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ЭЛЕКТРОННЫЙ СБОРНИК МАТЕРИАЛОВ МЕЖДУНАРОДНОЙ КОНФЕРЕНЦИИ СТУДЕНТОВ, АСПИРАНТОВ И МОЛОДЫХ УЧЁНЫХ **«ПРОСПЕКТ СВОБОДНЫЙ-2016»**, ПОСВЯЩЁННОЙ ГОДУ ОБРАЗОВАНИЯ В СОДРУЖЕСТВЕ НЕЗАВИСИМЫХ ГОСУДАРСТВ

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SAYANO-SHUSHENSKAYA HYDRO POWER PLANT DISASTER: INVESTIGATING CAUSES AND CONSEQUENCES

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The destruction of the turbines and auxiliary equipment at Russia's Sayano-Shushenskaya Hydro Power Plant in August 2009 claimed the lives of 75 workers and wrecked an indispensable source of electricity that will take years to fully restore. In this report we tried to analyze the disaster and find out if it was predictable and preventable.

RusHydro, with its 55 hydro plants, is the leading power company in Russia by installed capacity (25.4 GW) and the second-largest hydroelectric power company in the world, after Canada's Hydro-Québec. The energy generated by SSH, about 23.5 TWh annually, was about one-quarter of that produced by RusHydro's resources for the Unified Energy Systems of Russia and Siberia. About 70% of the energy generated by RusHydro goes to United Company Rusal's aluminum smelters, which produce about 12% of the world's aluminum.

With its 10 turbines, SSH was the largest hydroelectric power station and the sixth-largest in the world, based on installed capacity. In fact, SSH was once included in Guinness World Records as a plant with the most durable dam in the world. At 6,400 MW, SSH was also the largest of the hydroelectric plants positioned along the Yenisei River basin.

At the start of construction in 1961, SSH was the largest hydro power plant in the world. The length of the completed dam is 1,066 meters (m), and it rises 242 m above the river floor. The width of the dam is 105.7 m at its base and 25 m on the ridge. The dam itself is of the arch-gravity type, a design where the center of the dam extends upstream and ends arch back in order to direct most of the hydrostatic force against the canyon walls. The maximum capacity of the spillway is 13,600 m3/sec (3.6 million gallons/sec). The project's turbine gallery housed 10 turbine units, each rated at 640 MW but each capable of peaking up to 720 MW. Rated head for each of the hydro turbines was 192 m.

Fig.1. Turbine room of the Sayano-Shushenskaya hydroelectric power plant before the accident

The sequence of events that led up to the incident began early in 2009 when three months of repairs to the Unit 2 turbine were completed that included improved speed regulation controls. The turbine was resynchronized to the grid on March 16. Although the

turbine's vibration levels remained high, the unit continued to operate through July, when it was shut down for repairs.

Fig.2. Turbine room of the Sayano-Shushenskaya hydroelectric power plant after the accident

August 16, 2009. In accordance with usual generating schedule practices, all possible units at SSH were online and providing the grid with baseload and regulating power, including Unit 2, which was started up shortly before midnight.

August 16, 2009 at 8:31 p.m. A fire alarm tripped at Bratsk plant. Primary and secondary communication lines connecting Bratsk and the Siberian UDCC were lost due to the fire, and UDCC was unable to use Bratsk in regulating mode. The UDCC dispatcher ordered SSH to replace Bratsk in providing load frequency regulation. Staff at SSH switched the plant's active and reactive power joint control systems (ARPJC) into regulating mode. From this moment, most of SSH's units began to operate under the direct control of ALFCS located at the Siberian UDCC.

August 16, 2009 at 11:14 p.m. Dispatchers at the Siberian UDCC made the decision to start Unit 2 (which was kept in reserve) and immediately switch it to regulating mode. Unit 2 was selected to provide power regulating services as it was considered to be the most reliable unit at the plant given its recent servicing.

August 17, 2009. Soon, Units 1, 2, 4, 5, 7, and 9 were all operating in regulating mode with Units 3, 8, and 10 generating baseload power. Unit 6 was undergoing scheduled maintenance and was not in operation. Instead of the normal 12 or so operators who staffed the turbine gallery on a typical day, on this day there were more than 100 workers present performing repair work.

When Unit 2 was quickly pushed back into service, vibration levels in the turbine were extraordinarily high and quickly rising. Vibration data taken from the plant logs (Figure 3) show that the vibration levels had risen to dangerous levels.

By this date, visible cracks showing the propagation of fatigue cracks in the attachment points of the Unit 2 cover were plainly visible at the locations where the mass of the turbine was secured to the plant's structural foundation. Equipment fatigue, especially in the turbine anchor bolts, caused by the excessive vibration from turbine cycling and imbalance over an extended period of time, had finally reached the point of explosive failure.

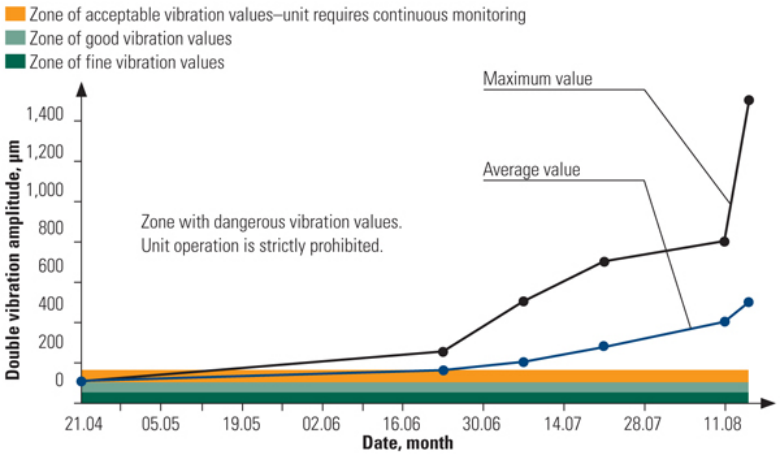

Fig. 3. Increasing vibration

August 17, 2009 at 8:13 a.m. The failure of the turbine anchoring system began the catastrophic sequence. First, the 1,860-ton turbine cover was blown off, leaving the Unit 2 turbine in its pit with no turbine mountings but with its wicket gate and head gate opened. In an instant, the 212-m water head pressure from the dam immediately ejected the turbine rotor from the pit. The rotor, continuing to spin as it flew across the gallery, destroyed everything and everyone in its path (Figure 4).

Fig.4. Turbine ejection

Within seconds of the turbine being completely ejected from the pit, a torrent of water began to fill the gallery because it was now connected to an open penstock. Water damage soon cut through the structural steel, and the turbine gallery roof collapsed. The water then started to flood pits of nearby units, causing further turbine failures. Electrical short circuits forced all the units to emergency shutdown. SSH power output tumbled from 4,100 MW to zero in an instant, while the in-house power supply system also shut down.

Water was washing away people from the turbine gallery into the river. Some of them were later caught and rescued. Some were not. The staff later learned that the turbine gallery was not equipped with proper emergency exits.

In sum, the accident completely destroyed Units 2, 7, and 9. Units 5 and 6 were damaged but were repairable. The remaining five units were seriously damaged.

More than 1,500 rescue workers arrived at the plant within 24 hours and were able to locate 14 survivors. The death toll was 75 when rescue operations were halted on August 29.

The equipment destruction also caused damage to the surrounding environment from releases of industrial oils. More than 100 metric tons of oil was released into the river, which killed thousands of fish in downstream trout farms. Rescue teams used special chemicals spread by helicopters to congeal oil that was later manually removed from the water. By their quick action, rescue teams managed to minimize the environmental damage caused by these oil spills.

A number of forensic investigations were carried out following the incident. Turbine foundation bolts were subjected to thorough examination. The bolts found were broken, and fatigue damage covered an average of 65% of a bolt's cross-sectional area. Some of the bolts had no traces of nut breaking, meaning that nuts had not even been installed on the bolts.

The logs and discussions with plant staff indicate that Unit 2 was again removed from service in early August due to continuing excessive vibration and was held in reserve. Moreover, Unit 2 was started and placed into baseload operation the evening of August 16 and then immediately placed into "regulating mode" in the early morning of August 17. That means it was subjected to more intense cycling service to follow loads, forcing the unit into multiple passes through "not recommended" zones of output power. Those stresses were in addition to the long-term excessive rotating vibration already being experienced by the unit.

Plant reconstruction work continues at full speed to ensure that a similar accident doesn't occur. At first, the work focused on Units 5 and 6, which were not seriously damaged by the accident. The reassembly of those units was thoroughly scrutinized by the manufacturer.

On December 30, 2009, operation of Unit 6 was restored, and it was successfully tested in open-circuit operating mode. Unit 5 was completely restored and restarted on March 22, 2010, bringing the station's capacity up to 1,280 MW.

Other positive plant improvements are under way. The wicket gate control systems have been redesigned. Now, the wicket gate will close automatically in case of power loss. Also, the unit head gates now can be directly controlled from the main control room. Backup power sources were also installed to provide power for head gate closing should the in-house power supply fail. In another significant procedural change, all the completed work will be accepted by primary equipment manufacturers.

It's been about 7 years since the terrible accident at Russia's Sayano-Shushenskaya Hydro Power Plant claimed 75 lives, caused significant destruction of primary hydropower plant equipment and buildings, and affected the region's ecology.

