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ЭЛЕКТРОННЫЙ СБОРНИК МАТЕРИАЛОВ МЕЖДУНАРОДНОЙ КОНФЕРЕНЦИИ СТУДЕНТОВ, АСПИРАНТОВ И МОЛОДЫХ УЧЕНЫХ **«ПРОСПЕКТ СВОБОДНЫЙ-2015»**, ПОСВЯЩЕННОЙ 70-ЛЕТИЮ ВЕЛИКОЙ ПОБЕДЫ

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THE EARTHDAY DURATION AS AN IMPORTANT FACTOR OF GEOPHYSICAL INVESTIGATION

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In astronomy, geodesy and geophysics the Earth's rotation is the indispensable basis for the introduction of different coordinate systems. That's why carrying out a full field prospecting for minerals is impossible without detailed examination of all various aspects of the Earth's characteristics and in particular the study of Earth's day length.

During the entire history of mankind, and long before its existence, the Earth's time directly manifested itself as a change of day and night. The Earth's rotation around its axis is used by man for centuries to measure time. Sunset and sunrise seem to be so much ordinary, commonplace and constant things that most of us cannot think of even the idea that this process may be multi-faceted and include many subtle details.

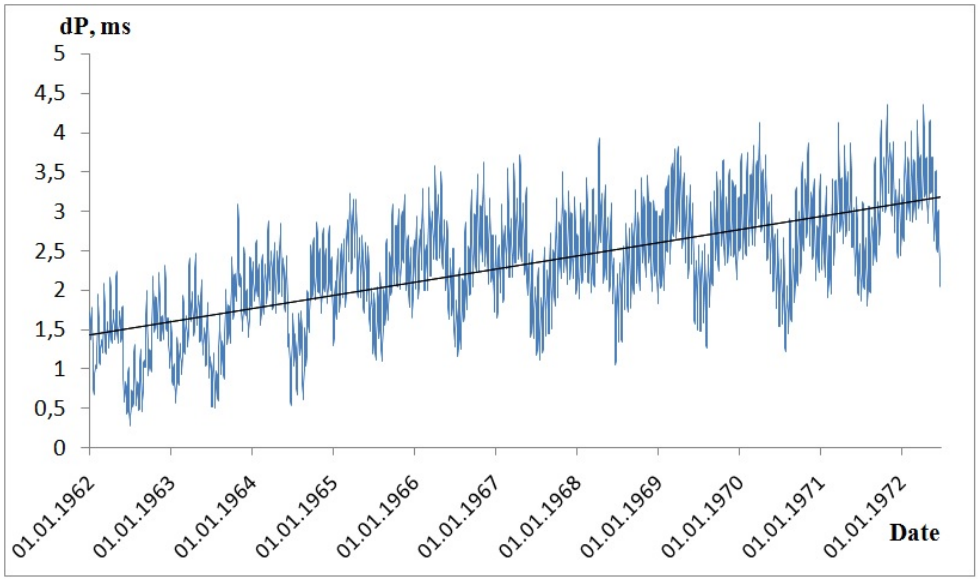
A day is nothing more than a unit of time, approximately equal to the period of revolution of the Earth around its axis. A day in astronomy is a period of time between the two upper culminations of the sun. The duration of the day on the planet depends on the angular velocity of its own rotation. But the length of the day is not something constant, as it may seem at the first glance. Its duration is constantly changing, and it is influenced by a number of factors: the Earth rotation speed changes, geographic poles are in a constant movement, the location of rotation axis varies in space. These instabilities cause much trouble to astronomers, surveyors and geophysicists because they distort the coordinates of celestial and terrestrial objects.

Unevenness of the Earth's rotation and polar motion are the results of processes occurring on our planet, and depend on the characteristics of the structure and physical properties of the Earth's interior. As a reflection of Earth processes, unstable rotation of the Earth contain valuable information about these processes issued by nature. In such a way, the study of non-uniformity of the planet's rotation, polar motion and nutation of the Earth's axis has the big practical and scientific importance. It allows to correct the distorted coordinates of celestial and terrestrial objects, helps broaden and deepen our knowledge in various fields of Earth Sciences.

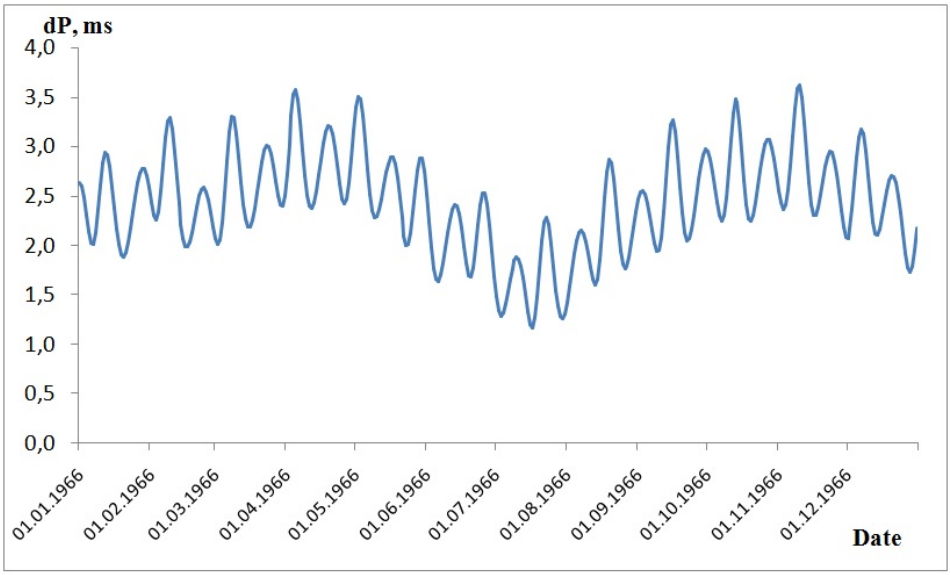
The speed of the Earth's rotation can be described most simply by deviation of a day length from the reference (86 400 seconds). The shorter the terrestrial day, the faster the Earth rotates. Because of the ellipticity of the Earth's orbit linear speed and angular speed of rotation of the Earth around the Sun varies throughout the year. The speed is the slowest when the Earth moves in its orbit at the point of aphelion(the most remote point of the orbit from the Sun), the speed is the highest at the point of perihelion. The Earth's tilt causes the movement of the Sun along the celestial sphere up and down the equator during the year. Besides all this, due to the attraction of the moon, the visible manifestation of which are ocean tides, rotation of the Earth gradually decreases. The speed of rotation can also be influenced by other celestial bodies, and even by the Earth's own terrestrial processes. For a century, the Earth's day length increased by about 2 milliseconds. For example, in the Jurassic period, the length of a day was only 23 hours. Changing the length of the day in the course of geological time has been verified experimentally through ring counting lines in fossil corals. Corals lay calcium carbonate in the form of rings on its outer skeleton; cyclical deposition of rings is connected both with natural daylight and with a periodicity of seasonal changes.

