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A NEW METHOD OF COAL SEPARA TION IN GRANULOMETRIC CLASSES AND THE b STUDY OF SOME ANAL YTICAL PROPERTIES

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ABSTRACT

Coal is a complex heterogeneous material and for its knowledge a homogeneous fractionation is necessary. Coal presents variations in the same grains depending on density, so a more adequate fractionation is obtained by its separation according to density. The density was determined with a pycnometer and the separation of coal in different fractions according to density. The organic and inorganic solutions were replaced with distillated water.

KEYWORDS: coal, density, ash, biphasic model of coal.

RESUMO

O carvão é um material heterogêneo complexo e para o seu conhecimento é necessário um fracionamento homogêneo. O carvão apresenta variações nos mesmos grãos dependendo da densidade e consequentemente uma separação mais adequada é obtida de acordo com a densidade. A densidade foi determinada usando um picnometro e a separação do carvão em frações diferentes foi efetuada., As soluções orgânicas e inorgânicas foram substituídas com água.

PALAVRAS CHAVE: carvão, densidade, cinza, modelo bifásico para o carvão

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INTRODUCTION

The methods of gravimetric separation and the obtention of coal fractions of different density with organic solvents or inorganic solutions have the disadvantage that coaly material interacts with these solutions and after separation a modified sample results with physical, chemical properties different from the initial sample.[1-3] The replacement of the organic and inorganic solutions with distilled water precludes this process.[4-12]

EXPERIMENTAL

In principle, two methods may be used to determine the density of coal, the hydrostatic balance and the pycnometer. In this paper, the density (specific volume) was determined with the pycnometer.

The determination of the coal dust density with the hydrostatic balance is impractical because of the loss of weight during the repeated sinking in distilled water.

To determine the relation between the imbibition humidity, the density and other parameters, a method must be found that permits the determination of the coal dust density and maintains the weight of the selected samples constant. The determination of the density of coal dust or grains with the help of the pycnometer satisfies these conditions. The working condition for coal grains is that the diameter of the grains to be smaller than the diameter of the pycnometer neck.

A simple pycnometer with a run in cork and a capillary hole in the middle of it was used. The determination of the coal density is based on the formula:

$$\rho_{coal} = \frac{m_{coal}}{V_{coal}}$$

where:

m_{coal} is established by subtracting the mass of the empty pycnometer from the mass of the pycnometer filled with coal.

V_{coal} is calculated from the mass of the pycnometer filled with coal and distilled water up to the mark and subtracting the mass of the empty pycnometer. The mass of the coal and the water is determined. Using the density of the water, the water volume is obtained. By; subtracting the water volume from the pycnometer volume, the coal volume is obtained.

The samples whose density was determined with the pycnometer weighed 50g and consisted of random samples (populations) of grains from sixteen different layers (XVI-stratum) of the Chiesd-Sarmasag Coal Mine. Table 1 includes the weights and densities from which the final densities of the fractions were obtained.

The determination of the ashes represents a major problem for the study of the parameters that characterize the coal. The results of the experimental results of the ashes are shown in Table 2.

Table 1: Weights and densities for the fractions of coal samples.

	Mass of the coal	Density	Final density
Fraction	fraction (g)	(g/cm^3)	(g/cm^3)
1	18,0812	1,3754	1,3810
	16,1394	1,3873	
2	17,9812	1 4032	1,4179
	19,5321	1,4317	
3	20,7042	1,4123	1,4275
	18,3548	1,4450	
4	22,7226	1,5570	1,5863
	26,2257	1,6127	
5	22,6183	1,6817	1,6833
	22,6783	1,6850	
6	19,0751	1,7513	1,7156
	17,7247	1,6788	
7	21,5738	1,7444	1,7572
	15,8049	1,7751	
8	20,8137	1,8487	1,8257
	23,5828	1 8060	
9	17,0078	2,0770	2,1031
	21,8660	2,1240	
10	22,0191	2,2033	2,1835
	18,1400	2,1600	
11	7,0400	2,2600	2,4439
	14,0212	2,4680	
	17,0212	2,5082	

Table 2: Results of the experimental determinations of the samples.

Sample	A_{anh}(%)	A_a(%)	A_1(%)
I	4,20	3,68	
II	4,20	3,69	
III	9,40	8,13	
IV	10,08	8,93	6,13
V	11,40		
VI	11,50	10,06	6,98
VII	11,70	10,35	7,22
VIII	12,80		
IX	13,30	11,67	
X	13,70		
XI	15,90		
XII	34,48	31,09	22,23
XIII	45,32	41,32	29,97
XIV	46,13	42,12	31,03
XV	46,51	42,96	32,19
XVI	57,87	53,60	40,68
XVII	72,35	67,94	52,93
XVIII	76,98	72,80	58,39
XIX	89,30	85,70	71,56

RESULTS AND DISCUSSIONS

The method for the determination of the density of coal with the pycnometer is faster and more accurate than with the use of the hydrostatic balance. It involves the use of an analytical balance and the determinations have more precision.

