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POSSIBILITIES OF THE NEXT INDUSTRIAL USSEFULNESS OF NEPHELINE BASANITE FROM DEPOSIT BULHARY

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ABSTRACT: Bazalt rocks are mostly exploited as a building stone and over the last years found an application in petrurgy. Submitted article deals with study of chemical, physico-chemical properties of nepheline basanite from deposit Bulhary. On the base of this basanite properties is possible to appreciate his further industrial utilization.
KEYWORDS: nepheline basanite, viscosity, chemical properties, physico-chemical properties, melting temperature, analyses

❖ INTRODUCTION

Bazalt rocks are one of the raw materials, which are mostly exploited as a building stone. On the basis of their continuous load resistance, salts and chemical defreezing resources are used on roads, paths, squares and by other vulnerable places. Efficiency of basalts was in essential measure limited for their hardness and problematic workability. Over the last period this material of eruptive origin found an application in petrurgy [1]. It makes use of crystallized basaltic cast stocks and basaltic fibers manufacture, because basalts came through natural thermal processes during their spontaneous formation. Raw material, with SiO_2 content lower than 52 %, with fine-grained structure, without xenoliths and excrescences of olivene, over one till seven mm, with granularity 8 till 15, melts around 1 hour in a shaft-furnace at 1 300°C. Consequently the melting is cast in sundry forms or its spraying air streaming from nozzles rise silks [2]. Perspective utilization of this natural material is connected with nanomaterials manufacture. Reviewing of additional industrial utilization of basalts is possible only on the base of study his chemical, physico-chemical facilities.

Petrographic characteristic and utilization of nepheline basanite from deposit Bulhary

Deposit Bulhary is situated in village Bulhary northeast of Fiľakova (figure 1). It belongs to deposits of the Pliocene – Pleistocene basalt formation, which are represented by about 20 m thick lava flows of olivine basalts to nepheline basanite. A given deposit is registered as fusing basalts since 1998. Estimated volume of balance reserves is 3 906 000 tis.m^3 (tis. ton).

Figure 1. Locality of deposit and mined deposit Bulhary (Source of data: according to reference [3])

Products of exhausted stocks use as gravel aggregate, in bitumen concretes, in unkneadly and hydraulic kneadly materials, A part of exhausted raw material uses to flag-cube and street curbs too. From cast stocks of fused basalt manufacture tubes, elbows, channels, floor tiles, fittings, special cast stocks, which are characterized by high resistance to abrasion, abrasion and action of the acids. They use by pneumatic or hydraulic transport of hard stuff, on brickwork and lining of shirt-sleeved planes of tanks, coal crossing gates, cyclones etc. Basalt silks and products produced by his pressing have incomparable thermal and sound insulate properties, which are exploited by furnace aggregate and tubing in building industry [2].

Macroscopic characteristic and microanalysis of nepheline basanite from deposit Bulhary

Macroskopic description of the rock from under storey mined quarry pointed to that is concerned texture of rock, which is non-directional, compact, fine-grained, but doesn' t have quite equally grain structure. Her color is taupe. Fracture plains of rock are generally equal and have ragged surface. Their surface segmentation is small. Shape of the fragments bested in basanites is platy or irregular and the edges are sharp. One of the physico-chemical facilities is mechanical solidness that is in remembered rock tall. Mineral composition of nepheline bsanite from mined deposit Bulhary is possible to divide into:

- main minerals – pyroxene (augite, erigine), plagioclases (andesite, labradorite),
- subsidiary minerals – nepheline,
- secondary minerals – olivene, magnetite, hematite.

Samples of nepheline basanite from mined deposit Bulhary were submitted to WDS and EDS analyses, which identified presence of minerals. WDS analyse was done with CAMECA SX 100 equipment (figure 2). Quantitative data evaluation of chemical composition of individual points was confirmed with installed software pyroxene presence in A – point, in B – point presence of plagioclase, in C – point nepheline presence, in D – point presence of olivine, in E – point presence of ilmenite and Ti – magnetite.