Taking into consideration the significance of the different aspects of science irregularities in the rotation of the earth, in this work, we decided to explore this process in

detail. We have taken the astronomical data on changes in the duration of Earth days dP for 10 years, from 1962 to 1972. This interval has been chosen because of its particular bright values. In this work we try to understand whether the variations dP for 10 years are periodic, and to find their relation to global factors, consequences of which they may be.



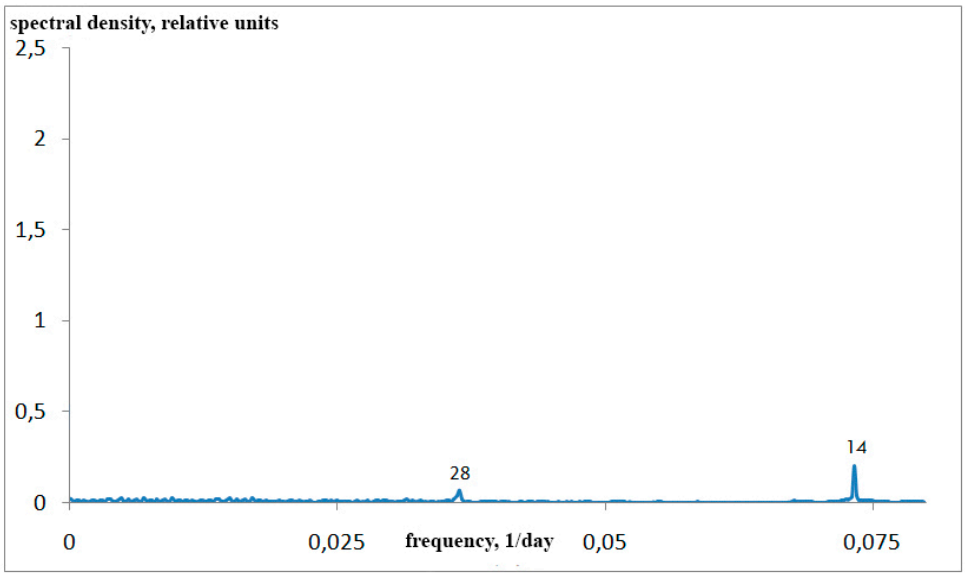
This graph shows the dependence of day length change dP for 10 years. As it can be seen, the trend line clearly shows an overall increase of dP with time, for this period of Earth's day has increased by about 1.5 ms. Also it's easy to spot a regular semi-annual ups and downs of dP, but on this graph it is impossible to examine them in more detail, so another graph has been built, where one year is highlighted separately.



On the second graph the year 1966 was selected individually and, as we expected, semi-annual basis is clearly visible, the maximum peaks of which occur in May and November, and it lowers in July and January. But all the data is indicated only visually, so we need a deeper and more complex calculation.

We reviewed spectral composition of changes in dP in the years 1962.0-1972.6 by calculating the spectrum and built its schedule. Indeed the graph of spectrum showed the pres-

ence of harmonics in the decadal variations, in particular, we clearly saw two major peaks of the spectral density function and their periods, the rate of their frequency, which corresponds to the annual and semiannual laws.



As a result this work has shown that the rate of rotation of the Earth, and hence the length of an earthday may depend on periodic factors, and therefore can be calculated. It can greatly assist the performance of surveying tasks, and thus indirectly influence the development of hydrocarbon deposits.

The most probable cause of periodic changes in the velocity is the seasonal redistribution of air and water masses on the surface of the Earth. The relationship of the mass movement with a duration of Earth's day may be correlated, but this is a subject for another investigation. Unevenness of the Earth's rotation which we have also seen in the graph of the spectrum appears presumably in the differences of observed positions of the heavenly bodies surrounding the planet.

The examining of the phenomenon of the irregular Earth rotation really allows to solve more accurately the geophysical and astronomical problems, as well as assist in the development of hydrocarbon deposits.

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УДК 542.06

SORPTION EXTRACTION OF PAH FROM SOLUTIONS OF GAS PURIFICATION IN ALUMINIUM PRODUCTION

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Aluminium production.

Aluminium reception also supplies with lots of emissions on the different production stages.

Emissions of Polycyclic Aromatic Hydrocarbons (PAH) from prebake anode production are closely monitored. The PAH concentrations downstream the gas treatment facility are normally in the ultra-trace range.

PAH are released when heating coke pitch in numerous industrial processes.

Table 1.

<table>
<tr><th>stage</th><th>Emissions</th><th>Chemistry process</th></tr>
<tr><td>Creation of alumina from aluminium ores</td><td>Red or nepheline slime</td><td>$AlOOH+NaOH \rightarrow NaAlO_2 + H_2O$
$Al(OH)_3 + NaOH \rightarrow NaAlO_2 + 2H_2O$
$SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$
$Na_2O \circ Al_2O_3 + 4H_2O \rightarrow Al(OH)_3 + 2NaOH$</td></tr>
<tr><td>Creation of aluminum from alumina</td><td>Oxide of carbon (CO) or carbon dioxide (CO2). Release of fluorine, SO2, C2F6, CF4, PFU, aluminum alum, aluminum hydroxide, aluminum acetate</td><td>$Al_2O_3 \leftrightarrow Al^{+3} + AlO_3^{-3}$ $Na_3AlF_6 \leftrightarrow 3Na^{+} + AlF_6^{-3}$
<table>
<tr><th>Electrode</th><th>Category potential</th><th>Priming reaction</th></tr>
<tr><td>cathode</td><td>+2,71
+1,66</td><td>Na^{+}
$Al^{+3} + 3\bar{e} = Al$</td></tr>
<tr><td>anode</td><td>More than 0,5
-0,47</td><td>AlF_6^{-3}
$2AlO_3^{-3} - 6\bar{e} = Al_2O_3 + 1.5O_2$</td></tr>
</table></td></tr>
<tr><td>Aluminum refinement process</td><td>SiO_2</td><td>$\{Al + Mg + Ca\} \rightarrow \{MgCl_2 + CaCl_2 + AlCl_3\} + Al$</td></tr>
<tr><td>Receiving alloys and products from aluminum</td><td>SiO_2, Fe_2O_3 , HF, NO_2, CO, CO_2</td><td>Electro[2]</td></tr>
</table>

In our work release of PAH which are emitted when roasting anodes when receiving Aluminium on Soderbergh's method was investigated.