There are many important technical and cultural improvements to be done. For example, staff safety must be paramount and guide all operating decisions. The plant must also install modern real-time vibration monitoring systems on each unit and have unambiguous rules for their use that do not depend on operator interaction to shut down a malfunctioning unit. Finally, without a fully funded robust inspection (including random inspections by an independent organization), repair, and maintenance program, expect more part fatigue failures in the future, hopefully with less terrible results.

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УДК 528

SATELLITE TECHNOLOGIES REPLACING TRADITIONAL SURVEYING METHODS

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High above the Earth, a constellation of satellites orbits our planet, transmitting radio signals that allow us to determine where we are on the Earth's surface. This satellite system, when used according to specified procedures, can determine positional coordinates to centimeter-level accuracy anywhere on the surface of the Earth. It has revolutionized surveying, providing latitude, longitude, and height information more quickly, inexpensively, and accurately than was possible by traditional surveying methods. Satellite data is enhancing the reliability of transportation and communication systems, boundary and property surveys, land record systems, mapping and charting, and many scientific and engineering applications.

There are three types of "traditional" surveys: triangulation, traverse, and leveling. Prior to the advent of satellite surveying in the early 1980s, these surveys provided the basis for information.

Since 1983, GPS has revolutionized surveying. GPS offers an alternative to traditional surveying and can eliminate several of the limitations imposed by traditional surveys. Using GPS, it is now possible to perform surveys much more easily over long ranges and in areas where clear lines-of-sight between points are not available.

Surveying serves society by providing a wide range of practical applications, such as navigation on land, sea and in the air, the building of infrastructure and the determination of reliable boundaries for real estate properties or even maritime zones. In the past, such reference frames were created on a national or regional level. Today, through the exploitation of the existing and planned Global Navigation Satellite Systems (GNSS) (Fig.1)such as GPS, Glonass, Galileo and Compass/BeiDou, geodesy provides access to point coordinates in a global reference frame anytime and anywhere on the Earth's surface with centimeter-level accuracy.

Fig.1 Global Positioning System satellite used for precise positioning and navigation

Due to today's significantly improved geodetic instrumentation and techniques, geodesy has become more concerned with changes in the ‘geometry' and ‘gravimetry' of features on, beneath or above the surface of the solid Earth and oceans than it was previously. What are the implications of this development for geodesy's role? In the past, geodesy's main ‘customers' came from the surveying, mapping and geospatial disciplines, whereas today geodesy serves all geosciences, including the geophysical, oceanographic, atmospheric,

hydrological and environmental science communities. Geodetic ‘products' are not only contributing to our understanding of the Earth, but they also benefit many societal activities, ranging from disaster prevention and protection of the biosphere and the environment. Geodesy contributes to increased security, a better use of natural resources and to achieving the goal of sustainable development on our fragile planet.

The first satellites has revolutionized the ways of investigation in surveying and greatly increased the accuracy of navigation and position indication of points and objects on the Earth's surface. Satellite geodesy is the most advanced way of determining the coordinates of geodetic networks and points of the earth's surface.

Satellite geodesy is focused on the implementation of precise geodetic measurements on the ground with the help of artificial satellites;it started in late 50s, just after the launch of the first artificial satellites (fig.2).

Fig. 2 The first satellite was launched into orbit October 4, 1957

The two satellite systems, the Russian Global Navigation Satellite System (GLONASS) and the US Global Positioning System (NAVSTAR GPS)(Fig.3) include three basic parts: satellites, ground monitoring and control stations and ground-based receivers.

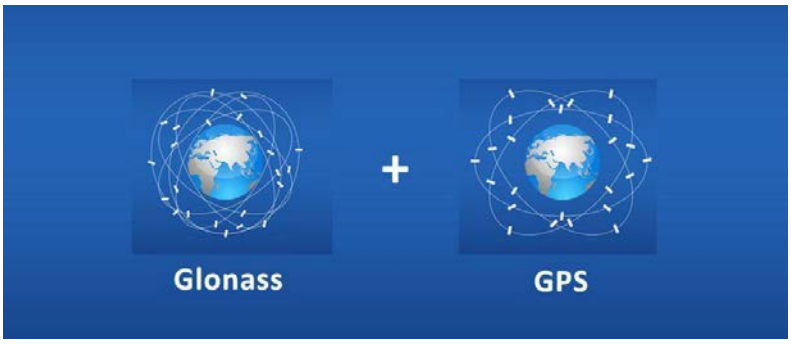

Fig.3 The Russian Global Navigation Satellite System (GLONASS) and the US Global Positioning System (NAVSTAR GPS)

The space part of the system consists of 24 NAVSTAR satellites and 6 GLONASS satellites.The satellites flyin orbits at an altitude of about 20,000km with an orbital period of

12 hours, with 4 satellites revolving in each orbital plane.GPS system consists of six orbital planes inclined at 55 degrees to the equator (Fig.4).

The systems, originally created for military purposes, are widely used for civilian purposes.

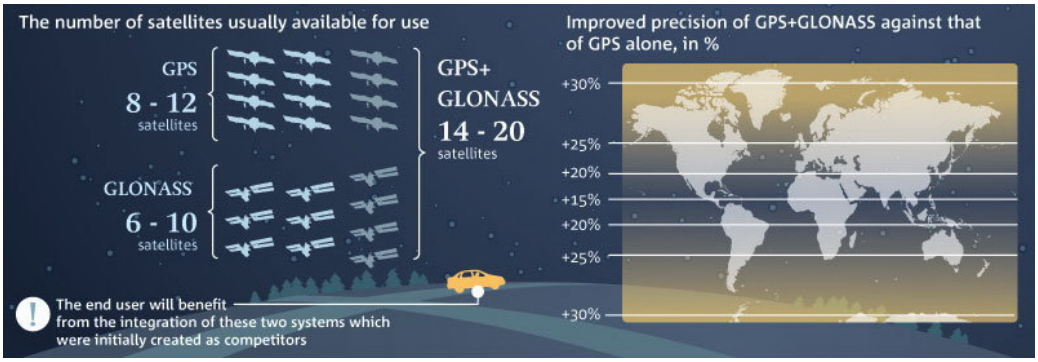

Fig.4 The number of satellites usually available for use in GPS and GLONASS

The calculating the coordinates are corrected by the rotation of the earth, ionosphere and troposphereimpact, distortion of the signal frequency and reflected signal.

It is not always convenient to use satellite technology when dealing with traditional surveying tasks. For example, the relative accuracy of short-range positioning is insufficient, and fixing the reference marks is sometimes complicated and expensive, but it is easily solved in enclosed grounds.

Now the equipment of the tools production technology is beingimproved and their performance and functional capabilities are expanding.Satellite technologiesare replacing traditional surveying methods. The evolution of surveying from chains, bars, tapes, theodolites, and levels through the satellite surveying today has produced a dramatic increase in the speed and accuracy with which positioning can be accomplished.

The negotiations between countries for a long-term co-operation in Earth observation from space are going on. The aimof the project is to build, launch and operate technological remote sensing satellites, in which costs and operational responsibilities would be shared. Many challenges have to be overcome in order for the project to advance and culminate in the successful launches of the satellites, such as language, different technological stages, distance between the countries, logistical aspects, etc.

The emergence of new, low-cost, internet-based mapping tools like Google Earth, Google Maps, that make thousands of satellite images available to a wide audience has greatly influenced perception and awareness. This goes for both the general public and the scientific community, who now see the enormous potential of mapping from satellite imagery. Such tools highlight the crucial role of remote sensing in providing fast, up-to-date cartographic information for informed decision making, particularly for mapping, planning, geomarketing, etc.

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УДК 331.453

MAINTAINING SUITABLENOISE LEVELIN INDUSTRIAL ENVIRONMENTWITH THE USE OFACOUSTIC ENCLOSURE

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According to the world statistics, every15 seconds,a worker diesfrom a work-related accident or disease.Every15 seconds, 153 workers have awork-related accident. Every day, 6,300 people die as a result of occupational accidents or work-related diseases – more than 2.3 million deaths per year. 317 million accidents occur on the job annually; many of these resulting in extended absences from work. The human cost of this daily adversity is vast and the economic burden of poor occupational safety and health practices is estimated at 4 per cent of global Gross Domestic Product each year.

In modern industry maintaining suitable noise levels in a manufacturing or industrial environment is often a very challenging problem. There are too many noise sources in our routine life like audio systems, construction activities, emergency sirens, electric megaphones, power tools and the noise of people itself.All these unwanted sounds are just called noise. Noise pollution is a kind of environmental pollution which could be created by any human, animal or machine and disturbs the human being life.

In this paper we discuss unwanted sounds of machines in industry. An unwanted sound is produced by some mechanical works (by rotary machines, hammering, engine sounds, pneumatic machines sound). There can bea lot more causes of noise in industry. The noise badly affects industrial workers and theirproductivity. Noise directly effects on the health of human being as well as the behavioral change of both human being and nature. All these unwanted sounds are harmful for human psychological health, as it could createcertain work-related diseases:

- irritation;
- anger;
- high blood pressure;
- hearing loss;
- forgetfulness;
- severe depression.

Tinnitusis also a critical problem which could be faced due to the noise pollution.

