TRACE ELEMENTS ANALYSIS OF OKABA COAL AND THEIR ENVIRONMENTAL IMPLICATION

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Abstract
Trace elements analytical studies were carried out on coal samples from Okaba coal deposits in the Lower Benue Trough of Nigeria to ascertain their constitutional levels and consequent environmental impact. Chemical analyses of the coal samples indicated that they contain on average basis 2.77% Fe, 0.06% Mn, 13ppm Cd, 0.013ppm Co, 1.22ppm Zn, 0.65ppm Pb, 1.29ppm Cr, 0.85ppm V, 0.65ppm Mo, and 1.02ppm Ni. Copper was not detected in any of the samples. The trace elements show concentrations generally lower than the generally anticipated concentrations in coals. This implies that the mining, processing and utilization of the Okaba coal will have only minimal negative environmental and health impacts on account of its negligible trace elements contents.

Introduction

Geologically, the Okaba coal deposit forms part of the Upper Cretaceous Formations within the Benue Trough and belong to the Lower Coal measures (Adeleye, 1975). The top is covered by false-bedded sandstones while the bottom is supported by the Enugu Shales. The average thickness of the coal seams is over 2.4 metres. The Okaba coal deposit is located about 16km north-east of Ankpa in Kogi State, and the site is accessible through the Ankpa-Makurdi Trunk A road. The area lies between longitudes 7^0 and 8^0 15'N and latitudes 6^0 and 7^0 15'E (Abdullahi, 2001; Onoduku, 2002). Coal samples were obtained from the run-of-mine stocked by both the Nigerian Coal Corporation (NCC) and the Nordic Mining Company, as well as from some exposed coal seams at the mine face.

Coal Analysis Technique

A total of ten (10) samples were collected across the entire coal mine for analyses. The coal samples were ashed after initial crushing into powdered form. The fine grained ash was then digested using nitric acid and filtered. The filtrate was used for the various trace element determinations using the Atomic Absorption Spectrometer. In the atomic absorption spectrometric analysis, part of the sample solution (filtrate) is aspirated into a flame and atomized. A light beam is circled through the flame into a monochromator and onto a detector that measures the amount of light absorbed by the atomized element in the flame. Since each metal has its own characteristic absorption wavelength, a source lamp composed of individual element to be analyzed for is usually used. This makes the method relatively free from spectral or radiation interferences. Thus the amount of energy absorbed in the flame is proportional to the concentration of the element in the sample. All the analyzed trace elements are calculated in parts per million (ppm) except for Fe and Mn which were calculated in percentages (Onoduku, 2002; Bustin,et al, 1983; Elliot, 1981; Ibrahim, 2001; Mwadinigwe et al, 1985).

Results

The result of the analysis is presented in Table 1.

Table 1: Trace Elements Analysis Result of Okaba Coal Deposit

Sample Element	1	2	3	4	5	6	7	8	9	10	Average Value
Fe (Iron)	2.8	2.81	2.78	2.60	2.78	2.60	2.78	2.68	2.8	2.8	2.77%
Mn (Manganese)	0.06	0.06	0.07	0.05	0.06	0.05	0.06	0.05	0.06	0.06	0.06%
Cu (Copper)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Cd (Cadmium)	0.12	0.13	0.12	0.15	0.13	0.15	0.13	0.13	0.14	0.12	0.13
Co (Cobalt)	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.013
Zn (Zinc)	1.23	1.22	1.23	1.20	1.23	1.20	1.20	1.20	1.23	1.21	1.22
Pb (Lead)	0.001	0.001	0.002	0.001	0.002	0.001	0.002	1.28	1.30	1.30	0.65
Cr (Chromium	1.32	1.29	1.28	1.27	1.28	1.27	1.28	1.28	1..30	1.30	1.29
V (Vanadium)	0.86	0.86	0.83	0.83	0.83	0.83	0.85	0.85	0.86	0.86	0.86
Mo (Molybdenum)	0.66	0.64	0.63	0.65	0.63	0.65	0.64	0.66	0.64	0.66	0.65
Ni (Nickel)	1.02	1.01	1.03	1.02	1.03	1.02	1.01	1.03	1.03	1.01	1.02

ND = Not Detected

Discussion of Results

The trace elements analysed for indicated concentrations generally lower than the general anticipated concentration in coals. The average concentration of the trace elements are as indicated in Table 1, viz: Fe = 2.27%, Mn = 0.06%, Cd = 0.13 (ppm), Co = 0.013 (ppm), Zn = 1.22 (ppm), Pb = 0.65 (ppm), Cr = 1.29 (ppm), V = 0.85 (ppm), Mo = 0.65 (ppm) and Ni = 1.02 (ppm). The very low concentration of lead (Pb) in the coal samples that were studied means that such coal samples are of the non-lethal type. The prime sources of lead are galena or lead sulphide (PbS) and causthalite or lead selenide (PbSe), the latter usually responsible for an unusual concentration of lead in geologic materials. The iron (Fe) content is fairly much (2.77%) and it mostly occurs as oxide in the form of hematite or magnetite. Its presence usually increases the weight of coal samples and can easily be removed through conventional coal washing. Cobalt and manganese are generally negligible while cadmium, vanadium and molybdenum are generally low (concentration less than 1ppm). Zinc, chromium and nickel, which indicated concentrations of little above 1ppm, pose no environmental risk because their concentrations are generally lower than the tolerable limit. Copper was not detected in all samples. This means that its presence, if any, will be completely negligible.

Conclusion

The study has shown that the Okaba coal, in the light of the analysed trace elements constitution poses no disturbing environmental impact during mining, processing and its utilization. However, usual conventional coal washing is highly recommended for the coal products before usage to reduce the contents of most coal constituents that usually constitute fly ash during carbonization processes.

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