Results of Monitoring

uG/m3	After ahex-1	After ahex-2	Before ahex
Acenaphtlene	0.71	0.73	8.79
Acenaphtylene	<0.2	<0.2	11.2
Benz[a]antracene	<0.2	<0.2	4.85
Benzo[b/j/k]fluoranthene	0.37	0.62	
Benzo[ghi]perylene	<0.2	<0.2	<0.2
Benzo[a]pyrene	3.12	6.05	10
Chrysene	<0.2	<0.2	15
Dibenz[a,h]antrhracene	<0.2	<0.2	0.34
Fluoranthene	1.14	1.18	98.1
Fluorene	<0.2	<0.2	5.5
Indeno[1,2,3-cd]pyrene	<0.2	<0.2	0.22
Naphthalene	19.6	22.09	84.3
Antrhracene/Phenanthrene	15.6	18.9	
Pyrene	6.71	7.84	59.4

Harmful effects of PAH on a human body

There are several reported health hazards related to the different PAH components. Such as respiratory effects and decreased fertility. In addition, they are classified as Group B2 carcinogenic substances according to EPA.

What means EPA?

The **United States Environmental Protection Agency** (**EPA** or sometimes **USEPA**) is an agency of the U.S. federal government which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress. The EPA was proposed by the President Richard Nixon and began operation on December 2, 1970, after Nixon signed an executive order.

The agency is led by its Administrator, who is appointed by the president and approved by Congress. The current administrator is Gina McCarthy.

Real conditions of continuous monitoring of emissions of PAH.

The emissions of PAH components are strictly regulated by national governments, as well as international rules. Control on the emissions as well as process tuning to reduce the emissions is therefore essential. In order to analyze the entire range of PAH components multiple technologies will have to be applied. A potential procedure is to split a side stream from the off gas, in fractions suitable for the different analysis technologies, capture them and finally analyze them.

Methods of analyze.

Nowadays were found several methods of PAH emissions analyze, they are:

- Fourier Transformed Infra Red Spectroscopy (FTIR)
- Gas Chromatography(GC)
- Mass Spectrometry(MS)
- Liquid Chromatography(LC)

FTIR is based on adsorption or emission of light waves in the infrared spectra, and is a well-known technology. Different molecules will adsorb the IR radiation at different wave

lengths and to different extent. This gives accurate and reproducible analysis, and is compact and robust enough to easily be transformed into the field.

GC/MS is a powerful method to analyze gas samples. The gas is first passed through a traditional GC column wich is a long thin column packed with a substrate that interacts differently with different gas components.

In GC analysis the components are separated by the time they use to emerge from the column. Several detectors are available for GC analysis of which Thermal Conductivity (TC) perhaps being the most common. In a GC/MS a mass spectrometer (MS) is used as a detector. In a MS, the gas are passed through an electron beam, which ionizes the components in the gas. The molecules are then passed through a vitiating electric field and the weight of the molecules can be determined based on how much their path is bent when passing through the field.

Experiment Methodology

The question of a choice of the most qualitative adsorbent for catching of PAH in systems of gas purification still is actual. Experiments with MN200 adsorbent use were made.

For performance of experience on a support fixed a flask of a cylindrical form with an additional opening from below, from above established a funnel with the filter on which MN200 is filled. Attached a silicone tube through which, by means of the pump, technological solution of gas purification passes to a funnel to the lower opening of a flask. By means of this installation solution is cyclically filtered through MN200 which in turn catches PAH.

It is skilled it is established that time of one cycle makes 1 minute 25 seconds. Experiments were repeated serially from 2 to 24 cycles. After each experience solution went on the analysis of a liquid chromatography. The main objective of experience was establishment of quantity of cycles which would allow to adsorb as much as possible PAU from gas purification solution.

Range of PAH.

Acenaphthene
Acenaphtylene
Anthracene
Benz[a]antracene
Benzo[b]fluranthene
Benzo[k]fluranthene
Benzo[ghi]perylene
Benzo[a]pyrene
Chrysene
Dibenz[a,h]antrahracene
Fluoranthene
Fluorene
Indeno[1,2,3-cd]pyrene
Naphthalene
Phenanthrene
Pyrene

УДК 622.362.3

TECHNOLOGY TO EXTEND THE MINING SEASON WINTER

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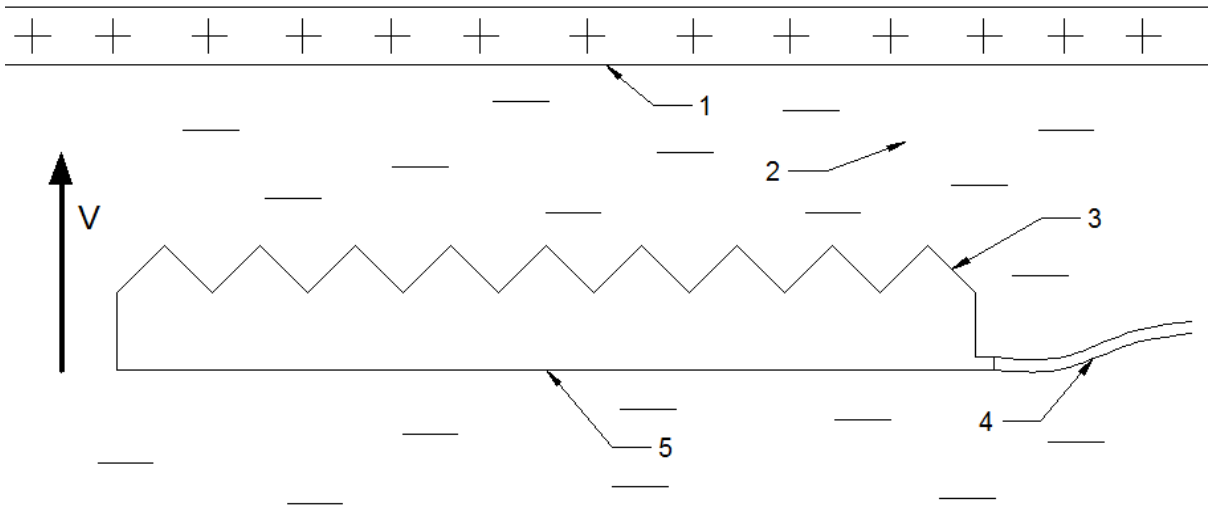
Most watered mineral deposits is excavate only in the summer time, because of the difficulty of excavation in winter time. Ice - the main obstacle is the extension of the mining season. There are many ways of breaking the ice, and they all have their advantages and disadvantages. The main disadvantage is the high energy costs. Therefore, we need solutions that reduce these disadvantages to a minimum.

This way of making a hole in the ice, based on immersion in water of a parallelepiped with a pointed tooth on the top, for easy breaking the ice.

Then, my device rises under a layer of ice, so that the ice breaks.