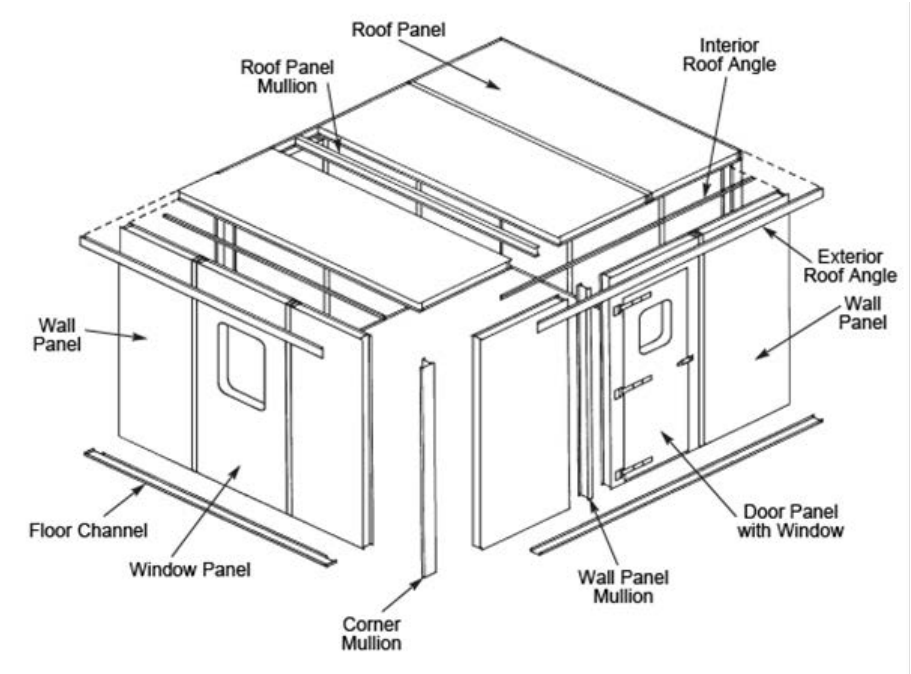
Moreover, the output from machinery can be deafening and keeping the noise within acceptable OSHA (Occupational Safety and Health Act) levels is important for the health and well-being of employees. To solve the problem a wide-ranging options are available as wall panels, ceiling tiles, enclosures, barriers, or architectural elements, noise control products are constructed from polypropylene, cotton fiber composite, vinyl, or cellulose.

Effective sound insulation is essential industrial environments for privacy, comfort, and health and safety.Our work is aimed at searching effective solution of the problem on one of the Krasnoyarsk plant. In order to assessthe improvementof working conditions,the analysis of noise level at working place was performed according to standards. The excess of noise level as compared with a standard value is determined by analysis’s results as being equal to 5 times. The maximum excess wasfound on bucker machinist working place, so it is suggested to decrease noise level of 17 dBA (Table 1).

Table 1 – Analysis of noise level at working places at “Volna” plant (Krasnoyarsk)

Working place	Machinery	Negative effect: Noise, dBA	GOST 12.1.003-83
Engine operator	Sheet-forming machine	84	80
Engine operator	Compressor system	89	80
Joiner	Grinding machine, pneumatic chipper	88	80
Machine-tool operator	Cutoff saw, Lengthwise machine, Panel planer	97	80
Engine operator	Coating machine	83	80
Dogman	Crane	63	80

By offering a large variety of noise control products we suggest using acoustic enclosure to reduce sound transmission and keepnoise. Acoustic enclosure can be made of aluminum or magnesium alloys, fiberglass, wood laminates and plywood. The layer soundproof material in 40-50 mm thickness (for instance cotton fiber composite) should be placed inside the acoustic enclosure. Expanded lath with cotton fiber composite or vinyl (in20-30 micrometersthickness) should be used to protect acoustic enclosure from physics influences, dust and other contaminants. Acoustic enclosure must not have contact with machinery and pipe lines. The space between the mechanism and the surface of the soundproof cover wall should be at least 0,06-0,1 meter. If it is possible, the amount of binding or contact points should be minimumwith elastic gaskets set in. It is supposed to be possible to find an effective solution for difficult noise problem. Acoustic enclosure design is shown on Pic. 1.



Pic. 1 – Acoustic enclosure assembly.

In industrial environments, reverberationand reflected noise from machinery can easily exceed statutory limits and cause a serious health risk to production staff. The acoustic

enclosures reduce noise pollution from machinery without reducing the efficiency or cleanliness of the plant during normal operations.

Application suggested acoustic enclosure assembly is focused on removal leakages. Chinks between planes are eliminated by single or double compaction (docking interface sealing). If chinks are inevitable, soundproof covering are applied. All holes for breathing, cables, pipe and raw transportation are arranged at urgency. Hatches for operation are carefully closed during its work. Besides, machineisset in elastic foot to avoid casual noise dissemination. In special case planes are coved by shock-absorbing material for better soundproofing, which depends on mass, and to weaken bending vibration.

The acoustic enclosure offer the following benefits and key features:

- noise reduction from 15dB(A) to 50dB(A);
- vibration isolation, noise-controlled, shock-resistant systems;
- air inlet drive for combustions (filtered air optional);
- indoor or outdoor applications;
- integration of lighting, ventilation, firefighting systems, air-conditioning etc;
- modular solutions;
- easy access for operators and maintenance personnel.

Components of acoustic enclosuresare:

- Sound Absorptive Panelsthat prevent the build-up of noise and reverberation inside buildings. The panels can attach to walls or hang from ceilings as baffles.

- Acoustic Doors contain reduce noise emissions from production areas and prevent noise pollution problems from affecting nearby communities.

-Acoustic Windows thatallow visual access to monitor production lines and manufacturing processes at a safe distance from noisy machinery and equipment.

When noise from industrial machinery exceeds statutory minimums of the Noise at Work Regulations, employees operating within the vicinity of the piece of equipment in question are at genuinerisk of ill health, including impaired hearing and stress. Acoustic enclosure panels offer the ideal solution. Acoustic enclosure panels present a soundproofing solution that is both flexible and effective. Self-supporting and easy to install and adapt, acoustic enclosure panels can be used indoors or out to contain the intrusive noise generated by machinery in factories, on oil rigs, in print works or just about anywhere.

It is obviously thatindustrial safety organization should maintain suitable noise levelon working place. Solving thisissue is related to the monitoringthe observance of corresponding standards and realization of safety measures to protect from unfavorableworking environment effects.Thus both employees and environment can be protected from negative effects.

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EXTRACTION OF GERMANIUM FROM CARBONACEOUS FEED

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Today germanium is a widely used material, however, until the second half of the twentieth century the practical usefulness of germanium was limited. Industrial production of metal began after the production of semiconductor electronics [1].

The germanium has given rise not only to the age of microelectronics, but also a new science – Geochemistry of fossil coals. At the present time, it is appropriate to develop new methods of extracting germanium from the bowels of the earth, to simplify the processes of extraction. In Russia, the prospecting work is carried out to detect new places of accumulation of coal containing compounds of germanium. In Krasnoyarsk region there is one of the largest companies for the production of semiconductor germanium and compounds based on it – JSC "Germanium", for which the availability of own germanium raw material base is of great importance.

Lignites of the middle reaches of the Yenisei river, located within mesocenozoic deposits of Kass depression are seen as a new source of germanium in Russia. Many prospecting works were conducted in the area Kass depression. They identified the most prospective area for discovery of commercial accumulations of germanium. Such is the plot of "Kasowski". The total resource potential of germaneness area in the cavity is known as 1112 T [2].

Germanium lignites occur at depth of 100 meters. In order to extract lignite from the depths, it has been suggested that it is possible to create special boreholes. They pass through deposits of lignite and come outside. Specially treated water with certain acidity will be supplied into the well under pressure. After exiting the borehole liquid will be enriched in germanium and other essential elements.

Water presents a variety of abnormal properties. This is a consequence of its structural features. At the moment there is a possibility of changing the properties of water and its transfer to a metastable state due to external physical influences (electromagnetic, mechanical, and other). In the paper it is proposed to use cavitation. The method is supposed to be a strong physical factor that affects water, especially in bubble shape. During the collapse of mikrobubble cavitation in the local volume near and within it, there appear fields of high pressures (up to 1000 MPa) and temperatures (up to 1000-2000°C) [3].

The goal of this research was to study the influence of the method of cavitation treatment on the extraction of germanium from lignite.

Lignite suspension with a certain solids content and acidity of the dispersion medium was subjected to cavitation treatment in the mixer elements. After the cavitation treatment, the dispersed phase was separated by filtration from the dispersion medium, and dried at room temperature. The content of germanium was determined by x-ray fluorescence spectral analysis using spectrometer Lab Center XRF-1800 Shimadzu (Japan). The content of germanium in the dispersion medium was controlled by means of atomic emission spectroscopy using spectrometer iCAP 6500 Duo.

The experiments investigated the effect of solid phase on the extraction rate of germanium, with pH of the dispersion medium being supported equal to 3 with the introduction of a 3M HCl solution.

The experimental results were showed in Table 1.

Table 1 – The effect of lignite content on the extraction rate of germanium

№	ω (suspension), wt. %	m (lignite), g	V(H_2O), ml	Extraction rate, %
1	10	10	90	10,16
2	20	20	80	15,25
3	30	30	70	25,17
4	40	40	60	44,76
5	50	60	40	6,99

The results show that the greatest extraction of germanium from lignite occurs when the content of solid phase in suspension is 40 wt. %. The increase of lignite content up to 50 wt. % reduces the recovery of germanium. This may be due to uneven mixing of the system.

We also conducted experiments to study the influence of pH of dispersion medium on the extraction of germanium from lignite. The lignite content in the suspension was 40 mass% with pH being changed in the range of 1-9.

The extraction of germanium was performed by adding different chemical reactants such as HNO_3, HCl, NaOH, H_2O, H_2O_2, etc.

