB'093	262.2	620.2	752.5
Exinite concentrate GB-148	217.0	571.2	671.4
Vitrinite conentrate GB-148	240.4	594.6	715.6
Inertinite concentrate GB-148	255.8	610	766.0
Exinite concentrate Cerrejon	285.3	571.5	521.2
Vitrinite conentrate Cerrejon	293.3	579.5	738.7
Inertinite concentrate Cerrejon	317.8	603.8	791.1

Where: IT, Initial temperature; PT, Peak temperature or temperature of maximun burning rate; BT, Burnout temperature; D, demineralized coal.

It can be conclude that maceral composition has a great influence in the reactivity of coal. The order of reactivity found was exinite>vitirinite>inertinite. The contend of mineral matter has also a great influence in the combustibility parameters.

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