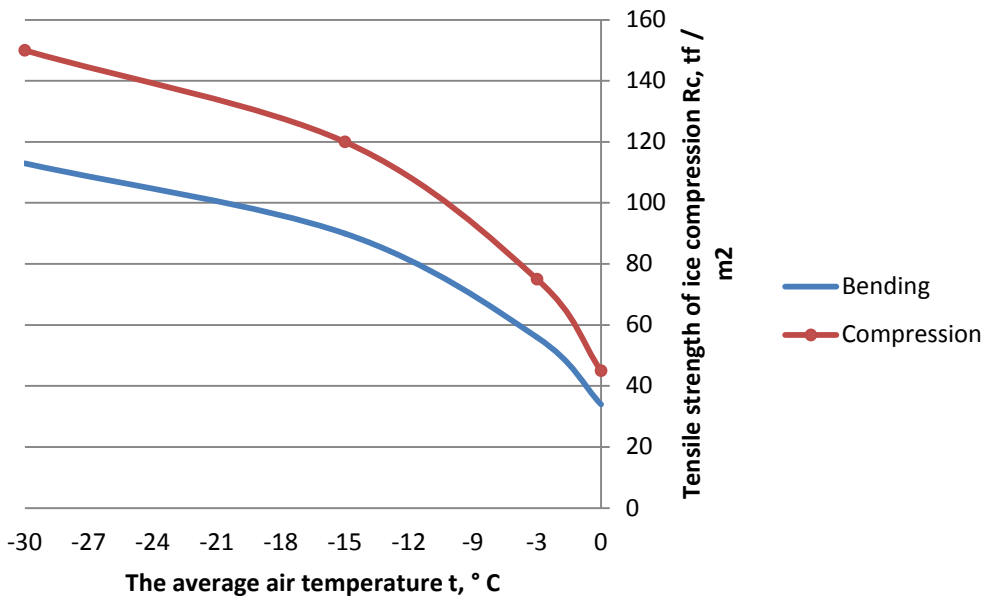
Immersion and rises happen with help pumping in and pumping out air in the device.



Pic. 1. Device for making a hole in the ice
V – the direction of movement when pumping air; 1 –ice; 2 – water; 3 – sharpening;4 – air hose; 5 – Device for making a hole in the ice.

For confirm this ice breaking methods, we must determine the strength of the ice on the bend. Tensile strength of ice on the compressive and on the bend, should be determined from the experimental data, if this data is absence, allow to take the value of building regulations 1989

The salinity of the ice S, ‰	Tensile strength of ice compression Rc, tf / m2. The average air temperature t, ° C			
	0	-3	-15	-30
<1 (freshice)	45	75	120	150
1-2	40	65	105	135
3-6	30	50	85	105



Pic. 2. Dependence of the strength of fresh ice in bending and compression temperature

Using a tensile testing machine of the sample was determined by the compressive strength of a 50 mm thick. You can determine the strength of the ice compression thickness of 2 meters:

$$\sigma_2 = \sigma_1 * \frac{h_2 * \sqrt{h_1^3}}{h_1 * \sqrt{h_2^3}} = 3 * \frac{2 * \sqrt{0.000125}}{0.05 * \sqrt{8}} = 0{,}47\ MPa \qquad (1)$$

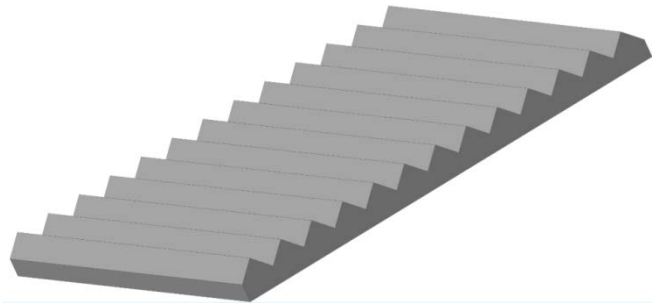
Accordingly, the strength of the ice compression:

$$R_f = 0.75 * R_c = 0.75 * 470 = 353\ \text{кПа} \qquad (2)$$

Was constructed three-dimensional model destroying element, the area taken into account for the largest possible width of stope dredger. Material - steel 10, the thickness of 3 mm.

With the program "Compass" was automatically calculate the mass of the element and the total volume:

1. The total volume - 8075 m3
2. The total weight - 175,728 kg



Pic.2. Three-dimensionalmodel.

If the calculations take g = 10 N / kg, the force of gravity acting on an element:

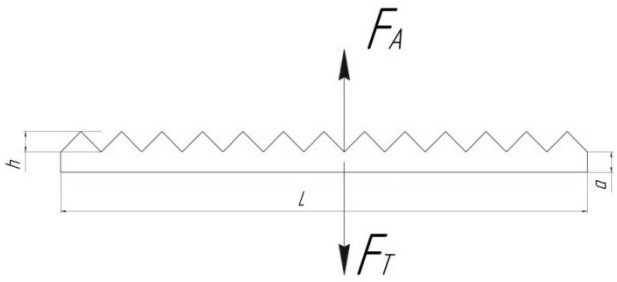
$$F_{grav} = m * g = 175728 * 10 = 1\ 757\ 280N \quad (4)$$

Buoyancyforce (Pic. 5):

$$F_A = \rho_{water} * g * V_{body} = 1000 * 10 * 8075 = 80\ 750\ 000\ \text{H} \quad (5)$$

The resultant force acting on the body, directed vertically upwards and is equal to:

$$F_{sum} = 80750000 - 1757280 = 78\ 992\ 720\ \text{H} \quad (6)$$



Pic. 3. The forces acting on the device:
h - height taper; a - the height of the working space; L - length of the device

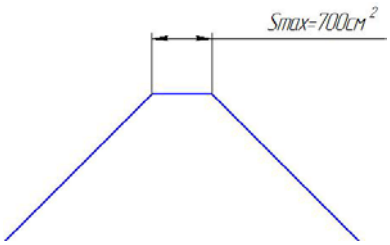
Calculate the pressure generated destructive element on ice. The area of the body is 52 * 52 = 2704 m2:

$$\text{P} = \frac{78992720}{2704} = 29213\,\frac{\text{H}}{\text{м}^2} = 29213\ \text{Па} \quad (7)$$

$$\text{P} < R_f \quad (8)$$

But this power is not enough to break the ice. For solve this problem have been created sharp teeth on the workpiece surface, which reduce the contact area with ice, thereby increasing the burden on him. The smaller the load, the more pressure is created on the body. For break the ice, it is sufficient to calculate the maximum allowable contact area of 1 m2 of ice, it is equal to 700 cm2.

$$S_{max} = \frac{27213}{353000} = 0{,}07\ m^3 \quad (9)$$



Pic.4. The minimum possible sharpening of the working body

A result of research was determined the bending strength of the ice, it was determined that the ice is not enough to destroy one buoyancy forces necessary adaptations increasing load on ice. The device can be stored under the ice for a long time without fear of failure. Thus, the device for making ice-holes may be used on flooded mineral deposits in winter with least energy cost, which is advantageous in the long term.