As germanium in lignite is generaly found in the form of dioxide, the possible reactions can be represented as follows [4]:

$GeO_2 + 4HCl \longrightarrow GeCl_4 + 2H_2O \quad \Delta G_{0298} = -33367$ J/mol

$GeO_2 + H_2O \longrightarrow H2GeO_3$

$GeO_2 + NaOH \longrightarrow Na2GeO_3 + H_2O$

The results were showed in Table 2.

Table 2 – The effect of pH on the extraction of germanium

№	pH	Reagent	Extraction rate, %
1	1	HNO_3	13,99
2	3	HNO_3	2,09
3	3	H_2O_2	18,18
4	3	HCl	44,76
5	5	–	4,19
6	7	NaOH	23,78
7	9	NaOH	19,58

It can be seen from Table 2, that the most efficient extraction is performed at pH=3 using HCl.

The content of germanium in the dispersion medium was controlled by means of atomic emission spectroscopy (Table 3).

Table 3 – The results of atomic emission spectroscopy

№ п.п.	Concentration of lignite in suspension, wt. %	pH	Reagent	Extraction rate, wt. %
1	42,9	3	HCl	1,74
2	20	3	HCl	3,66
3	40	1	HNO_3	5,65
4	40	3	HCl	2,6

It can be seen from Table 3, that the most efficient extraction is performed when using for the cavitation processing of suspension of lignite with a solids content of 40 wt.%, pH = 1 using HNO_3.

The results of x-ray analysis in various conditions show the germanium recovery to 45 %, whereas according to atomic emission analysis, the extraction ranges from 1 to 5 % under the same conditions.

The difference in results may be explained due to the colloidal system formation in the liquid phase of as a result of hydrolysis of GeCl4, where a large part of germanium moves into. The possibility of occurrence of the hydrolysis reaction is confirmed by the calculation of the Gibbs energy.

$$GeCl4 + 2H2O \longrightarrow GeO2 + 4HCl \quad \Delta G0298 = -157590 \text{ J/mol.}$$

The suspension of lignite with a solids content of 40 wt. %, pH=3 using HCl, were subjected to cavitation. Then the change in the density of the liquid phase was investigated. The figure 1 shows that for 200 hours there is an increase of density. This confirms the assumption about the flow of the sol-gel process.

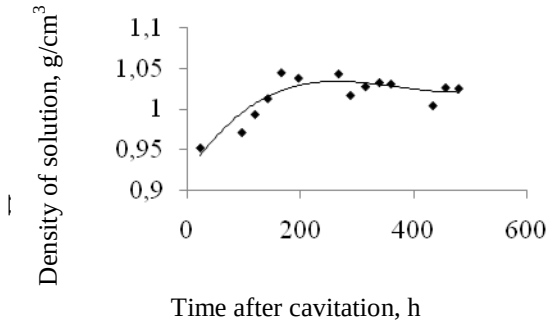

Fig. 1 – The relation graph of solution density and time after cavitation

As a result of the research it is determined that the cavitation processing of suspension with a content of lignite 40 mass. %, the pH of the dispersion medium equal to 3 during 1 min leads to the recovery of germanium equal to ~ 45 %. The cavitation processing of lignite suspensions is a promising method of germanium extraction.

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УДК 553.044

MINING AND THE CHALLENGE OF ECONOMIC DEVELOPMENT

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The relationship between mineral resources and economic development is an important aspect of the International Council on Mining and Metals programme. It is so because it is one of the two parts of industry's case for accces to land and countries' non-renewable resources – namely that these resources are essential for society and their exploitation provides economic development.

Mineral resource endowments have been beneficial for the economic development of many countries, as illustrated by the records of nations like Canada, South Africa, Australia, Chilie, Botswana and Malaysia. Nevertheless, various economic studies show that a significant number of countries that are rich in natural resources have lower economic growth rates than those with little or no mineral resources. This paradox of resource riches coinciding with loweconomic growthis known as the "Resource Curse" and is a multi-dimensional phenomenon covering economics, governance and institutional capacity, and human rights.

In light of these widespread and serious problems it is not at all surprising that there are many calls for restrictions on investments in resource rich countries, primarily in the form of mandating governance and revenue transparency improvements before investment occurs. The effect could be to greatly restrict access to valuable resources and to deny poor people opportunities for economic development.Equally, it is not possible for mining companies concerned about maintaining long-term shareholder value to operate in circumstances characterised by social unrest, poverty, income disparaty, corruption and political instability. Such operating conditions are even more untenable in a world of greater corporate transparency. The challenge are clearly significant and fundamentally important.

An example of successful international cooperation is Joint Stock Company Kyrgyzstan. The Kumtor gold mine is the Kyrgyz Republic's largest enterprise.Kumtor, one of the highest gold deposits in the world, is situated in the southern region of the Central Tien-Shan at an altitude of 4,000 meters above sea level in a permafrost zone. The deposit is located 350 kilometers from Bishkek, the capital of the Kyrgyz Republic.

Despite the fact that the Kumtor gold deposit was discovered in 1978 and the feasibility study was drafted by GINALMAZZOLOTO of the Chief Directorate of Precious Metals and Diamonds of the USSR Council of Ministers in 1989, the development of the mine was delayed as the project was seen as being too costly: 995.4 million Soviet rubles (an approximate equivalent of 1.46 billion USD as it stood in those days).

It was not until after Kyrgyzstan gained independence that it found itself in a position to attract western investment to start developing its own mineral resources. After thoroughly examining several investment offers, the Government of the Kyrgyz Republic favored those made by Canadian Cameco Corporation, one of the world's largest uranium producers. On December 4, 1992, in Toronto the sides signed the Kumtor Master Agreement.

Based on exploration findings, the Kumtor open pit mine-life has been extended to 2023. The period for the gold ore processing at plant – up to 2026.Gold produced at Kumtor is wholly purchased by Joint Stock Comapnay Kyrgyzaltyn. The Kumtor Company was not engaged and is not engage with gold export. The Kumtor mine's final product is the Dore bars which are purchased at the mine site by Kyrgyzaltyn for further processing at its refinery at Kara-Balta as it is stipulated by the Gold and Silver Sales Agreement concluded by Kumtor Gold Company, Kyrgyzstan and the Government of the Kyrgyz Republic. The exclusive right to sell

refined gold and silver both in the Kyrgyz Republic and abroad being held by Kyrgyzaltyn alone.The Dore bar is the final product of the Kumtor mine which contains more than 70% of gold as well as from 10% to 29% of silver, admixtures (iron, zinc, copper and nickel) not exceeding 10% the whole composition. Gold is purified at Kyrgyzaltyn's refinery at Kara-Balta.

The Kyrgyz Republic, through the Open Joint Stock Company "Kyrgyzaltyn" is the shareholder of the largest shares portfolio of the "Centerra Gold Inc." – 77 401 766 shares – around 33%.Kumtor remains to be an enterprise contributing the largest benefit to the Kyrgyzstan's economy. In all, contributions made within the Kyrgyz Republic between 1994 and 2014 have exceeded$2.707billion.Besides the fact that the company is the largest tax payer in the private sector, it is also the largest employer in the Kyrgyz Republic. 97% of the Company full-time employees are Kyrgyz citizens, and this proportion is ever growing as the result of foreign managerial personnel being gradually replaced by national employees.About 600 Kyrgyz companies at the present moment supply almost 11 000 product items, necessary for sustaining operations activities on a daily basis. Company renders significant aid to local community by executing our strategic programs of the social responsibility.In addition to all mandatory payments and taxesKumtor transfers 1% of gross income to the Development Fund of the Issyk-Kul region.The Kyrgyz Republic benefits from the Kumtor mine through a number of channels including:

• Taxes and other mandatory payments to the government budget, in particular, the revenue-based tax which has resulted in Kumtor having a much higher effective tax rate than the sector-average;

• Expenditures on local procurement of goods and services; this includes full processing of gold at local refinery as opposed to production of gold concentrate only on some other mines; • Inflow of foreign exchange from Kumtor gold exports, which is essential for maintenance of the country's balance of payment and stability of the national currency;

• Kumtor's benchmarking role as one of the country's best employers, based on its high local wage levels and, hence, as possibly the largest payer of labour-related taxes and SF contributions in the country, despite its relatively small direct contribution to total employment in the country;

• Kumtor's contribution to social development of the country, through mandatory payments to the government budget and extensive social corporate responsibility programmes implemented in the communities in the mine area and across the country.

Arguably to receive substantial tax collections for the government and high wages for local employees it may be preferable to deal with large corporations, which usually are formal and then more transparent, have a longer-term approach, allow for establishing trade unions, and are more accountable due to their international presence. Large corporations are also associated with higher probability of implementing any significant corporate social responsibility programmes.

It is clear that community development activities at the operational level are most effective when they are aligned with existing local or regional development plans and are linked to long-term strategic objectives. From a company perspective, a partnership approach also potentially avoids the company assuming the role and responsibilities of government.The mining industry faces significant challenges in being able to access resources in developing countries and this will only be possible when there is sufficient political and community support.

