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Part 3

ASH AND SLAG HANDLING

3.3. Ash and slag properties

3.3.4. BIOGEOCHEMICAL CHARACTERISTIC OF FUEL POWER ENGINEERING WASTES BY THE EXAMPLE OF URGALSK COAL FIELD

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ABSTRACT

Biogeochemical characteristic of fuel power engineering wastes by the example of Urgalsk coal field is considered.

MATERIAL AND RESEARCH METHODS

On storage basin of Bureisk water-storage reservoir fields of black coals are located. For element composition characteristic of coal ash and adjoining rocks borehole №7-2000 of Bureisk coal cut, including groups of beds B-6 and B-7 was approved. Probes of coals and adjoining rocks were sampled from drill cores every 10 cm. Total width of coal bed are more than 7 m. Top and soil of beds are in the most cases combined by fine-grained formations: siltstones, mudstones, tuffits impurities and sandstones. Field coals are humus and black [3]. Industrial developing of the given beds is realized by the Open JSC «Urgalugol» and it's used the open-cast mining. Coals of the given field are applied as a fuel in boilers of the village Chegdomyn and domestic furnaces of a private sector. Detailed testing of coal cut allows to gain averaged characteristic of element composition of coal ash for estimating air and soil pollution of the village by its combustion products; ashes and slags are wastes of coal power engineering, and containing sediments characterize geochemical natural background of the investigated territory. Coals and adjoining rocks are completely incinerated in laboratory conditions in a muffle furnace at temperature of 800°C, and chemical elements were defined in initial ash. By weight loss at ignition ash content of the test samples was calculated. Probes of coals, adjoining rocks of Bureinsk coal cut and suspended matters of a snow cover of Chegdomyn village and its surroundings, prepared in a correspondent way, were completely analyzed using emission-spectrum analysis in the central laboratory of physical research methods of FSEGSI «Khabarovskgeologiya». Complete emission-spectrum analysis in the test of insignificant button allows defining simultaneously over 40 chemical elements, metals, and by these opportunities, and also by velocity, immediacy, precision and reproduction of analytical work results it exceeds practically all kinds of analysis on definition of heavy metals in solid substance worked out for the moment.

GAINED RESULTS

Ash forming elements — silicon, aluminium, magnesium, calcium, iron, sodium, potassium, and also chemical elements, belonging to heavy metals — manganese, nickel, cobalt, titanium, vanadium, chrome, molybdenum, tungsten, niobium, tantalum, zirconium, copper, lead, argentic, antimony, bismuth, arsenic, zinc, cadmium, stannous, germanium, gallium, barium, beryllium, uranium, thorium, yttrium, ytterbium, lanthanum, strontium, cerium, scandium, lithium, boron, tellurium, selenium and phosphorus (i.e. seven macrocells, 37 microelements, total — 44 chemical elements) have been defined. From 37 defined microelements 27 chemical elements are found in ash composition of coals: manganese, nickel, cobalt, titanium, vanadium, chrome, molybdenum, niobium, zirconium, copper, lead, argentum, bismuth, arsenic, zinc, stannous, germanium, gallium, barium, beryllium, yttrium, ytterbium, lanthanum, strontium, scandium, lithium and phosphorus. 10 elements were outside revealing: tungsten, tantalum, antimony, cadmium, uranium, thorium, cerium, boron, tellurium, selenium. It is necessary to underline, that arsenic is found only in six coal streaks which ash content makes less than 10 %. In other coal, adjoining rock probes arsenic is not found. Arsenic is not also found in aqueous phase of snow cover. In suspended matter of snow cover, from 27 enumerated coal elements germanium, arsenic, bismuth, lithium, phosphorus, that is five chemical elements are not found.

From practical and theoretical points of view it's expedient to compare average values of element chemical composition of adjoining sedimentary rocks as a whole, that is sandstones + siltstones + mudstones + tuffits (that characterizes a natural geochemical background of the territory) with element coal composition of different ash content, and element composition of suspended matters of snow cover, as a result of fuel power engineering waste.

Available materials, in our opinion, allow to approach to account of domestic clerkes that is average values for elements in coal ash, sediments and suspended matters of snow cover in the investigated territory.

It is known, that coal ash contains some elements with higher concentrations, than rocks, containing coal beds. As mineral components of the majority of coals, anyway of middle and high ash content, represent terrigene material, we observe its beneficiating by certain elements at coal incinerating. This beneficiating largely occurs because elements particular for coal are concentrated in biogenic and getter forms combined with organic substance. At incineration they «are added» in ash composition moreover of that amount which is in terrigene material. It's clear, that ash of low-ash coals should be the most beneficiated. Such elements, particular for coal, Y.E. Yudovitch has offered to call as typomorphic [2, 4, 5].