УДК 553.04

HELIUM RESOURCES OF EAST SIBERIAN GAS FIELDS: PROSPECTS OF DEVELOPMENT

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Nowadays, natural gas is considered as one of primary energy sources. It mainly (70–98%) consists of methane and its heavier homologues. But, instead of them, there are some non-hydrocarbonaceous substances such as hydrogen, hydrogen sulfide, nitrogen, carbon dioxide, helium. Despite the potential prospects of associated recourses application they are burned along with fuel hydrocarbonaceous products.

Natural gas is currently the only one source of helium industrial production. This gas is widely spread all over the world, however, there is no helium in a free form in the subsoil and its production by air separation plants is ineffective and unprofitable because of the low helium content in atmosphere (only 0,00052%).

Global helium demand grows every year parallel to modern innovative technologies development. This connection caused by unique properties of the resource and wide range of spheres where it is involved. Its indispensability in high-technological, science-intensive industries (electronics, semiconductor industry, fiber optics, cryogenics, medical tomography) determines the list of main consumers. Primarily, this list includes Asia-Pacific countries: Japan, China, South Korea, Taiwan, Singapore. For example, high-speed magnetic levitation trains (or simply maglevs), which use helium superconductivity, are commissioned in China (32-kilometre branch line linking the city with Pudong International Airport). The usage of “cold”(0,1–10 K) and “warm” (273–6000 K) helium in reactor cooling systems increases the safety in atomic energetics which is uncontested and vitally important energy source in Japan and Korea and gradually displacing environmentally unfriendly coal raw-stuff. Generally, helium industrial consumption in Asia-Pacific region annually rises 6–7% in average, sometimes jumping to 9–10% [5].

At the same time, a small number of countries possess resources of such a valuable fossil. Decreasing trend is observed in many traditional producing countries, for example, in Poland (from 0,8 to 0,3 billion cubic meters) and the Netherlands (from 0,7 to 0,6 billion cubic meters). According to report introduced by OAO Scientific Production Association *“Geliymash”* on Siberian Energetics Congress (Novosibirsk, 2005), total amount of helium was estimated at 27,8 billion cubic meters; the biggest resource bases were located in Russia (9,1 billion cubic meters), the USA (8,9 billion cubic meters), Algeria (3,0 billion cubic meters) and Qatar (2,0 billion cubic meters) [4]. Future prospects of their production potential are represented in table 1.

Table 1 [1,4].

Country	Counted resources in 2005, billion m^3	Counted resources in 2009, billion m^3	Production forecast, 2020, million m^3	Production forecast, 2030, million m^3
Russia	9,1	16,2	35–75	90–150
USA*	8,9	8,5	57–91	44–78
Algeria	3,0	8,4	33	33
Qatar	2,0	10	14–29	14–35

* *With reserves of Cliffside Field helium storage reservoir.*

The USA have lost their first position in the beginning of XXI century while still being one of the greatest helium consumers in amounts close to volumes of extraction. In the short term, the United States do not plan a development of helium industry, besides, a reduction of reserves by their intensive sale is presumed. Due to this fact, Qatar, Algeria and, the most, the Russian Federation have opportunities to occupy this almost empty economic niche.

Initial resources of the main helium fields in Russia total approximately 9403 million cubic meters. At the moment, amounts of production along with the loss of this gas are evaluated as 673 million cubic meters. The majority of deposits is located in gas-petroliferous basins of the Siberian Craton: about 4590 million cubic meters (more than 50%) in the Siberian Federal District, mostly in Krasnoyarsk Krai and Irkutsk Oblast, and 3169 million cubic meters (nearly 35%) in the Far Eastern Federal District – in the Sakha (Yakutia) Republic. The Volga Federal District (primarily, Orenburg Oblast) as well as the Southern Federal District (mainly Astrakhan Oblast) has 7% of all-Russian reserves. Among explored gas fields, 176 facilities can be considered as helium sources. It is worth noting that amounts of helium in the above-mentioned regions are not declining because of continuing geologic exploration (probable and possible resources are estimated as 34 billion cubic meters). Moreover, in contrast to North American fields of the Mid-Continent, which are significantly depleted, the development of most Russian, especially East Siberian, fields has not actually begun and their industrial reserves are still increasing [1].

Advantageous geographic location of the resource base near its main consumers – Asia-Pacific countries – is also an important factor of becoming an exporting country. Russia has already supplied Japan with liquefied helium in annual amounts of 500 tons since 2006. Also a consignment of this non-hydrocarbon substance was sent to a South Korean company *Samsung Electronics* on a trial basis in 2014.

At the same time, the Russian Federation gets an opportunity to assume the role of not only the leading helium producer but also a one of its greatest consumer. Helium resources would be actively used in exploitation of the *Vostochny* Spaceport which is being constructed in 180 km from Blagoveshchensk, the end point of the *Power of Siberia* first section. Moreover, they are used in construction of the pipeline itself as a helium and helium-argon medium for welding and cutting of metal details. To continue the topic of oil and gas industry, the prognostic growing demand for helium on Sakhalin should be mentioned. This fact is connected with expansion of the offshore works. Helium-oxygen breathing gas is three times lighter than air and increases possible diving depth from 50 m to 200–300 m, i.e. to a level of the continental shelf. An advanced regional trunk pipeline system facilitates the supply of this works with required resources [5]. However, petroleum engineering and industry is not the only consumer of helium. An availability of own reserves will be able to stimulate experimental design and scientific researches, if these resources are sold to Russian research institutes cheaper than market price.

In spite of the above-mentioned prospects, nowadays helium is commercially extracted only at the Orenburg Gas Processing Plant, but also it is planned to build Boguchany and Amur Gas Processing Plants for these purposes. Unless protective actions are taken, annual losses of this resource will be near the volumes of its production since East Siberia – Pacific Ocean pipeline system is commissioned. The protection of helium reserves is required on a governmental level. Helium should be included in the list of strategic resources of Russia and its production and selling should be regulated by a special law. An experience of the USA, where similar program was being successfully implemented in 1925–1996, can be used as a basis.

For now, the only one way to save quality helium deposits and not to slow down natural gas production is their extraction in amounts exceeding demand and injection of the

surpluses into underground storage reservoirs as a helium crude (nitrogen-helium concentrate). There are three possible variant of storages: exploitation of small depleted gas fields, return of helium concentrate to one of the layers of developed field, disposition in salt caverns. OOO "*Podzemgazstroy*" has considered prospects of the third variant and specified the following geographic locations: p. Balagansk and p. Tyret (Irkutsk Oblast), p. Boguchany (Krasnoyarsk Oblast) and the region of Chayadinskoe gas field [2].

