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STUDY OF FURTHER UTILIZATION OF ČAMOVCE NEPHELINE BASANITE

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ABSTRACT:
This article describes further utilization of untraditional sources of non - metallic raw materials (Čamovce nephelinic basanite) in metallurgical processes based on mineralogical and chemical composition and physical-chemical properties (fusion point and viscosity).
KEYWORDS:
Nepheline basanite, Čamovce, fusion point, viscosity.

1. INTRODUCTION

Expanding industrial development and increasing production in pyrometallurgy requires not only higher grade raw materials, but also an improvement in quality of production processes. Quality of production in many pyrometallurgic processes is improved by application of synthetic materials that results in higher costs. Significance of utilization of materials increasing production quality is determined on the basis of economical criteria. One of the possibilities to decrease costs of production conserving quality is utilization of natural materials. Within the scope of study untraditional raw sources utilization in metallurgical processes another possibility of Čamovce nepheline basanite were studied. Camovce nepheline basanites are nowadays used as building stone.

2. GEOLOGICAL SUMMARY

From the geological point of view Slovakia belongs to Western Carpathians. In this wide spread volcanic area, in the inner part of Carpathian arc and on northern promontories Pannonian Basin, basalts occur. The occurrence of basalts is mainly incidental to evolution of Carpathian arc in process of subduction and backarc extension during Tercier and Quarternary periods. Basalts are a product of alkaline basic volcanism, which creates variety of geological bodies – lava necks, dykes and main lava streams which occur mainly in Central and South Slovakia.

Together with basalts volcanoclastics occur which create cinder cones, streams, maars, diatremes. The forms of basaltic geological bodies and their volcanoclastics are significant elements creating morphology of country and in many cases are protected [6]. The most extensive occurrences of basalts in Slovakia are in wider neighbourhood of Fiľakovo. Basalts occure in smaller extent also in South Slovakian Basin which is a part of Cerova vrchovina.

Čamovce deposit is located south-easterly from Lučenec in cadastral area of Čamovce. It is displayed on the wall quarry what provides very good opportunity for sampling and enables the study of distribution and abundance of basalt types in rock pillar of deposit (Figure1). Estimated amount of deposit resource is 4 937 000 m3 [3].

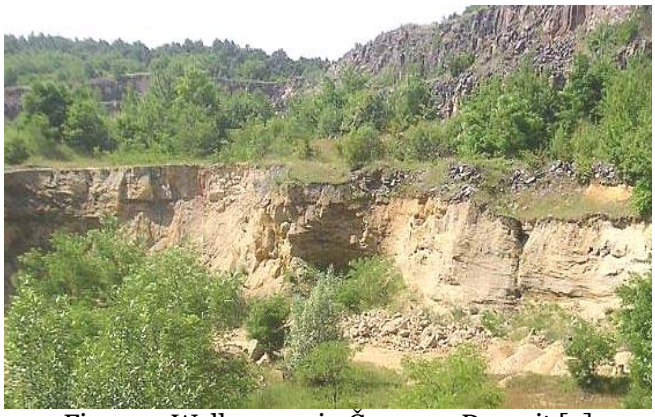

Figure1. Wall quarry in Čamovce Deposit [5]

3. PETROGRAPHICAL CHARACTERISTIC OF THE ROCK

The analyzed sample (Table 1) is macroscopically grayish and darkgray or even black rock with fine grained structure with visible cavities with sizes in range of 0,X – 4 mm. Refraction surfaces are rough and lightly rugged, the shape of fragment is irregular, mechanical solidness is high. Microscopically it is fine grained rock which has porphyric holocrystaline structure. The matrix and olivine phenocrysts is uniform except of olivine phenocrysts which reach size up to 10 mm. In smaller extent phenocrysts are represented by pyroxene and in few isolated cases plagioclase phenocrysts occur (Figure 2).

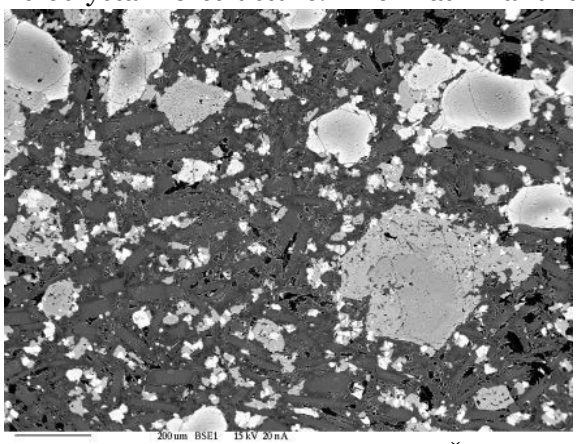

Figure 2. Nephelinic basanite from Čamovce locality, nemat-granoblastic structure

Table 1. Percentage share of minerals in Čamovce nephelinic basalt samples

Mineral	Semiquantitative representation	Minerals size [mm]
Plagioklase (labradorit)	39 %	0.06 – 3
Pyroxen (augitdiopsid-augit)	19 %	0.01 – 1.7
Olivine	17 %	up to 8
Nefeline	11 %	up to 0.4
Magnetite	9 %	0.03 – 0.15
Other minerals	5 %	–

4. CHEMICAL COMPOSITION

The chemical composition of basalts varies depending on variable mineralogical composition. Resulting from analyses of SiO_2, Al_2O_3, Fe_2O_3, CaO and MgO are the major components of the pure material studied (tables 2). From utilization of metallurgical processes point of view it is necessary to study the system of major components, eventually with minor components, which are important to assume properties of real slag melting.