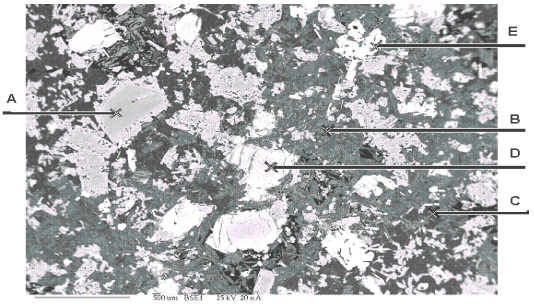

Figure 2. Nepheline basanite from mined deposit Bulhary

EDS analyse was done with high – resolution scanning electron microscope JEOL JSM-7000F with auto – emission jet and microanalytical element INCA Energy 250 Microanalysis System (EDS) and HKL Chanel 5 (EBSD) firmy Oxford Instruments. The results of EDS analyse are displayed on figures 3 and 4.

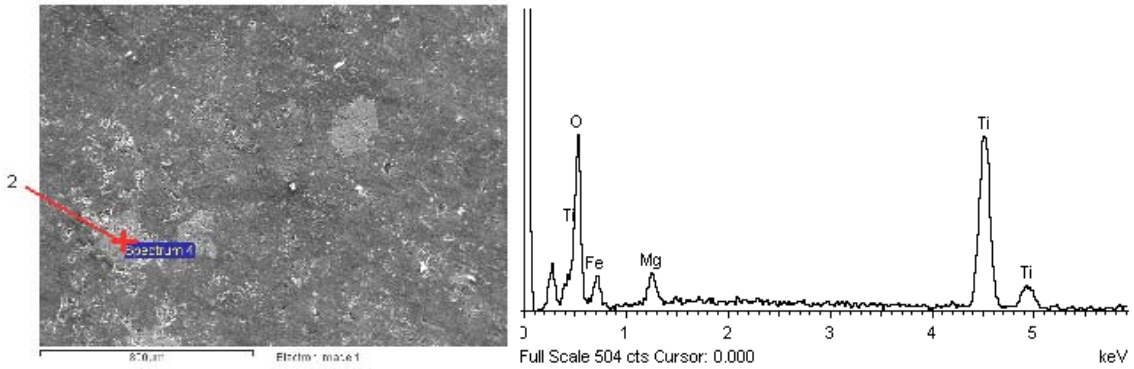

Figure 3. EDS analyse of element spectrum in 1 – point

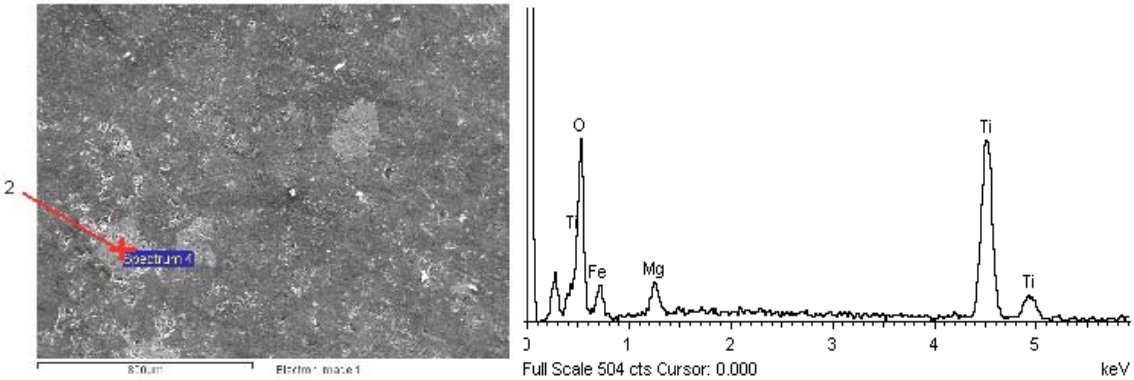

Figure 4. EDS analyse of element spectrum in 2 – point

On the ground of EDS analyse diagram is possible to identify element composition of sample in individual points. In the fine-grain stock exist mostly allotriomorfic phenocryst of pyroxene and rarely olivine, whereby mienrals distribution is unstable. Most of nodulation is created of pyroxene. Major section of pyroxene - diopside is fixed on stock, which introduces independent irregular crystals or clumps of crystals with 0,00X – 0,05 mm size.

❖ METHODOLOGY AND RESULTS

Chemical composition of nepheline basanite

Analyze of chemical composition of nepheline basanite from deposit Bulhary is possible to observe, that majority components are SiO_2, Al_2O_3, MgO and CaO. Chemical composition for mined quarry and abandoned pit is present in percentage by weight in table 1a and 1b.