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УДК 666.313

DEVELOPMENT OF TECHNOLOGICAL PRODUCTION MODES OF CERAMIC THERMAL UNIT BASED ON SILICON DIOXIDE FOR GROWING GERMANIUM SINGLE CRYSTALS

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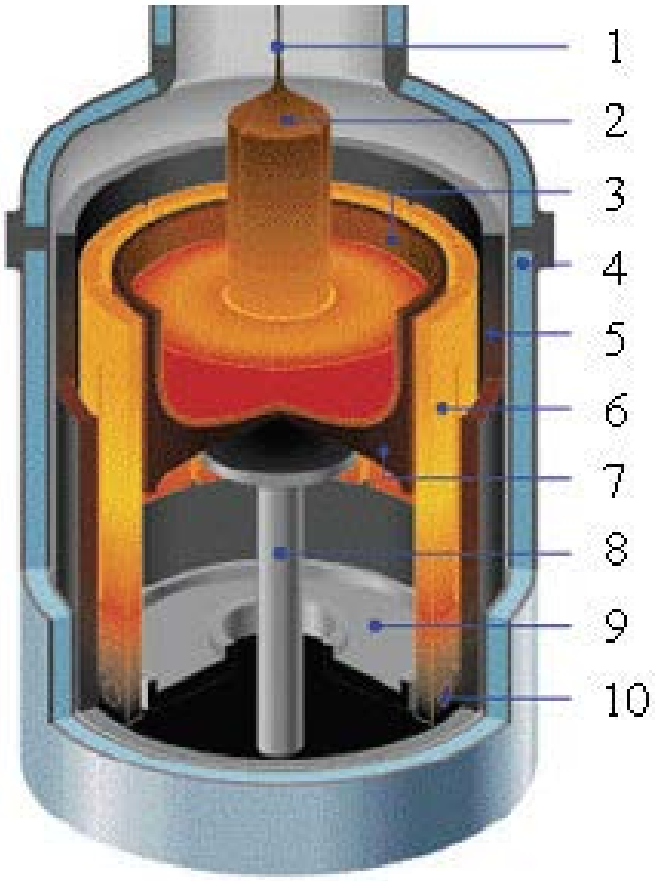
At present, constructional ceramic materials based on silicon dioxide are used in various fields of engineering: aerospace industry for manufacturing of missiles radomes [1]; in the instrument making industry as covers for thermocouples[2], in the steel industry as steel-pouring nozzles[2], etc. These materials are interesting due to their high temperature resistance and thermal insulation[3]. The aim of this work is the development of technological production modes of ceramic thermal unit based on silicon dioxide for growing germanium single crystals.

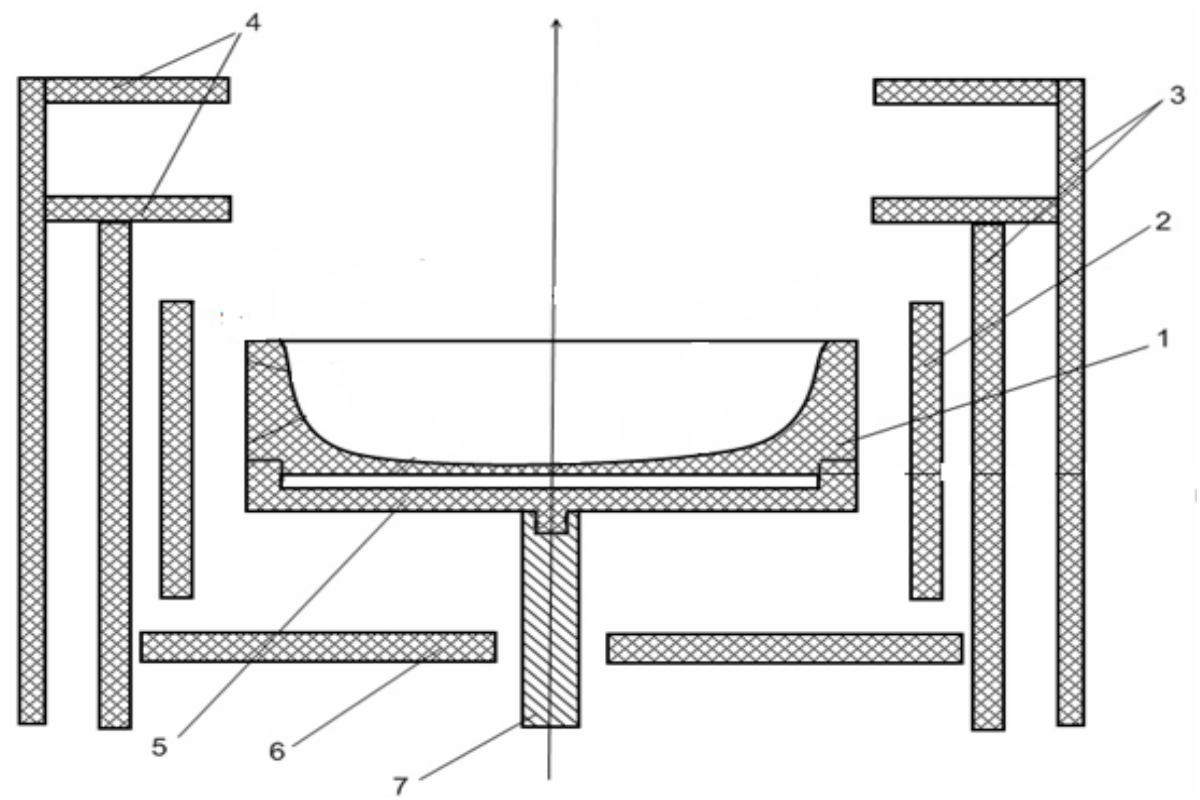
Figure 1 shows of a device for growing germanium single crystals[4].



1 – seed; 2 – crystal; 3 – crucible; 4 – furnace body; 5 – lateral screen; 6 – graphite heater; 7 – graphite crucible; 8 – the lower rod; 9 – tray; 10 - current lead

Fig. 1 - The cross-sectional view of device for growing germanium single crystals according to Czochralski growing process [4]

The unit includes a lateral screen to reduce heat loss from the ingot and the melt. Typically, shielding is much more difficult. For example, Figure 2 shows the thermal unit shown in [5], which consists of top, side and bottom heat shields.



1 - crucible; 2 - cylindrical heater; 3 - lateral heat shield; 4 - the upper heat shield; 5 - support; 6 - lower heat shield; 7 - rod.

Fig.2 - Scheme of the thermal unit[6]

The elements of a heating unit, generally made of graphite, however, graphite has a high conductivity[3] ($\lambda_{graphite}$ = 120 W/m·K at 1100 K) and does not provide sufficient thermal insulation. Quartz ceramics the thermal conductivity is considerably lower[3] (λ_{SiO2} = 1,98 W/m·K at 1100 K), so the use of quartz for the fabrication of ceramic elements of thermal unit is preferred.

As a raw material, fused quartz was used with a purity of 99,98-99,99 %[6]. Quartz is crushed in a jaw breaker ЩД-6 till the size of particles is less than 3 mm. Then obtained powder was washed with distilled water and dried for 24 h. For purification of from impurities, quartz powder was carried out by etching in a mixture of nitric and hydrochloric acids that are taken in the ratio 1:3. Further, the etched quartz powder was used for preparation of slurry. This was carried out by grinding quartz powder grinding bodies in a ball mill in distilled water with a weight ratio of 1:2:0,5. At this technological stage after the start of grinding in 15 h 37,5% of glass powder was loaded into the mill every 6 hours in relation to the weight of initial load. As a result, the content of quartz in the resulting slurry was increased from 65 mass. % to 82 mass. %. The density of the slurry before and after adding the load was measured by bottle method. It has been established that when adding of quartz powder in the slurry, the density of the slurry increases from 1,54 g/cm^3 to 1,84 g/cm^3. Then the slurry is molded by casting in plaster moulds, where a forming of slip layer happened. After that, molded products were dried in an oven at a temperature of 373 K for 1 h, and annealed at 1448 K for 2 h.

The technology elements of ceramic thermal unit are presented in Figure 3.

a) *b)*

c)

a) top screen; b) bottom screen; c) crucible
Figure 3 - The elements of thermal unit

At the moment, the products are undergoing pilot tests.

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УДК 574

PROCESSES OF CREATION MINERALS IN OXIDATION ZONES OF SULFIDE DEPOSITS AS ADVERSE ECOLOGICAL FACTOR

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Malachite, azurite, chrysocolla... Everyone, certainly, comes across with them as they are using in making adornments very often but only few people know that these minerals are lineal descendants of sulfides – ores of various metals. Wonderful metamorphoses are taking place in zones of sulfidic deposits, in sites with enough water and oxygen.

Generally, there are about a half of known kinds of minerals in oxidation zones. The majority of them are deposited in small limonite cavities under the iron hat.

What the oxidation zones are? They are the sites, rich with water and oxygen, which are located near to the earth surface. For example, in infiltration places above level (mirror) of subsoil waters, all sulfides oxidize. There are three factors of oxidation — oxygen, the electrochemical phenomena and bacteria activity.

Chemical reactions of sulfides oxidation could be considered on an example of chalcoryrite — its behavior is quite interesting, and processes taking place are evident.

Ion Fe^{2+} is unstable, in water it easily hydrolyzes and turns into ferric hydroxides, for example in goethite.

In water ferric hydroxides are almost insoluble, so they accumulate in a place of chalcopyrite decomposition and in cracks and cavities of superficial sulfidic veins parts. Congestions of ferric oxide above deposits of nonferrous metal called “iron hats”.

Copper behaves more complexly. Its part reacts with the carbonates which are the parts of a containing rock or which are contained in ore vein with appearance of poorly soluble substances, e.g. azurite and malachite.

Formed malachite, accumulated in places of the vein, exits to the surface.

In distribution of oxidation products vertical zone layers are observed: in the top part ferric hydroxides (limonite) accumulate. There are oxidized ores much low. Primary minerals are oxidized and exposed to chemical aeration so oxidation products have a porous, cavities structure. There relic sulfides and veins minerals, such as quartz and calcite, are remained, and malachite, smithsonite, ceruse are formed.