Values of coal clarkes allow to calculate clarkes of concentration (CC) of elements in coal ashes, that is to calculate average estimation of typomorphism for each element. On graduation of Y.E. Yudovitch, elements with CC, less than 1, are called not typomorphic, 1…2 — moderately typomorphic, 2…5 — simply typomorphic, and more than 5 — high typomorphic [6].

With the purpose of typomorphism estimation of the viewed elements we calculated domestic clarkes for sediments, containing coal beds, domestic clarkes of elements for coals of Bureinsk coal cut and clarkes of elements content for

suspended matters of snow cover. At the same time we calculated average contents of elements for ash of all coals, characterized by average ash content of 24,7 %, and coals of different ash content, with average ash content of 27,1 % and 10,2 % accordingly.

From the gained data follows, that maximum microelements content in relation to sedimentary adjoining rocks is observed in coals with the lowest ash content. Concerning coals with average ash content of 10,2 % to adjoining rocks zinc (CC= 0,3), phosphorus (CC= 0,8), strontium (CC= 0,9), silicon and aluminium (CC= 0,9 and 0,7 accordingly), magnesium (CC= 0,9) and potassium (CC= 0,2) are not typomorphic elements.

Moderately typomorphic elements are stannous, copper, lead, argentum, bismuth, lithium, cobalt, nickel, vanadium, chrome, lanthanum, niobium, barium, titanium, yttrium, zirconium, ytterbium, gallium, scandium, iron, magnesium. Germanium, molybdenum, beryllium, manganese and calcium are simply typomorphic elements.

Difference of ratios between elements is clearly can be seen in coals of low ash content — 10,2 % and coals at average ash content of 27,1 %. The less coal ash content is, the higher content of microelements in ash residue is.

On the other hand, content of microelements in suspended composition of snow cover relative to adjoining rocks has certain differences from ash composition of coals. As it is marked earlier, in suspended matters of snow cover germanium, arsenic, bismuth, lithium, phosphorus were outside revealing by emission-spectrum analysis. The following elements: stannous, molybdenum, cobalt, nickel, vanadium, chrome, barium, strontium, titanium, yttrium, zirconium, ytterbium, gallium, scandium, silicon, aluminium, magnesium, sodium and potassium are not typomorphic chemical elements.

In all probability, introduced association of chemical elements transfers in soluble fraction of snow cover.

Only such elements as copper with (CC= 1,8), zinc (CC= 1,2), argentum (CC= 1,2), beryllium (CC= 1,7), manganese (CC= 2,8), lanthanum (CC= 1,3), niobium (CC= 1,3), iron (CC= 1,9), calcium (CC= 3,5) have higher content in relation to sediments of the investigated region. For the present moment it is possible to put a question on pollution of top-soil of Chegdomyn village by the mentioned association of chemical elements. It has been displayed [1] earlier that such elements as copper, zinc and manganese in higher concentrations in relation to ash composition of coals are in pure carbon. At quantitative assessment of pollution by suspended matters of snow cover, evidently, it is expedient to consider averaged element composition of suspended matters and their amount in snow cover.

REFERENCES

1. **Ивашов П.В., Сиротский С.Е., Климин М.А**. Эколого-геохимическая оценка отходов угольной энергетики на основе Ургальского месторождения // Биогеохимические и экологические оценки техногенных экосистем бассейна р. Амур. Владивосток: Дальнаука, 1989. С. 20—33.
2. **Китаев И.В.** Золообразующие и малые элементы углей Дальнего Востока. Владивосток: ДВО АН СССР, 1989. 140 с.
3. **Опритов В.В., Шарикова Е.А., Коновалова Л.Н**. Физико-химические свойства углей Дальнего Востока. М.: Наука, 1978. – 108 с.
4. **Юдович Я.Э.** Геохимическая ассоциация типоморфных элементов-примесей в углях и связанные с ними генетические проблемы // Тектоника, стратиграфия и литология осадочных формаций Якутии. Якутск,1966. С. 204—218.
5. **Юдович Я.Э.** Геохимия ископаемых углей. Л.: Наука, 1978. 262 с.
6. **Юдович Я.Э., Кетрис М.П., Мерц А.В**. Элементы-примеси в ископаемых углях. Л.: Наука, 1985. 239 с.

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