Another important aspect of helium industry development is gas transportation. The only industrial helium pipeline system in the world links Cliffside Field helium storage reservoir (USA) with Mid-Continent oil and gas fields. At present times, it is beneficial to use this type of pipeline just in field development. Nevertheless, this type of pipeline is considered to become a more effective alternative to auto transport of liquefied gas in tanks, which is commonly used now, so there is a possible prospect of trunk helium pipelines construction several decades later, as the resource demand grows rapidly. Particularly, the delivery of 20 tons of cargo by auto roads from Kovykta gas condensate field to Vladivostok (approximately 4000 km) can be evaluated as nearly 250–270 thousand rubles, container turnover equals to 160000 tonne-kilometres. The continuous supply of helium by a pipeline would cost less as well as exclude a number of technologic and organizational operations such as registration of vehicle entry and exit to the protected area, connection and disconnection of flexible metal hoses, package and product quality control, package security check [3].

In addition, helium pipeline transport is environmentally friendly and has nearly zero accident rate. Inert and non-explosive properties of helium determine the possibility of constructing pipelines practically ubiquitously: in protected areas, railway zones of alienation, riverbeds, along with fiber optic lines, parallel to hydrocarbonaceous trunk pipelines. At the same time, careful monitoring is required because helium easily volatilizes and the slightest defect can cause heavy losses.

Thus, helium is one of the most prospective natural resources and is demanded more intensive year in year out because of its usage in innovative technologies. Russia, while possessing the greatest reserves of helium, can fulfill its potential on a global scale as well as in own resource-efficient projects. That is why, in the short term, Russian Fuel and Energy Complex needs to solve legislative, technological and transport-infrastructure problems.

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УКД 67.08

THE PROBLEM OF FORMATION, RECYCLING AND UTILIZATION OF OIL SLOPS

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The essential problem of crude oil refining productions is oil slops formation, recycling, and utilization. Particularly the Paiginsk oil and gas deposit attracts practical interest of refining slop products process on oil-refining smelter Taymura.

Taymura is the smelter that makes products of processing oil and specializes on the production of paraffin oil, residual oil and etc. The smelter is based on chemical,oil and gas processes and pollutes environment with gas, solid and liquid wastes.

Initial products enter to the oil-refining smelter Taymura from wellsite in crude oil pipeline. There are a lot of slops on the territory of the smelter containing oil, water and solid phase, accumulating in settling pond and reaching critical rate. The problem of effective oil slops utilization is an important ecological and resource saving issue under the modern condition licensing and land uptake.

The difficulty of the situation is connected with the contradiction between growing range of industrial production and imperfect technology.

The aim of the research is to develop refining technology for recycling raw or accumulated oil slops.

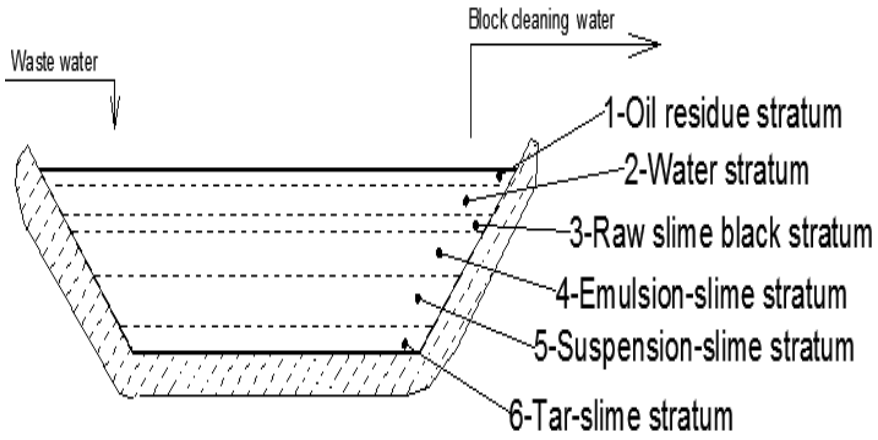
Plan:

1 To learn phases of oil slops formation

2 To analyze modern utilization and recycling technologies

3 To choose and prove technological arrangement of oil slops utilization for Taymura smelter

Practically, during longtime keeping in containers, slops decompose on several stratums with peculiar characteristics. On the picture 1 oil slops stratums are performed.



Picture 1. Oil slops stratums

For example, oil residue stratum is the first in slop and should be returned into technological circle for recycling, as about 97,99% of slime is clean oil product. Water stratum is technologically cleared by gravity separation: light suspended solid particles rise to the surface, weighty ones fall. Stratums from 3 to 6 are oil slops. Residue concentration grows up in extent of oil products with increase of their molecular weight (to weighty oil particles). Besides, polydisperse systems are formed in fluid of oil products while transporting and stowage.

Oil slops can be characterized by 3 phases: 2 non-miscible liquids (water and hydrocarbon phases) and solid phase (physical impurities). For research purpose, phase composition of oil slops was studied by the following methods:

1 the method attenuate-lysing

2 the method distilling- lysing

As a result we see that in the second method physical impurities are higher as flushing out of residue with toluene does not provide missing physical impurities. Practically it would be better to apply both methods.

Analyzing modern oil slops utilization technology, we can determine the most progressive ones:

Company Aristocrat AC8 (USA) has developed system of refining and clearing oil waste MTU 530. Assembly is able to separate slops to different phases (oil, water, solid matter) at the expense whizzing heating slop. Assembly is used for elimination the aftermath of oil-pipe line emergency. Assembly efficiency is 10 m^3/h.

Company KHD Humboldt Wedag AG (Germany) suggests technology for separation slops to phases with following burning of slimes. Assembly efficiency is 10 m^3/h. Practically the method is impossible to use for recycling wastes if it contains phosphorus, halogens, sulfur. In this case there can be formed reaction products with toxicity level in excess of standards.

However these slops utilization technologies are not suitable for recycling large extent of slops, that accumulating on oil-refining smelter. It is required such technology that would allow recycling mighty extent of oil slops in short time. It must be sustainable and commercial viable.

Special interest is paid to complex assembly, developed by Alfa Laval Oil Field, Ltd (Great Brittan) that allows recycling all types of slimes to valuable products. *(Blocks, advantages and efficiency)*. Currently more perspective recycling slimes assembly is used for separation compound to oil product, water and solid residue, purposely following utilization weather water or solid phase.

Considering phase compound of oil slops, we suggest effective recycling technology for the smelter Taymura using assembly by Alfa Laval Oil Field, Ltd. The assembly kit contains: sample catcher, heat interchangers, raw containers and separator.