Below level of subsoil water regenerative processes take place. This zone is called “zone of secondary sulfides” or “zone of secondary sulfidic concentration”. Except primary chalcopyrite there are chalcosine, bornite and other sulfides, which are formed here at the processes of regenerative chemical reactions getting here ions of copper and sulfate-anions.

The powerful factor of ores oxidation is also the biochemical phenomenon. The concentration of bacteria in a solution moistening oxidized sulfidic ore can reach 108-109 cells for 1 ml of a solution or 1 gr ores there. The live cell acts as an oxidizer as biochemical processes take place with participation, produced by reactions on an inorganic substratum.

Three of the listed above factors influence the primary sulfide ore. As a result, oxidized ores are formed over primary sulfidic ores. Its capacity can be different from shares to the some meters and sometimes – dozen meters, depending on local conditions (climate, relief, level of subsoil waters, character splitting ores and matrix), composition and a structure of primary ores.

Oxidation zones of sulfidic deposits arise in districts with warm and moderately damp climate. Why in a warm climate? In a heat chemical reactions go faster though oxidation processes take place even in permafrost zones.

But why the climate should be moderately damp? After all, oxidation goes very slowly without any water. If there is too much moisture, oxidation products are carried away by water

earlier so they don't have time to react with ores and matrix. In favorable conditions the oxidation zone can spread the depths of many hundreds meters.

Bright raddles, copper and other fadings, auras of metals dispersion, subsoil waters are the search signs of primary ores. On a set of secondary minerals it's possible to define associations of initial minerals. As the matter of fact -- at the expense of migrations, chemical reactions and readjournment of substance in the course of oxidation of primary ores secondary sites, nests, horizons of industrially valuable copper, zinc, lead ores are formed. Sometimes in an iron hat there is industrial concentration of gold -- it was out off from sulfides at their chemical decomposition.

Experiment 1

Growing up crystals is possible on a piece of rock, which is rich with calcite. Then the reaction of exchange begins, similar taking place in nature. Calcium sulfate (gypsum) and carbonate copper (malachite) start the formation of copper sulfate and a calcium carbonate. I have already mentioned it in another section.

In the sated solution of a copper vitriol I entered a fragment of limesendstone which has enough calcite to start reaction and to achieve an evident result.

The crystallizer remained in a warm place at rest more than for a week.

Rock has got a greenish shade as neogenic malachite has painted it. Considering in detail, it's possible to find out thin colorless needle crystals. It is gypsum.

Thus, it was possible to receive 2 new insoluble substances.

Experiment 2

In a crystallizer we entered some slices of a pyrite and calcite, a teaspoon of a copper vitriol was added and hot water was filled in. The reaction began almost at once -- copper vitriol started to react on carbonate of calcium with gas allocation. Crystallizer was left at rest for a week. During this time curious changes happened.

For the analysis of the formed substances it was necessary to use a microscope as all neogenic minerals mainly were the small besieged and suspended in solution particles. The drop of a solution with suspension of the formed substances was taken and placed on platen glass.

With a microscope it was possible to define that ferric hydroxides, gypsum, ferric sulfate were formed and copper sulfate remained. Gypsum and ferric hydroxides were already in a firm state, other substances were still in a solution. Gypsum crystals were extended and transparent, while ferric hydroxides were very fine-grained. In process of drop drying other substances started to crystallize and the size and quantity of gypsum crystals increased. On the drop edge ferric sulfate (analog of a mineral melanterite) started to crystallize first. Its crystals are colorless and transparent, they are easy to diagnose in the form, and also in interferential coloring in crossed Nicols.

Unfortunately, sulfidic deposits quite often cause the pollution of environment. The thing is, that in oxidation zones insoluble connections of many elements (Co, Ni, Cu, As, Sb, Pb, Bi, Mn and other) become soluble. One of the most widespread sulfides – a pyrite (its contained in the earth crust 150-200 times more than other sulfides taken together) accumulates in dumps because the industry uses it only for receiving of sulfuric acid. As a result of its oxidation not only ferric hydroxides, but also sulfuric acid, and various hydrosulfates of iron (melanterite, rozenite, szomolnokite) are formed. It leads to acidosis soil and accumulating gypsum – gypsum is formed as a result of reaction of sulfates with carbonates which is contained in soils almost everywhere.

We suggest that using sulfate-reducing and transforming sulfate-anion into sulfur bacteria in dumps of sulfidic deposits will create the conditions similar to ones in zones of secondary enrichment: sulfates will be restored into sulfides which can be used as ore of nonferrous metals, and limonite, formed by pyrite destruction will become rich iron ore. Thus oxidizing processes won't stop, and PH environments will be close to the normal.

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УДК 621.22

MICRO HYDRO POWER AS EFFICIENT ENERGY SOURCE

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Alternative energy encompasses all those things that do not consume fossil fuel. They are widely available and environment friendly. They cause little or almost no pollution. There have been several alternative energy projects running in various countries to reduce our dependence on traditional fossil fuels. There are many impressive options, we took into consideration one of them.

Small-scale micro hydro power is both an efficient and reliable form of energy, most of the time. It is crucial to have a grasp of the potential energy benefits as well as the limitations of hydro technology. With the right research and skills, micro hydro can be an excellent method of harnessing renewable energy from small streams. In this paper we made an attempt to outline some of the advantages and disadvantages of small scale water turbines and analyze the practical examples of using small-scale micro hydro power plant.

A micro hydropower plant (MHP) includes a generator, a turbine and an automatic control system (fig.1). According to the type of water resources used by MHP are divided into new riverbed or dam station with reservoirs of small size; stations operating at high-speed energy of the free flow of rivers and stations using the differences in water levels.

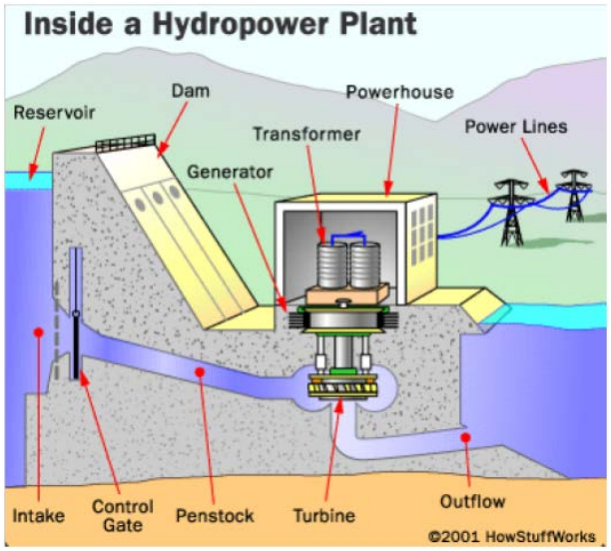

Fig.1 A scheme of micro hydropower plant

A micro hydropower plant (up to 100 kW) can be installed almost anywhere. It includes a water intake, power unit and automatic control device. Micro hydropower plants are used as power sources for farms, small villages and enterprises in remote areas.

Micro hydro technology uses a waterwheel, known as a turbine, to convert the energy of moving water into mechanical energy which is then converted into electricity. Micro hydro power systems can provide continuous, cost-effective power night and day given the right conditions.

Micro hydro can be used in both off-grid and grid-connected systems.

In wooded sites, where solar is not possible, micro hydro may be a renewable energy option. Micro hydro is a long-lasting and robust technology – systems can last for 50 years or more with appropriate upkeep.

A micro hydroelectric system works by capturing the energy of flowing water in streams. The water rotates a turbine or waterwheel, which spins a generator, converting the energy of the water into electricity. This electricity can be connected to either an off grid or grid-tied system (fig.2). A well-designed micro hydroelectric system is environmentally sensitive, harnessing the energy of a stream or river without harming natural systems.

Fig.2. Waterwheel spins the generator, converting the energy of water into electricity

Moving water contains considerable energy, which you may be able to capture with a micro hydroelectric system. How much energy depends primarily on two factors – how much water moves per unit time (the 'flow' also known as 'Q'), and the vertical distance the water drops across your site (the 'head' also known as 'H'). The theoretical power 'P' available from your site is in exact proportion to the product of these two factors ('C' is a constant and is the mathematical product of the density of water and the acceleration of gravity.)

$$P = Q \times H \times C$$

A well-designed micro hydro system is environmentally sensitive and does not harm the ecology of the stream. A portion of the flowing water is channeled from the stream at the highest available point, routed through the micro hydro turbine, and returned to the stream at a lower point. The turbine simply extracts the energy from the water flow and returns it to the stream otherwise unchanged.

The micro hydro turbine converts the energy of the moving water into mechanical energy, rotating a shaft which, in turn, spins a generator and produces electricity. Turbines come in different sizes and types (fig.3).

We studied a number of examples of successful use of micro hydroelectric power plants and one of them is located in mountain district of Namangan region. This micro hydroelectric power station is designed to generate electricity without construction of dam. Structurally the MPS rotor is mounted vertically; the rotor height is 0.25 to 2.5 m. Hydraulic units are designed to operate in a wide range of flow rates and pressures with high power characteristics. The payback does not exceed 1 year.

