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Shungite Market Research in the CIS

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Annotation

The report is devoted to investigation of current standing of market of shungite in CIS countries and forecast of its development. The report includes 6 Sections, containes 69 pages, including 12 Figures, 27 Tables and 3 Appendices. The report is a desk study. As information sources, data of Federal Service of State Statistics (Rosstat), Federal Customs Service of Russia (FCS), Inter-State Statistic Committee of CIS Countries, official domestic railage statistics of Ministry of Railways of Russia, data of companies, the sector and regional press, annual and quarterly repots of companies, internet-sites of company-producers and consumers of shungite were used.

The first Section of the report presents gives an estimate of mineral-resources base of shungite in Russia/CIS, presents brief data on deposits of shungite, their characteristics and reserves of the resources.

The second Section of the report presents technological classification of shungites, enterprises of the CIS, producing shungite products, and statistical data on the production in 2002-2006.

The third Section of the report is devoted to description of CIS enterprises, producing shungite products, presents nomenclature of the commodity products, prices, fields of application and the main consumers.

The fourth Section presents information on export-import supplies of shungite products in Russia in 2002-06, volumes of the supplies, average annual contract prices on various kinds of shungite.

The fifth Section of the report describes consumption of shungite in Russia. The Section presents supply-demand balance of shungite (2002-2006), sectoral structure of its consumption, presents the main Russian consumers (including their volumes of the consumption in 2002-06), and describes current standing and prospects of development of the greatest enterprise-consumers.

The sixth Section of the report appraises possible consumption of shungite in Russia as a whole and in individual end-uses.

The Appendices contain expert opinions on shungite products and contact information on producers and consumers of shungite in the CIS.

Introduction.
General information on shungite

Shungites and their amazing qualities are long time known. It can be used not only in medicine, which was the first end-uses of the rock from the earliest time – for instance, in the Russian North, Tzar Peter the Great has commanded to establish a resort in a vicinity of shungite deposit in Karelia) but also in industrial production, construction, agriculture and many other areas. Yet, no large-scale research was to follow and the interest to the natural phenomena has faded away for many decades.

At the heart of the mineral there is the derated carbon that after billions of years became neither coal, nor graphite nor diamond. Apart from carbon, unique properties of shungite rely upon macro elements, such as calcium, magnesium, potassium, phosphorus and micro elements – vanadium, cobalt, copper, zinc, rare-earth elements that also compose the mineral.

Shungite is an amorphous variety of graphite of intense black color, which outwardly resembles anthracite. Shungite is unique in its composition, structure and properties. It is a natural composite with a homogeneous distribution of crystalline silicate particles in a carbon matrix.

It was found initially in Russia the Zazhoginskoe deposit near Lake Onego in the Shunga district of Karelia (the mineral was named after Shunga settlement).

Shungite is an uncommon carbon-constained mineral. Its unique features are attributed to the structure and properties of shungite carbon and its interaction with the silicate components in the rock.

Shungite carbon is elementtary carbon with original shungite structure. Its basis is a multi-layer globules about 10 nm in size. Such structure is stable to graphitization; it is highly active in oxidization and reduction process; it possesses sorption and catalytic properties.

Structure of the rock: carbon forms a matrix in the rock in which highly-dispersed silicates with particle size 0.5 - 5 mc are located. Silicates are rather evenly distributed in the shungite matrix.

Shungites are Pre-Cambrian rocks, saturated with non-crystalline carboniferous (or shungite) matter. Non-stratified shungite contains up to 99% carbon and occurs as layers and counter-veins, amugdales, inclusions. Stratified shungite forms layers of various thickness in Middle Proterozoic volcano-sedimentary strata.

Shungite rocks a classified into kinds in composition of mineral basis (aluminosilicate, siliceous, carbon) and amount of shungite component.

Shungite rocks with silicate mineral basis are subdivided into low-carbon shungite-containing (up to 5% C), medium-carbon (5-25% C) and high-carbon (25-80% C).

Physical properties of shungite are as follows: density – 2.25-2.40 g/cm^3; porosity – 0.5-5%; compression strength 100-150 MPa; elasticity index (E) – 0.31*105 MPa; electrical conductivity - (1-3) x 103 cn/m; heat conductivity – 3.8

w/m·k. Mean value of temperature expansion ratio in temperature range 20-600^{0}C is 12x10^{-6} 1/grad.

