Oil Shale, 2003, Vol. 20, No. 2
pp. 161-166
ISSN 0208-189X

https://doi.org/10.3176/oil.2003.2.07

SHORT COMMUNICATIONS

ELEMENTAL COMPOSITION OF SOUTHEASTERN ANATOLIA ASPHALTITES (TURKEY) AS A FUNCTION OF PARTICLE SIZE

C. HAMAMCI[*,*1], M. Z. DÜZ[*1]
A. SAYDUT[*2], M. MERDIVAN[*1]

[*1] Department of Chemistry,
Faculty of Science and Art, Dicle University
21280 Diyarbakır, Turkey

[*2] Department of Mining Engineering,
Faculty of Engineering and Architecture, Dicle University
21280 Diyarbakır, Turkey

Elemental composition of asphaltites from Southeastern Anatolia was determined after grinding the samples and separating particles obtained into fractions by sieving. The total content of carbon, hydrogen, nitrogen and sulfur was highest in Halbur asphaltite where they were present over a wide size range (from 125 to 600 μm). The content of nitrogen, the least element in asphaltites, did not depend on grain size, whereas the carbon and sulfur concentrations increased with increasing size.

Introduction

Asphaltite is of petroleum origin. Petroleums pass gradual stages of metamorphism transforming into soft native asphalts, asphaltites, and finally into asphaltic pyrobitumens. Asphaltite deposits are known in many parts of the world, such as Peru, USA, Argentina, Mexico, Venezuela, Russia and Turkey.

In Turkey, asphaltite is one of the large sources of energy in the southeastern part of the country, in the provinces of Siirt, Şırnak, and Mardin (Silopi). Some of the resources are asphaltic pyrobitumens, some others are close to them by characteristics, but their metamorphism has not reached the stage of asphaltic pyrobitumens.

Asphaltites are divided into three types: gilsonite, glance-pitch and grahamite. Turkish asphaltites are of the grahamite type. Ammonia, sulfur, synthetic gas, liquid fuel and metallurgical coke have been produced from asphaltites using conversion processes. In addition, asphaltites could be used

[*] Corresponding author: fax 90 412 2488389, e-mail *candanh@dicle.edu.tr*

as fuel in thermal power stations for electricity production. Rare earth elements may be recovered from their ashes. However, because of high amounts of sulfur, hydrocarbons and ashes, processing of asphaltites causes environmental, industrial and technological problems [1]. Turkish asphaltites are high in sulfur and, therefore, not suitable for direct use in combustion without extensive cleaning.

Elemental composition of different-size particles is an important parameter for desulphurization and conversion processes [2–14]. Although the literature data about the coals and lignites are available [2–8], asphaltites have been studied much less [15–17]. The objective of the research was to determine elemental composition of three Turkish asphaltites as a function of their particle size.

Experimental

The Avgamasya, Segürük (Şırnak) and Halbur (Silopi) asphaltite samples were taken from asphaltite mines in Southeastern Anatolia, Turkey. After drying in an oven at 105 ºC the samples were crushed by a jaw breaker (Retsch BB 1/A) and ground in a rotor beater mill (Retsch SRZ).

Sieve analysis (passing a known amount of the sample material successively through a series of standard sieves of decreasing size) is one of the oldest methods to determine size distribution of solid particles. The Retsch 3B model test-sieving machine (Tyler series sieves: 3360–71 μm) was used, and the grain-size classes were weighed with an analytical balance.

Elemental analysis of the samples was done by Carlo Erba model 1108 elemental analyzer (see technical specifications in [15]) calibrated with standard compounds using the *K* factor calculation.

For determination of C, H, N and S quantitative dynamic flash combustion method based on complete and instantaneous oxidation of the sample by "flash combustion" converting all organic and inorganic substances into combustion products was used. The resulting combustion gases pass through a reduction furnace. They are swept (by the carrier gas helium) into the chromatographic column where they are separated and detected by thermal conductivity detector giving an output signal that is proportional to the concentration of individual components of the mixture.

Proximate Analysis of Asphaltites, wt.%

Parameter	Asphaltite		
	Avgamasya	Segürük	Halbur
Ash	39.10	40.84	32.52
Volatile matter	34.62	33.76	46.74
Fixed carbon	25.13	24.91	20.10
Moisture	1.26	0.62	0.63
Heating value, MJ kg^{-1}	26.23	23.53	22.70

Heating value, ash content, volatile matter, moisture and fixed carbon of the asphaltites (Table) were determined according to ASTM methods [19].

Results and Discussion

Grain Size Distribution

Each individual sample was separated into seven fractions according to the mesh sizes (3360, 600, 250, 125, 71 and 53 μm) of the sieves used. Mass distribution of the fractions obtained was expressed as a percentage (by weight) of the whole asphaltite sample mass (Fig. 1).