Table 1a. Chemical composition of basanite form mined quarry and abandoned pit Bulhary

Tittle of locality	Chemical composition in percentage by weight					
	SiO_2	Al_2O_3	CaO	TiO_2	Fe_2O_3	FeO
Bulhary – mined quarry	45,6	16,73	9,72	2,24	3,1	5,7
Bulhary – abandoned pit	46,04	16,47	9,93	2,25	2,55	5,85

Table 1b. Chemical composition of basanite form mined quarry and abandoned pit Bulhary

Tittle of locality	Chemical composition in percentage by weight					
	MnO	MgO	K_2O	Na_2O	P_2O_5	S
Bulhary – mined quarry	0,18	8,55	2,42	4,05	0,60	0,01
Bulhary – abandoned pit	0,17	8,62	2,30	4,08	0,56	0,04

Measuring of melting temperature of nepheline basanite from deposit Bulhary

Knowledge about melting temperature of multicomponent systems are very important not only from technological aspect, but also from quality aspect of end product and effectiveness of whole proces. By the expperimental measurement of melting temperature is necessary to observe a sample behaviour complex. Melting temperature has to correspond with temperature, by which sample is composed by homogeneous melt. It is likely that there is a change of reactions in the sample between single sample components or more precisely to reactions with the furnace atmosphere or with support. By the natural materials is necessary to reflect on meltdown interval. Solidus temperature conform to temperature, by which melting begins occur in the sample (it happens to soaking sample with lowest melting temperature). In the course of achievement this temperature melting begins discover on the surface of sample (but firstly on contact of sample with support). This melting forms meniscuses on the contact of sample with support. Formation of meniscuses regards as solidus temperature, i.e. temperature of meltdown inception of monitored system [4].

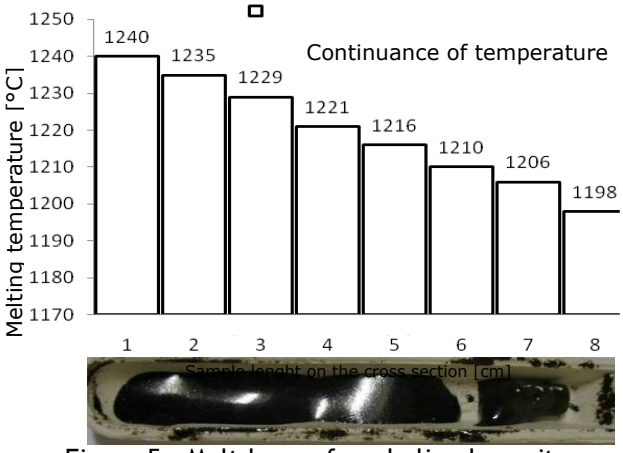

Figure 5. Meltdown of nepheline basanite from locality Bulhary in Marsh`s furnace

The first experimental measuring of melting temperature was realized in March's furnace. Temperature gradient, for which arrive during meltdown of samples, is graphic visible on figure 5. Melting temperature development is introduced on the cross-section, in one-centimeter intervals from left to right with melting-down near 1210°C.

On the second experimental measuring of melting temperature was used high-temperature microscope company Leiz – Wetzlar. The shape of surveyed sample of nepheline basanite near individual temperatures is visible on figure 6.

1100°C 1165°C 1190°C 1210°C

Figure 6. Determination of temperature melting-down and meltdown of nepheline basanite from deposit Bulhary

From reached results (figure 6) follow, that thermal interval for given natural material is 1100°C till 1210°C, at which temperature 1165°C introduces beginning of melting-down sample. Melting temperature of observed sample was assigned by standard DIN 51730 on attained hemispherical shape of original cube, i.e. 1210°C. Difference between temperature of beginning meltdown and temperature of creation homogeneous melting, of the so-called interval meltdown ΔT samples, was 45°C.

Differential thermal analysis of nepheline basanite from locality Bulhary

From aspect meltdown is important know of conduct natural material during its heating. On figure 7 is displayed derivatogram analyzing natural material, which describes thermal effects (exothermic and endothermic) induced of changes thermal content samples.

The evaluation of derivatogram of nepheline basanite were observed exothermic effect on curve DTA near temperature 830°C. From evaluation of curve TG resulting, that weight-shortage begins near temperature 630°C and finishes near temperature 930°C with maximum of weight-shortage near temperature 780°C. The annealing loss of nepheline basanite from locality Bulhary were 2,8 percentage by weight (table 6). The present of exo-pike near temperature 830°C is connected with weight-shortage and it is caused probably burning out of organic hydrocarbon, presented in primary rock.