Shungite carbon posseses amorphous structure, are resistant against graphitization and characterized by high reaction ability in thermal processes, chemical resistance, electric conductivity. The rock possesses valuable sorbtion, catalytical, bactericidal properties; it is biologically active; it can attenuate and neutralize high frequency elecrtomagnetic emissions.

Various kinds of shungite rocks have various chemical and mineralogical composition (Tables 1-2) that should be taken into account in their application.

Table 1: Chemical composition of shungite rocks of Karelia, %

Content	SiO_2	TiO_2,	AI_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	$C_{св}$	S_{total}
Crumbling											
Average	47.04	0.25	4.16	1.13	0.42	0.57	0.08	0.117	1.225	44.57	0.38
Minimum	38.62	0.19	3.11	0.35	0.27	0.43	0.01	0.03	0.94	31.9	0.13
Maximum	61.02	0.38	5.6	2.06	0.52	0.88	0.14	0.52	1.56	53.32	0.93
Massive											
Average	54.42	0.23	3.74	1.49	0.55	0.59	0.17	0.062	1.342	36.57	0.9
Minimum	41.82	0.14	2.1	0.37	0.14	0.21	0.07	0.03	0.58	22.17	0.11
Maximum	71.04	0.3	5.09	2.96	1.72	1.67	0.56	0.12	2.24	50.4	1.9
Quartz-shungite breccia with amugdales											
Average	60.58	0.201	3.16	1.17	1.06	0.54	0.13	0.048	0.964	31.42	0.73
Minimum	44.57	0.14	2.27	0.21	0.45	0.26	0.01	0.02	0.6	22.8	0.2
Maximum	70.07	0.32	4	4.12	4.04	1.65	0.43	0.1	1.74	44.31	2.65
Quartz-shungite breccia											
Average	62.44	0.182	2.96	1.07	0.42	0.44	0.09	0.039	0.789	31.04	0.38
Minimum	47.72	0.1	2.04	0.3	0.14	0.21	0.01	0.01	0.48	15.63	0.1
Maximum	76.8	0.26	4.14	3.14	0.87	0.87	0.29	0.08	1.51	46.84	1.32

Source: «Shungite rocks in Karelia», Petrozavodsk, 1981

Table 2: Mineralogical composition of shungite rocks in Karelia

Rock	Components of precipitate (minerals), %				
	Quartz	Clay minerals	Illite-montmorillonite	Feldspar	Carbonates
Shungite of first and second units (formation members)					
First unit	18.95	22.71	16.86	32.13	13.39
Second unit	66.82	19.49	17.17	3.49	4.81
High-carbon shungite					
Siliceous	45.0	31.0	27.1	12.0	3.3
Sodium	19.5	18.2	13.4	48.3	3.3
Potassium	20.9	43.7	32.2	24.7	2.8
Low-carbon shungite					
Siliceous	58.9	26.5	18.7	5.3	2.6
Sodium	21.5	25.8	14.3	41.6	2.0
Potassium	30.4	22.3	17.7	6.0	33.7

Source: «Shungite rocks in Karelia», Petrozavodsk, 1981

1. Mineral resources base of shungite in the CIS

In the CIS, reserves of shingite-containing rocks have been discovered in Russia and Kazakhstan. As yet, 5 deposits have been explored: **Zazhoginskoe, Nigozerskoe, Shungskoe, Myagozerskoe** and **Koksu**.

All the Russian deposits are located in Karelia, Medvezhegorsk and Kondopoga districts (Fig. 1).

Total balance demonstrated reserves ($A+B+C_1$ categories) of shungite rock deposits in Russia exceed 80 mln t. Total predicted resources of shungite rocks in Karelia estimate around 2 bln t.

Zazhoginskoe deposit (Maksovskaya lode and Zazhogonskoe section) of shungite rocks is situated in Medvezhegorsk district of Republic of Karelia on the territory of Zaonezhski peninsula - 3 km of navigational routes of Lake Onego (Tolvuya hithe) and in 70 km of railway stations Kyappeselga and Perguba. Shungite rocks occupy the area around the northern part of Lake Onego dipping under the lake bed.

The deposit exploration began in 1974, detailed exploration of Maksovskaya lode was completed in 1985, Zazhoginskoe section exploration continued in 1988, 1993-95.

Chemical and mineralogical composition of rocks of Zazhoginskoe deposit is presented in Table 1 and 2. As seen, shungite rocks of various kinds have different chemical composition, with carbon content ranging 31-45%.