This method can be used for the selection of samples formed by pure grains and also to determine the density of samples selected according to certain criteria.. Using the water as a fluid medium has the advantage that it does not produce any structural modification in the coal mass and gives the opportunity, beside the rapid preparation of samples, to compare the populations of samples from different deposits of coal of the same type.

The experimental data was analyzed using the biphasic model for coal. This model includes the parameters such as the specific volume (Vsp), ash content (As%), anhydrous ash content (Aanh%) and SIO_2 content.

Table3. Experimental results for ash content (As%) and specific volume (Vsp) for coal samples studied.

Aa, %	Vspa,cm3/g			b=	-0,003885
	0,745741	0		a=	0,745741
100		0,357241		bx=	-0,00391
3,68	*0,7751*			R=	0,996769
3,69	*0,7633*			so=	0,008247
8,13	*0,7352*			sb=	0,000111
8,93	*0,7246*			sa=	0,005716
10,06	*0,7092*				
10,35	0,7042				
11,67	0,6896				
31,09	0,6329				
41,32	0,5952				
42,12	0,5847				
42,96	0,5714				
53,6	0,5494				
67,94	0,4761				
72,8	0,4587				
85,7	0,4098				
89,3	0,4098				
	1				

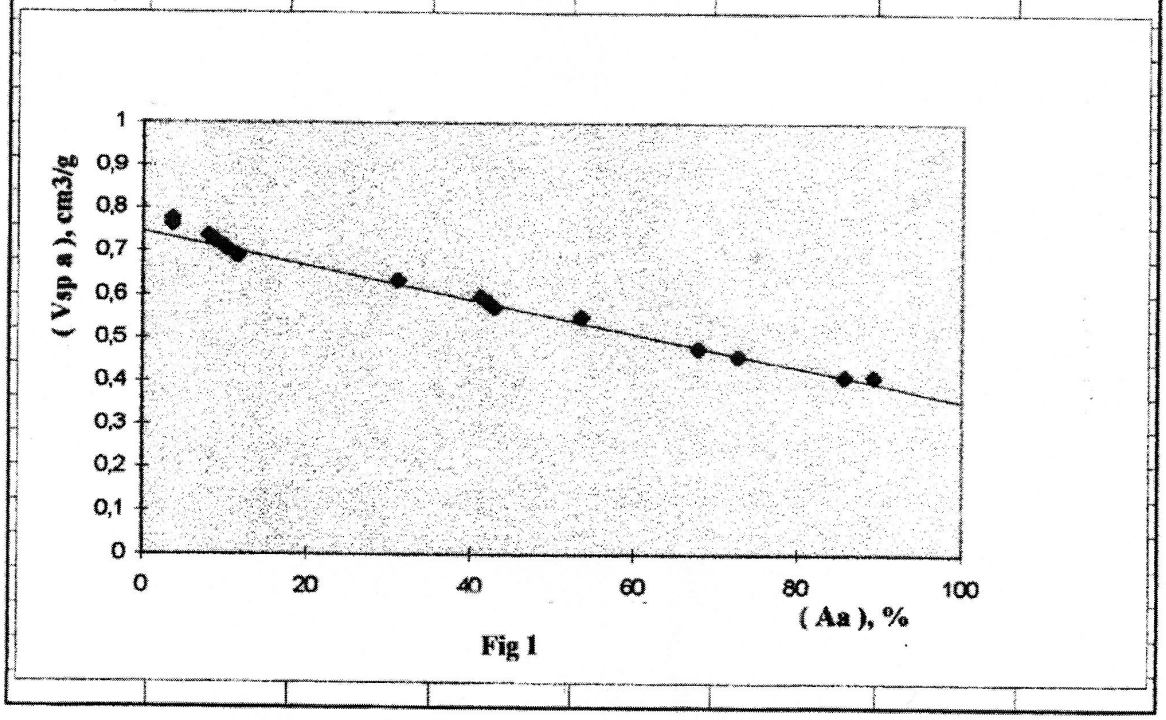

Figure 1. Variation of specific volume (Vsp) as a function of ash content (As%) for coal samples from the Chiesd-Sarmasag Mine.