Technological process of slime recycling with suggested assembly is effective in a certain way. From the sample catcher a slop is moved to raw container with intake, where getting ready before moving to separator. Firstly, a container is filled to the top level (7,35m), than passes on extra container and the filled container enters the system of raw preparing. Than pump brings into operation and raw moves to heat interchanger, though filter and returns to washing out arrangement. In such way the steady circle works: container → pump → heat interchanger → container. Via control the heat interchangers slime temperature attains 65 ^oC. Under attainment necessary temperature and homogeneity, slop moves to separator.

The assembly works 24-hour operation and about 7000 hours a year recycling 70 000 m^3 oil slops at supply of raw with nominal characteristics.

The correct assembly exploitation provides getting following recycling products: oil phase (where water substance is no more than 1 % and physical impurities are no more than 0,05 %), cleaned water, slime, that is used as element of pavement surfacing.

As a result, considering assembly's advantages and particular qualities, the technology solves the following problems of oil-refining smelter Taymura:

- clearing containers
- excluding growth and accumulating of oil slimes and bottom residues
- liquidating oil slops
- liquidating oil slops vaporization to environment
- preventing pollution of ground water

That is why the technology is effective in ecological and economical way.

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УДК 544.722.132

HYDROPHOBICITY. MECHANISM OF HYDROPHOBICITY AND WAYS OF APPLICATIONS

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Introduction

Accumulation of ice on various surfaces causes many problems in today's life. In many cases, it causes disastrous events such as crash of aircrafts and electric grid damages and so on. Researchers have focused on hydrophobic surfaces that can prevent ice formation. But not only freezed water can make problems. Since long time scientists have tried to find a way to create a waterproof and self-cleaning materials for various applications.

I would like to give an overview of the basics of Physical Chemistry to substantiate the importance of developing this discovery in modern life.

1. Mechanism of hydrophobicity

It's well known that one of the main properties of materials is hydrophobicity. Two centuries ago the English physicist Thomas Young observed and described the forces acting on the equilibrium liquid drop[1]. He found that there is contact angle θ between the liquid meniscus and the surface is defined as the ratio:

$$\cos\theta = \frac{\sigma_{sv} - \sigma_{sl}}{\sigma_{lv}},$$

where σ_{sv}, σ_{sl} are the specific surface energies of systems solid/vapor and solid/liquid, σ_{lv} is liquid surface tension.

In Figure 1 the drop shape is shown:

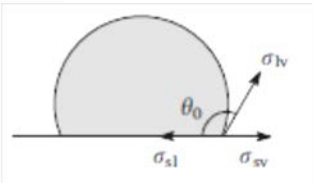

Figure 1. The equilibrium liquid drop

The analysis of the relationship showed that hydrophobicity can be observed at low value of σ_{sv}, so the contact angle θ increases that leads to the hydrophobicity.

By lowering of this value, the contact angle increases. To achieve this it is necessary to provide the surface roughness. As an example, we need to consider a rough surface immersed in water. As you know, many systems tend to decrease in Gibbs energy for enhanced stability. The change free energy of system ΔG that consists of a surface with little trough is described by the following equation

$$\Delta G = \sigma_{sv} S_2 + \sigma_{lv} S_1 - \sigma_{sl} S_2 + \Delta\rho g H V = (S_2 \cos\theta + S_1)\sigma_{lv} + \Delta\rho g H V,$$

where S_2 is the area of surface trough, S_1 is the area of system liquid/gas, $\Delta\rho$ is system density change, g is acceleration of gravity, H and V are drop's immersion depth and immersion volume. The last part of the equation and σ_{lv} are very small, they can be ignored and then we got the ratio:

$$\frac{S_2}{S_1} > -\frac{1}{\cos\theta},$$

It means that S_2 should be more than S_1 to increase contact angle. To solve this problem we need to construct the surface with small troughs to create it much more hydrophobic. The Figure 2 shows the scheme of non-wetting in a separate trough rough surface

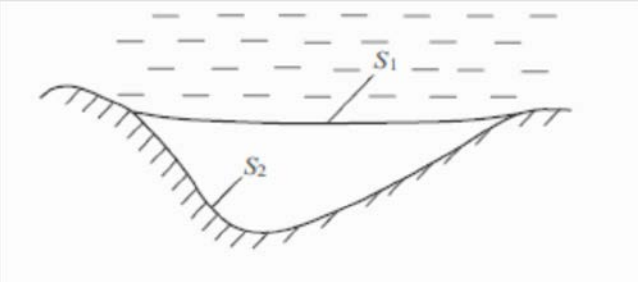

Figure 2. The scheme of non-wetting on the rough surface

The basic roughness equation is:

$$r = \frac{(a+b)^2 + 4ac}{(a+b)^2}$$

It is possible to vary the surface roughness and the contact angle by changing the height of the elements of texture.

We know an example of it in Nature. This is Lotus effect. A plant leaf surfaces, such as those of the famous Lotus plant, have a built-in elementary cleaning mechanism. Water drips on these surfaces and takes powder-like contaminants away. Dubbing it the Lotus effect, we are able to construct hydrophobic surface and then to use it as waterproof coats, roof tiles and others.

2. Ways of applications

As mentioned above, we are able to use these surfaces in a variety of applications.

The researchers have created a special hydrophobic filter of polytetrafluoroethylene [2], which can prevent water and simultaneously pass the oil. In Figure 3a the shape of a water droplet on the prepared film is shown. The contact angle there is about 156°. This film is super-hydrophobic with the rough structure on the surface. Figure 3b shows behavior of a diesel oil droplet on the film. Oil spreads quickly through the film only 240 ms.

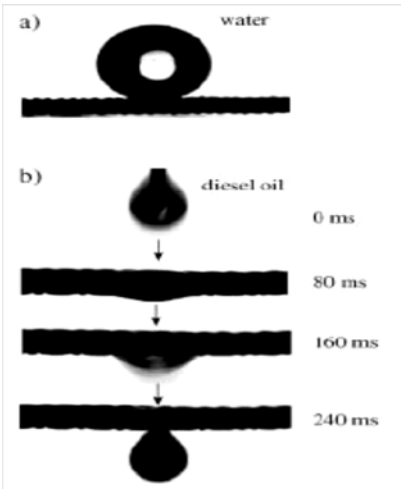

Figure 3. The operation scheme of liquid-oil separating filter

Figure 4 shows two plates. One side of an Al plate is coated with the Acrylic Polymer Resin made with 50nm particles and left the other side untreated. The plate was left outdoors in winter before freezing rain occurred. Figure 4a and 4b shows the two sides of the Al plate after the freezing rain: the side with the superhydrophobic composite has little ice, while the untreated side is completely covered with ice. Similar results were also obtained on satellite dish antenna (Figure 4c and 4d), where one-half of the dish was coated with the superhydrophobic composite and had no ice, but the other half was untreated and was completely covered with ice after the freezing rain. These results suggest significant application potential of the superhydrophobic nanoparticle-polymer composite as practical anti-icing coatings.