Fig.3. Small sized micro hydro turbine

The main specifications of the micro hydropower plants are as follows:

water pressure, m	4-12
water consumption, m^3/c	0,4-1,2
power output, kw	to 50
speed, rev/min	750-1000
voltage, v	230 (+15 -30) / 400(+25 -55)
current frequency, hz	50 ± 2
number of phases	3
phase connection	U
impeller diameter, mm	460
weight, kg:	
– power unit	1400 -2000
– ballasting unit	85/ 190
– automatic control device	200

Micro Hydro Plants advantages:

– Efficient energy source. It only takes a small amount of flow (as little as two gallons per minute) or a drop as low as two feet to generate electricity with micro hydro. Electricity can be delivered as far as a mile away to the location where it is being used.

– Reliable electricity source. Hydro produces a continuous supply of electrical energy in comparison to other small-scale renewable technologies. The peak energy season is during the winter months when large quantities of electricity are required.

– No reservoir required. Micro hydro is considered to function as a 'run-of-river' system, meaning that the water passing through the generator is directed back into the stream with relatively little impact on the surrounding ecology (fig.4).

– Cost effective energy solution. Building a small-scale hydro-power system can cost from $1,000 – $20,000, depending on site electricity requirements and location. Maintenance fees are relatively small in comparison to other technologies.

Fig.4. 'Run-of-river' system

As for disadvantages, they are not many:

– Suitable site characteristics required. In order to take full advantage of the electrical potential of small streams, a suitable site is needed. Factors to consider are: distance from the power source to the location where energy is required, stream size (including flow rate, output and drop), and a balance of system components — inverter, batteries, controller, transmission line and pipelines.

– Energy expansion not possible. The size and flow of small streams may restrict future site expansion as the power demand increases.

– Low-power in the summer months. In many locations stream size will fluctuate seasonally. During the summer months there will likely be less flow and therefore less power output. Advanced planning and research will be needed to ensure adequate energy requirements are met.

– Over the last few decades, there has been a growing understanding that micro-hydro schemes have an important role to play in the economic development of remote rural areas, especially mountainous ones. Micro-hydro schemes can provide power for industrial, agricultural and domestic uses through direct mechanical power or by the coupling of the turbine to a generator to produce electricity.

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УДК 528

STUDYING OF SURVEYING EQUIPMENT FOR USING IN MINING

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Dear colleagues, we write this popular science article for you. We hope it helps you get acquainted with surveying equipment which our foreign colleagues use.

Surveying is the technique, profession, and science of determining the dimensions and contour of the Earth's surface. Using specialized surveying equipment professional surveyors determine land boundaries for a variety of important reasons.

Surveying has existed in one form or another for at least 5,000 years; virtually all of recorded human history and likely even beyond. The pyramids in Egypt and Stonehenge in England are believed to have been created with the assistance of an ancient surveyor. It is an essential element of civilized society. Working with a combination of skills derived from physics, engineering, law, and the mathematics, surveyors are well trained to accurately measure flat and three-dimensional points, as well as the distance and angles between them.

Surveying requires data from three primary components. This includes the measurement of distance, angles, and elevation. There are several different types of survey tools but each tool is capable of providing the necessary data from one or more of the measurement types.

The art of surveying remained relatively unchanged until the late 1990s. Since the advent of more technologically advanced survey equipment, such as global positioning systems and electronic measurement devices, the tools available to the surveyor have become greater and more enhanced. As a result, some of the older techniques, such as the use of chains and tape are falling out of favor.

A necessary tool for any surveyor, the tripods provides a strong, balanced location on which to place certain types of survey tools ***(fig.1)***. Tripods are commonly adjustable and may be made up of wood, aluminum, or fiberglass. Though fiberglass makes a heavy load for toting from one job to another, aluminum and wood may swell or contract in certain weather conditions, slightly altering readings.

Fig.1.Tripods.

Levels are another common tool of the survey trade ***(fig.2)***. Often used in conjunction with a sturdy tripod and various rods, the tool is typically just a level attached to a sort of telescope or laser. The telescope is used to extend sight line in all directions,

offering a reference point from which to measure the various elevations. Just as there are multiple types of surveying rods, multiple styles of level exist.

The automatic level is a very common type of level for surveyors to use. It features a quick setup with a three-screw leveling head and can typically be identified by the bubble marked with a bullseye. To use the automatic level, the surveyor manually centers the bullseye bubble and from that point, a laser takes over to insure that the object remains level.

An electronic or laser level transmits a visible laser beam or invisible infrared beam. These levels may feature either a single or rotating beam and are considered to be precise up to 1,000 feet. Common uses of the electronic or laser level include grading, excavating, and checking the depth of trenches.

Fig 2. Level.

A professional surveyor may find use for several different types of levels, depending on the assignment. The most commonly used today are the automatic level and the electronic level. These advanced levels can be used for nearly any surveying task.

Laser detectors are needed when a laser level does not feature a beam that is visible to the human eye. The laser detector is attached to the rod, whether mounted or hand-held, and will move up and down in response to the laser beam. This gives the surveyor a clear idea of where the level beam is landing so that he or she may take accurate measurements

Range poles are a very common tool in the surveying world. They are used for sighting and marking ground points and lining up surveyors. Most range poles are six to ten feet in length and painted with alternating red and white stripes for easy sight. These poles may be made from fiberglass, wood, or metal.

Theodolites are primarily used to measure horizontal and vertical angles though they can also be used to determine horizontal distances and elevations. Theodolites are primarily used by professional surveyors, though they are sometimes used in other disciplines like metrology and rocket launch technology.

The theodolite features a movable telescope mounted between a horizontal and vertical axis ***(fig.3)***. Theodolites that feature a telescope, which can be moved in a complete circle along a vertical plane are known as transit theodolites. Theodolites that feature a telescope that can only rotate in a semi-circle are known as non-transit theodolites.

Fig.3 Theodolites.

An electronic distance measuring device detects the distance from one point to another based on the amount of time it takes a laser to travel from the measuring device to a prism. These advanced, but common pieces of surveying equipment have largely replaced chains as the standard for measuring distance.

The Global Positioning System or GPS may is one example of an electronic distances measurer. However, GPS does not work well with every terrain, as it is difficult to pick up the necessary satellite signals in heavily wooded or mountainous areas.

The device known as the total station is one of the most advanced forms or surveying equipment available ***(fig.4)***. An all-in-one device, the total station is a form of electronic distance measurer that is used to automatically measure both horizontal and vertical distances, as well as the angle of various slopes.

Fig.4. Total station.

We have studied the information about types of surveying equipment and belive that our research will be useful for students majoring in surveying while studying English.

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PRESENT ARCTIC TRANSPORT SITUATION AND CREATION OF ECOLOGICALLY SAFE MARINE TRANSPORT SYSTEMS FOR HYDROCARBON EXPORT FROM THE RUSSIAN ARCTIC OFFSHORE.

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The aim of this work is to show present situation with arctic oil-and-gas transport and give full plan of creation of ecologically safe marine transport system for hydrocarbon export from the Russian arctic offshore.

Only a few companies in Russia have special ships which can deal with ice in Arctic Ocean. Double acting ship (or DAS) is a type of icebreaking ship designed to run ahead in open water and thin ice, but turn around and proceed astern (backwards) in heavy ice conditions. Such ships can operate independently in severe ice conditions without icebreaker assistance but retain better open water performance than traditional icebreaking vessels. Russian fleet has one of the biggest amount of double acting ships in the world. Some of these ships were built in Japan and South Korea and are used now for «Rosneft» and «Norilsk Nickel ». This amount of ships is not enough for export from Arctic offshore. We analyzed that point during our research.

We concentrated on few certain points while planning ecologically safe marine transport system. Development of oil-and-gas fields on the shelf of the Russian northern territories is connected with creation of transport-technological complexes (TTC) comprising offshore platforms and terminals, icebreakers, technical fleet, support and supply vessels, shuttle and open-water tankers, gas-carriers, oil storages, offshore transshipment complexes, etc. Specific climatic conditions, light day duration, pattern of the ocean surface heat exchange with the underlying layers and the atmosphere, spatial distribution of the Earth magnetic fields, bottom contour, types of coast and shallow tides essentially reduce natural self-regulation of environment. In this connection, development of intensive navigation and creation of offshore industrial facilities in this region requires special attention to securing of ecological safety.

The basic areas of research and studies in MTS design are:

– Developing the state strategy and policy in creation of offshore technical and transport facilities and vessels, construction programs preparation;

– Developing the normative base for offshore facilities and vessels design, technical regulations, standards and rules;

– Design of new high technology vessels and facilities;

– Design of modem oil carriers of various displacement;

– Design of specialized rescue ships and ecological safety control vessels (oil and oil product spill response, oil skimmers, ecological control vessels etc);

– Definition of design type and optimum characteristics of offshore facilities of transport-technological systems, based on the problem to be solved, allowable environmental impact, maintenance of optimum habitability conditions with regard to minimum expenses on their creation and operation;

– Research and design-experimental support to design activities;

– Developing the techniques and programs for the control of habitability conditions and ecological safety on TTC facilities;

– Evaluating the occupational risks on TTC facilities and developing measures to reduce

Ecological safety of the region when exporting hydrocarbons from the Arctic offshore can be provided only through the complex of interrelated legislative, technical and organizational measures developed with respect to specificity of TTC operation conditions.

The legislative measures include development of legislative and normative technical documentation (laws, governmental decrees, technical regulations, rules and standards).

Among technical measures are:

– Design and use of vessels meeting the international and rational requirements to Arctic operation conditions;

– Use of modern ecologically safe transport facilities and transport operations support vessels;

– Providing facilities with modem ecological equipment, water surface survey aids;

– Improving reliability and ecological safety of hydrocarbon transport systems;

– Expedient selection of means for prompt oil and other hydrocarbon spill recovery, allocation of means, equipment and oil spill response vessels.