Table 4.Experimental results for SiO_2 content and anhydrous ash content (Aanh%)

Aanh, %	SiO2, %			b=	0,659664		
	-7,81201	0		a=	-7,81201		
100		58,15439		bx=	0,662669		
10,08	*2,0415*			R=	0,99773		
34,48	15,4402			so=	1,026617		
45,32	21,1663			sb=	0,022263		
57,87	30,954			sa=	1,457827		
72,35	38,7225						
76,98	44,1205						
89,3	50,9559						
	70						

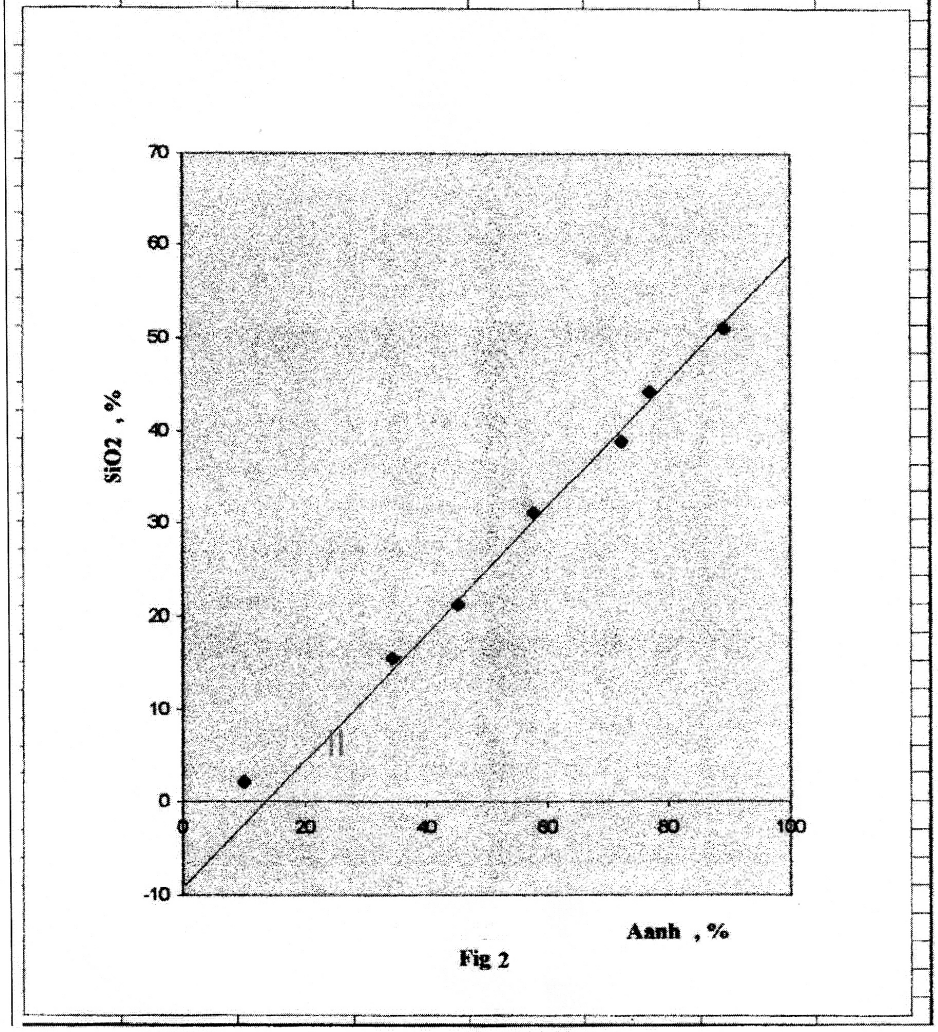

Fig 2

Figure 2. Plot of SiO_2 content as a function ash content (Aanh%)

The graphic representation of coal density in correlation with the content of anhydrous ashes is represented by a second degree curve. This shows that the density is

not additive, although it doesn't vary linearly with the ashes, compared with the specific volume. Figure 1 shows the variation of the specific volume as a function of ash content of coal samples from the Chiesd-Sarmasag Coal Mine.

Considering the biphasic model for the coal, the value Aanh=11,84% (Figure 2) has an important meaning. It is obtained from the intersection of the straight line of the plot of the SiO_2 content with the axis of the ash content. Drawing the parallel to the ordinate in Figure 1we obtain the intersection of the specific volume for anhydrous (the line x=11,84%).The value of the specific volume at the intersection to is 0,6643 cm^3/g, which means that the density of the maceral part is p =1,50 g/cm^3, and extrapolated to the null ash, the density of the organic material is 1,41 g/cm^3.

The density is the parameter that has a major importance in the character of the coal complex. It depends on the petrographic composition, the uncarbonized degree, the quantity and the character of the mineral substances contained, the content of humidity and the nature of the coal.

The determination of density is very useful and it also serves for sampling research and subsequent studies. The method of determination of coal density with the pycnometer has been described in the literature for the determination of the washing liquids, which were used to fraction the mixture of coal. In this paper the method was improved, the pycnometer being used directly for the determination of the density of solid samples, both as grains with the approximate diameter of 5 mm, and as dust with the diameter of the particles of approximately 0,02 mm. The amount of work is less than in the case of the hydrostatic balance and its use in the laboratory is to be preferred, especially in the preparation of samples based on density.

Density is a valuable parameter for the study of coal. The correlations found

between the specific volume and anhydrous ash, and also the $Si0_2$ content depending on the anhydrous ash, underline the validity of the biphasic model of coal as a law of nature.

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