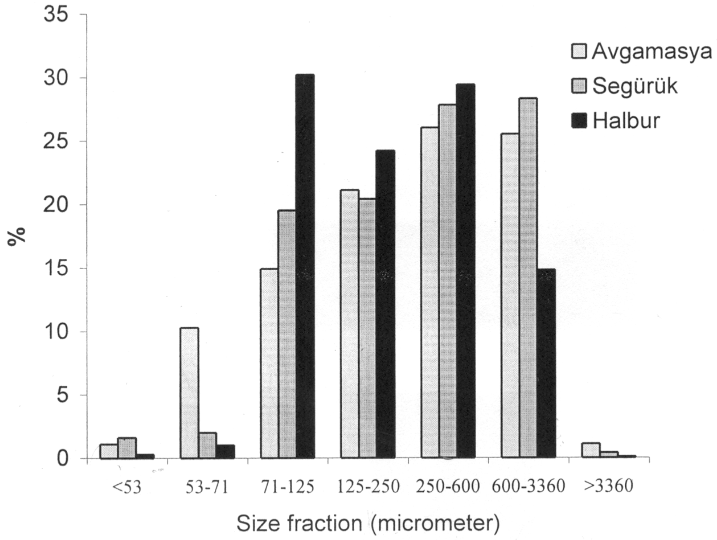

Fig. 1. Sieve analysis of asphaltites

One can see that in the case of Halbur asphaltite main fraction is between 71–125 μm whereas for Avgamasya and Segürük samples two main fractions are observed: 250–600 and 600–3360 μm. The shares of fractions < 53 μm and > 3360 μm were minor for all investigated asphaltites.

Elemental Composition of Size Classes

After determining elemental composition for each separate fraction, the total content of carbon, hydrogen, nitrogen and sulfur measured was expressed as a percentage (by weight) of the fraction (Fig. 2). All fractions of Halbur asphaltite contain more elements than Avgamasya and Segürük ones. Carbon and sulfur concentrations were slightly higher in large-size classes, while nitrogen showed no such tendency. In the case of Segürük and Avgamasya asphaltites, the content of hydrogen in the particles >250 μm was almost constant showing a slight increase in Halbur asphaltite.

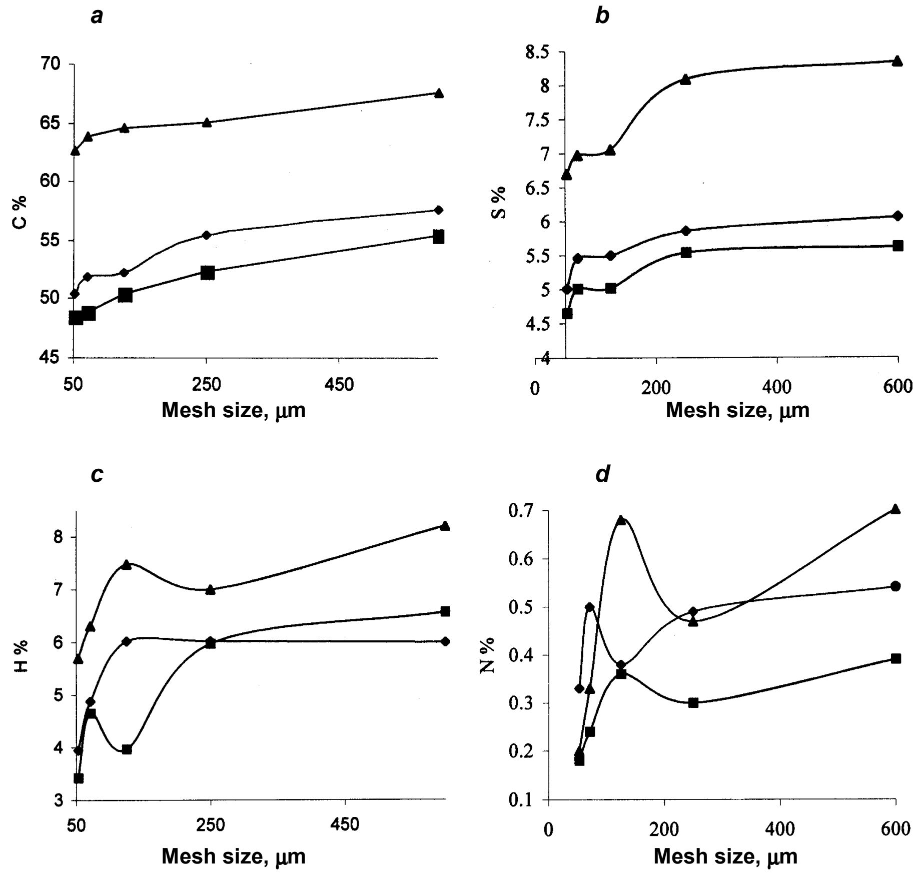

Fig. 2. Carbon (*a*), sulfur (*b*), hydrogen (*c*), and nitrogen (*d*) content of Avgamasya (◆), Segürük (■), and Halbur (▲) asphaltites as a function of particle size

Conclusions

- For Avgamasya and Segürük asphaltites, the grain size distribution of the crushed samples and their elemental composition as a function of particle size showed large similarity.
- For Halbur asphaltite, in spite of the highest carbon percentage, its free carbon content and heating value were the lowest within three asphaltite samples studied.
- The Avgamasya and Segürük asphaltite main fractions (125–250 and 250–600 µm) had the highest concentration of carbon, nitrogen, hydrogen and sulfur. Their concentrations in the Halbur asphaltite main fraction (71–125 µm) were found 10–25 % lower than in the larger-size classes.
- Typically, in asphaltites sulfur is present mostly as pyritic sulfur and organic sulfur. Since the amount, size and distribution of pyrite and other

mineral particles vary among asphaltites, they can vary greatly in affecting the contribution of asphaltites. So, using sulfur-rich asphaltite as fuel could cause the air pollution problem.

- As larger particles contain more pyrite sulfur, pyrite particles could occur in the form of free large-size crystals.

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Presented by J. Kann
Received November 28, 2002