Organizational measures include:

– Technical-hygienic monitoring of transport systems;

– Arranging local and regional ecological monitoring of water area and atmospheric air

– Arranging the operations of warning, spill survey, localizations and recovery;

– Training the personnel to act in emergencies and their examination;

– Preparation of qualified personnel, certification of TTC;

– Providing hygienically allowable conditions and labor regimes for TTC personnel and ships' crews;

– Developing the measures to reduce role of human factor as a cause of emergencies;

– Developing the facility's oil spill response plans and contingency planning.

The issues of reducing negative influence of physical, chemical and psychosocial factors on shipboard personnel have acquired significant importance in solving the problems ofenvironment protection in hydrocarbon transport, along with such issues as introduction of modem sewage treatment and disposal systems, garbage and wastes disposal systems, airpurification systems.

For good safety functioning of Arctic marine transport systems infrastructures are necessary for developing also:

– a complex of normative requirements regarding more strict regulation of pollutants emissions (flying organic compounds, inert gases etc.) and waste disposal and effluent discharging into the Arctic environment;

– informational - analytical system for estimation of risk and safety of marine operations and of marine oil transportation around the shelf of Russia;

– a concept of ecological monitoring of oil/oil products spills on export oil routes.

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LAND A CAREER IN OIL AND GAS

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The oil industry all around the world shed thousands of jobs in 2015, and it's expected to cut even more this year. So that lots of people are losing faith in finding appropriate jobs in the oil industry. Yet, there are still some areas in the sector that are relatively unscathed – and even growing. The situation of oil industry has changed greatly, and therefore the demand of employees was changed. Believe it or not, the demand for some energy industry professions is still growing. Before you trying to land a career in oil and gas industry, there is something you need to know.

The petroleum enterprises are shifting the focus of development

Petroleum enterprises all over the world are changing their focus of development from paying attention to outward expansion to improving the management and technology. During the era of high oil price, enterprises put all their focus on expansion the business. Buying more blocks, more oil rigs, more wells and productions, the faster you "run", the more money you will get. However, by all means, we are in the era of low oil price. Those companies began focusing on cost of production, better ways to manage and higher level of technology. Those who cost less will earn more or at least lose less.

Cost reduction is a war, which you can't see the battle or smell the smoke. Competing the level of management means, regardless of the oil price rising again or not, the old technology is going to be replaced by the new one. It means that some people will leave from the beloved industry, either temporarily or forever.

Technology development affecting our employment

According to EIA (the U.S. energy information administration), the number of active wells reached a new low last week. Although the number of gas-wells has been kept decreasing as much lower quantity for seven years, the production has been rising steadily. This fully shows us that with the progress of technology, the drilling efficiency is improving constantly. Forced by low oil prices, companies are trying to reduce the number of drillings as much as possible while maintaining quality and quantity of production. Rely on the drilling efficiency to improve output, instead of simply increasing the number of wells, this is what called tendency. As a result, all the staff related to drilling is the first and most to be affected, the number of current global drilling has plummeted, also difficult to have a big growth in short term, personnel redundancy is inevitable. Affected by this brunt of the redundancy, project managers are losing their jobs too, because a lot of new oil field construction projects have been forced to abort.

New technology

The recession is decimating some professions but it is also driving advanced technology that boosts operational efficiencies. It identifies increased use of measurement-while-drilling and logging-while-drilling tools, which collect data to improve drilling accuracy. Another new technology is micro-seismic monitoring of fracking. This kind of technology collects and

analyzes data to map geological impact, boost output and minimize the number of wells and fractures required. Workers with backgrounds in field operations, geophysics, geology, and reservoir and completions engineering are going to be needed hungrily driven by those technology mentioned above.

Fracking brought other seismic shifts to the labor market. NGLs output has leapt dramatically and is still increasing, requiring process operators. It also boosts the wastewater and desalination sectors. The recession is increasing the need to cut costs for trucking in water, boosting recycling technology demand. So despite spudding slowing to a near standstill, throwing drillers out of work, fracked wells are still creating new jobs for some professions.

Other boosts

People who dislike the oil industry have helped create and expand professions within it, which is so ironic. Increased public scrutiny of fracking and pipelines has created new growth in the regulatory, stakeholder and aboriginal relations fields within the energy business. Qualifications required to enter the latter typically include a degree or diploma in public relations, communications, journalism or business. In addition to the specialist engineering, business and marketing roles new markets bring us a great need in the future not far away.

Best choice for pursuing advanced study

Quite a number of petroleum college staff said that the computer technology in the oil industry has a vital position. Studying computer technology as a second degree has been a great choice made by those people who go back to university for further advanced study from their job. In spite of that, in the field of the oil and gas pipeline gathering, global universities lack for relevant professions.

Right now, companies are seeing a lot of job applicants but very few have the specific skills needed, so many of them have to train their employees by themselves. In the future not far away, the oil and gas pipeline storage and transportation professional may appear in more and more petroleum universities.

Big gap may arise

Many people are unemployed for now, the situation of oversupply in the petroleum industry is very serious. By the damaging impact of the 1985’s oil price slumping, currently large number of the oil industry practitioners are at the age of about 50~60. In the next 5 years, there will be a big amount of people retiring, The departure of these retirees will play a big role in promoting the employment situation of the oil industry.

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GEOLOGICALINVESTIGATIONS TO DETERMINE THE GEOLOGIC SETTING FOR CONSTRUCTING SPORTS FACILITIES OF WINTER UNIVERSIADE 2019

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I had never thought before I entered Siberian Federal University that geology and mining would be my future. Soon it is going to come true because in 3 months I will graduate from School of Mining, Geology and Geotechnology, SFU.

Moreover, I could not imagine that my degree project would be related to the construction of Universiade 2019 sports facilities.

The subject of my graduation research is “Engineering and geological conditions of the area Nikolaevskaya sopka (fig.1) and design of engineering and geological survey for construction of technical boxes”, the special part is “Comparison of mechanical properties of the subsoilas a result of the field and laboratory studies”. In simple phrase, my degree paper is about construction. I scheduled surveying and other mining operations to determine conditions of the construction. That is, the main purpose of my research is to find out how strong the subsoil is for the construction of particularbuildings.

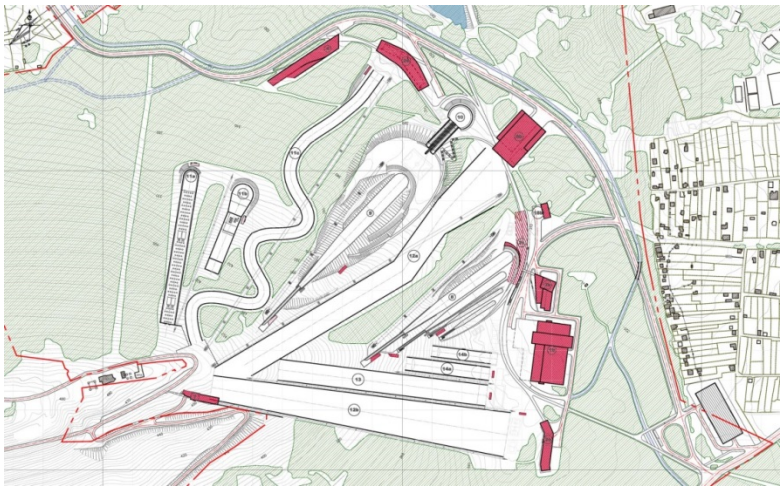

Fig.1. Cluster ‘Sopka’

I specialize in exploration and prospecting of groundwater and geotechnical investigation which deals with geological sciences to provide sustainable engineering solutions. These include resource exploitation and management, environmental and geotechnical design involving rock, soil and water interaction, groundwater protection and remediation, risk mitigation, and the non-destructive or geophysical investigation of the subsurface environment for engineering purposes.

Geotechnical investigations are performed to evaluate those geologic, seismologic, and soils conditions that affect the safety, cost effectiveness, design, and execution of a proposed engineering project. Insufficient geotechnical investigations, faulty interpretation of results, or failure to portray may contribute to inappropriate designs, delays in construction schedules, costly construction modifications, use of substandard borrow material, environmental damage to the site, post construction remedial work, and even failure of a structure and subsequent litigation. Investigations performed to determine the geologic setting of the project include: the geologic, seismologic, and soil conditions that influence selection

of the project site; the characteristics of the foundation soils and rocks; geotechnical conditions which influence project safety, design, and construction; critical geomorphic processes; and sources of construction materials (fig.2).

Fig.2.Investigations are performed to determine the geologic setting of the project

Geologic conditions at a site are a major influence on the environmental impact and impact mitigation design, and therefore a primary portion of geotechnical investigations is to observe and report potential conditions relating to environmental impact. Factors influencing the selection of methods of investigation include:

- nature of subsurface materials and groundwater conditions;
- size of structure to be built or investigated;
- feasibility study, plans and specifications;
- evaluate stability of existing structure, design a new structure;
- complexity of site and structure;
- topographic constraints;
- difficulty of application;
- degree to which method disturbs the samples or surrounding grounds;
- budget constraints;
- time constraints;
- environment requirements/consequences.

In the site of athletic-training complex ‘Academy of Winter Sports’, it is planned to constructmany sports, including complex ‘Snow’ and ‘Freestyle’ and technical boxes to store machinery and equipment for the ski slopes.

I believe that my research will contribute to the construction of sports and training complex for Youth Winter Sports Universiade and the development of youth sports in Krasnoyarsk in general.I really hope that I get a good review for my graduation paper, because it is important for my future career in mining.

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