Table 6. Results TG analyse from weighting (mg) sample from locality Bulhary

Weight of shot before analyze [mg]	31,25 mg
General weighted decrease [mg]	0,88 mg
General weighted decrease [%]	2,8 %

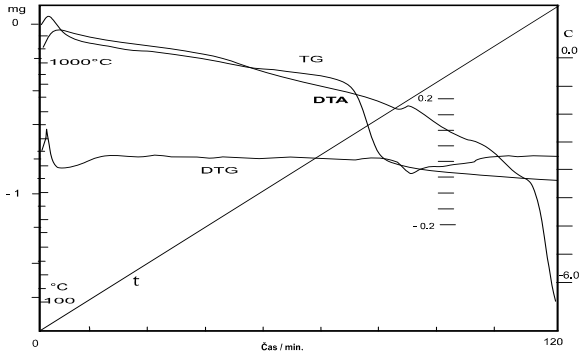

Figure 7. Derivatogram of nepheline basanite from locality Bulhary

The viscosity of nepheline basanite was simulated by program VISCO. Modulated results of viscosity depending up temperature are displayed on figure 8. On the basis of chemical composition we modeled course of viscosity in dependence on the melting temperature by the help of remembered program. From results follows, that viscosity value was in interval from 1270°C to 1310°C above 20 Pa.s. We suppose that sample will be so much viscous less than 1270°C, that it will not be possible to measure it by using correspondent technical device. From mentioned follows, that decreasing of temperature increases viscosity.

Measuring viscosity of nepheline basanite from locality Bulhary

Values of viscosity are one of the factors that they define reaction speed and partitions speed of individual products meltdown in independent phases. The measuring of viscosity is interesting from theoretical, but also practical view. From theoretical view, the study of viscosity is interesting primary from reason, that viscosity is sensitive structural characteristic of silicate meltdowns, which means that it can provide basis for superior explanation of construction these meltdowns with relatively high melting points [4].

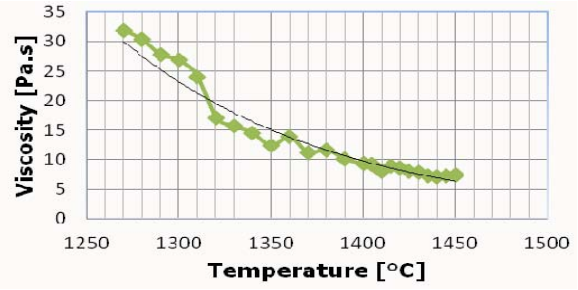

Figure 8. Dependence of viscosity nepheline basanite from temperature

❖ CONCLUSION

Basanite, primarily fusing basalts, are classification among superior and continuous of natural materials, which are often utilize in building industry and also for production of insulating materials. Nepheline basanites whit soft texture, homogeneous, give supposition of creation good melting without rest of crystallizations phases. Fundamental sense for conditions meltdown and resulting of quality melting has content of the major oxides SiO_2, Al_2O_3, MgO and CaO. From reached experimental results of study nepheline basanite from exploitation deposit Bulhary results, that is concerned natural material with content SiO_2 lower as 46 %, whereby is assing among basic natural materials. Contents of component Al_2O_3 is above 15 %, which causes increase of viscosity melting. Viscosity is fluctuating in dependence on the present of alkaline oxided, that are particularly at high temperature, value reduce and together appeal like fusing agent. Oxid calciferous of his presence at low temperature increases of value viscosity. Melting temperature of basalt is depending to concrete mineralogical composition. Advanced contents of lazily meltable minerals, type of plagioclases and pyroxenes in fine-grained compact substance, those have positive influence on melting temperature and ability of rock easily traverse into melting. Problem can happen at bigger phenocryst, eventually cumulating of olivine, which has of all of major rock-forming minerals present in basalt highest of melting temperature. From analyze of experimental attained results is possible establish, that existent natural material following of chemical and physical – chemical properties is perspective mineral stock for use in metallurgy too. Compared with others slag-former additive representative economically more suitable utilization and his primary composition representing ternary systems, those components are concurrently of primary components metallurgy slag and cover powder.

❖ Acknowledgements

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