Table 2. Chemical analyses of Čamovce nephelinic basanite in weight %

	weight%		weight%
SiO_2	46,41	TiO_2	1,74
Al_2O_3	14,75	MnO	0,15
Fe_2O_3	3,91	SO_3	0,38
FeO	7,26	S	0,02
CaO	6,83	P_2O_5	0,63
MgO	10,18	K_2O	1,32
losses of annealing	1,04	Na_2O	3,16

5. FUSION POINT

Fusion point is a very important parameter of metallurgical processes. It has an influence on effectiveness and quality whole melting process [1]. The melting process should run above liquid temperature due to precipitation of solid phase increases viscosity of

melting and it increases the creation of furnace aggregate [2]. Knowledge about fusion point of multicomponent systems is very important not only from technological point of view, but also from final product quality and process effectiveness point of view.

During the experimental measuring of fusion point it is necessary to focus on complex behaviour of the sample. It is possible that during the melting to incoming to the reaction between sample component or to reaction with furnace atmosphere or to reaction with base. Fusion point has to match to temperature where sample is created by homogenous melting. Fusion point has to match to temperature where sample is created by homogenous melting. In case of pure materials it is necessary to consider with studied materials interval of melting. Solid temperature matches to temperature where the melting in sample is starting to occur. Reaching this temperature the melting starts to occur on the top of the sample and mainly at the sample base contact. The melting is making meniscuses in contact with base. The origin of these meniscuses is allowed to be solidus temperature, i.e. starting temperature of melting of watched system. Difference between melting starting temperature ($t_{sol.}$) and temperature of homogenous melting origin represents intervals of melting specific material.

Experimental measurements of fusion point were realized due to comparison in two ways:

1. In Marsh furnace (figure 3)
2. In Leiz-Wetzlar high temperature microscope

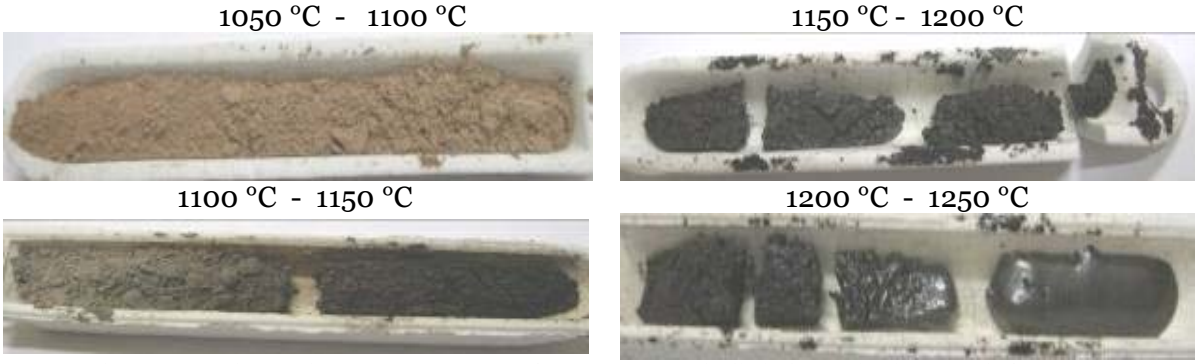

Figure3. Fusion point measurement of Camovce nephelinic basanite in Marsh furnace.

From analyses of results it was concluded that melting of the sample starts at 1180°C. Melting interval ΔT of nephelinic basanite studied is 45 °C.

6. VISCOSITY

Viscosity was measured by rotary viscosimeter HAAKE ROTOVISKO with seven steps of angular velocity. For heating ET.20 type Tamman furnace with 20 kVA installed capacity, 380 V voltage, 52,2 A maximum current and 50 Hz frequency was used. Furnace had seven step angular velocity for gross adjustment of temperature and six steps for fine adjustment. The sample was placed in 120 mm high and graphite crucible with diameter of 60 mm. Molybdenum rod with 4 mm diameter and graphite body in shape of 32 mm high cylinder with diameter of 15 mm was a sensor for viscosity measurement. During the measurement foaming was observed which can be caused by imperfect melting of olivine and feldspars crystals. Viscosity – Temperature dependence is shown in figure 4.

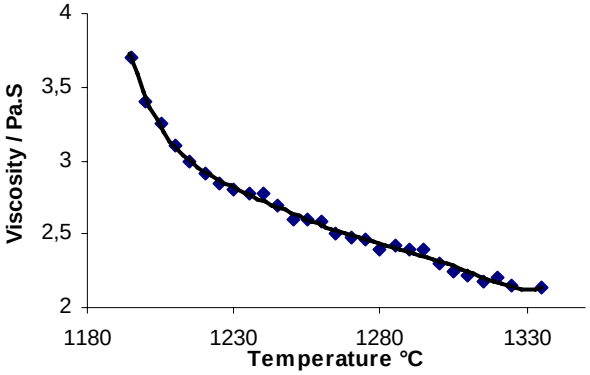

Figure 4. Čamovce nephelinic basanite viscosity dependence

7. CONCLUSION

From experimental results it can be concluded that in terms of basic composition of Čamovce nephelinic basanites SiO_2-Al_2O_3-Fe_2O_3, SiO_2-MgO-CaO ternary systems are concerned. Components of these systems are simultaneously the basic components of particular metallurgical slags and casting powders.

Because Čamovce nephelinic basanites are multicomponent systems which did undergo natural thermodynamic processes during their creation, their potential utilization in particular metallurgical processes is more convenient than synthetic materials (the first phase of synthetic materials production is an energy intensive process - diffusion in solid state, or melting of the component with the lowest melting temperature and further melting of other components).

Utilization of natural materials improves the economy of production. The price of Camovce nephelinic basanites is lower compared to e.g. slag forming additives for pig iron production in blast furnace, copper and lead production from secondary raw materials and basic material for production of casting powders.

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