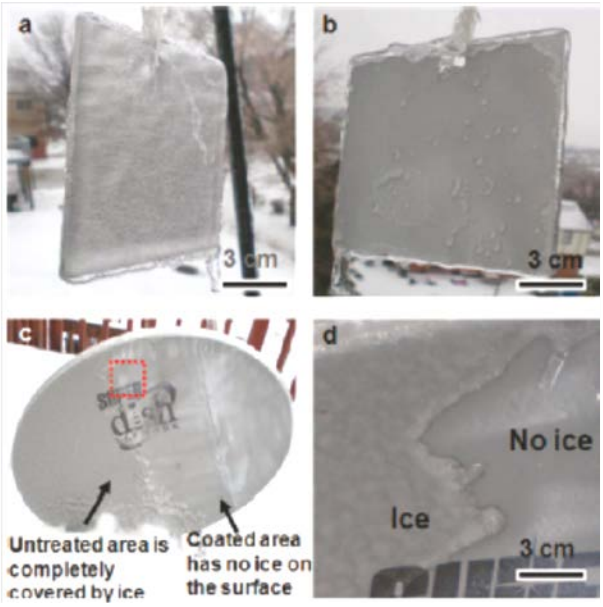

Figure 4. The anti-icing mechanism on different plates

One of the dynamic features of drops is the impact on ultraphobic surfaces. When a liquid droplet fall down onto a solid surface, it rebounds with amazing elasticity[4] that is shown in Figure 5. The way in which a water drop of radius R deforms during its impact with a highly hydrophobic solid depends mainly on its impinging velocity, V. The Weber number compares the kinetic and surface energies of the drop, where ρ and γ are the liquid density and surface tension. The greater the value of W, the larger are the deformations that occur during the impact:

$$W = \frac{\rho V^2 R}{\gamma},$$

where $\gamma = \frac{\rho R^3}{\tau^2}$, τ is drop's contact time.

When W is close to one, the maximum deformation during contact becomes significant. b, When $W \approx 4$, waves develop along the surface and structure the drop. c, When $W \approx 18$, the drop becomes highly elongated before detaching and gives rise to droplets.

During the first time, when the droplet falls onto the surface, there is drop's radius increasing, so the Weber number is growing. But during the second time the radius decreases and Weber number is also growing, because of free energy of Gibbs reduction that is achieved due to lowering surface tension.

$$\Delta G = \sigma \Delta S + S \Delta \sigma$$

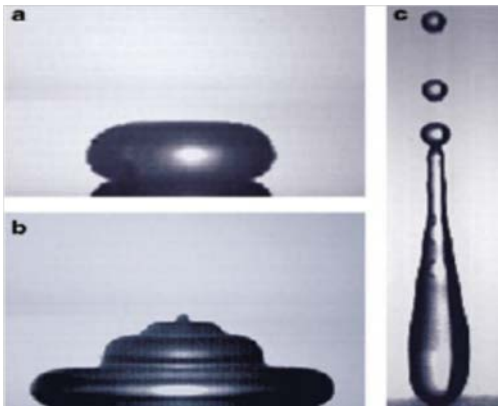

Figure 5. The mechanism of drop's rebounding on the hydrophobic surface

This behavior is certainly useful for drying and cleaning applications.

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УДК 523.68

PROBLEM OR DELUSION ABOUT METEORITES RADIOACTIVITY AND TOXICITY IN COLLECTIONS

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It's been over two years since the meteorite Chelyabinsk's fall, but meteorites continue to excite minds of many people. It’s happened at the 15th February 2013 about 9:20 AM in Chelyabinsk region. Of course, that caused a great interest among the a huge number of researchers, including our research group. This event has attracted our focus not only to the meteorite Chelyabinsk, but also to the meteorites in general. We have studied the classification of meteorites based on their composition, structure and texture and also describe our meteorites's samples from the collection.

What do you know about meteorite? What does it mean? Meteorite – a solid of natural origin, which falls on the surface of another cosmic body. Do not confuse meteorite and meteor! A phenomenon of small meteoroids' destruction in the Earth's atmosphere we call as "meteors". If a meteor is very bright, it is called a bolide.

About 94% of the all meteorites are considered to be stony. There are two kinds of stony meteorites: chondrites and achondrites. Chondrites are subdivide into three groups such as carbonaceous, ordinary and enstatite chondrites. Iron-stone meteorites are divide into palassites and mesosiderites. These ones are very rare, and their total number is roughly 1%. Iron meteorites have a complex classification according to origin and chemical composition. Basically, the total number of iron meteorites is approximately 5% [2, 3].

It is difficult to list in this article complete classification of meteorites, moreover, it is unnecessary. And now, when we know what is called “a meteorite” and what are the main types of meteorites, we can pass to the description of meteorites samples that are available in our collection. Stony meteorites: meteorite Chelyabinsk. Iron meteorites: Sikhote-Alin meteorite, Campo del Cielo, Canyon Diablo.

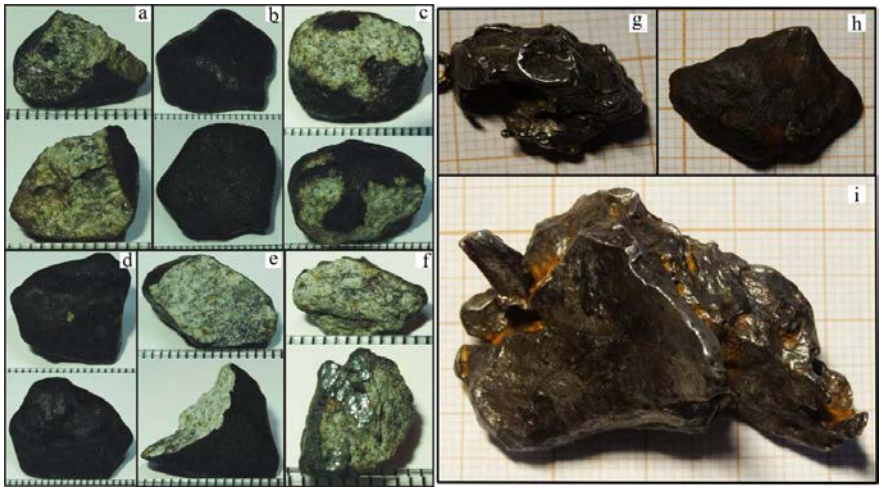

Рисунок 1. Meteorites: Chelyabinsk (a-e), Campo del Cielo (g), Canyon Diablo (h), Sikhote-Alin (i)

Meteorite Chelyabinsk

Fall date: February 15, 2013, 9:20 AM.

Coordinates: 54.955146° N 60.326614° E, Russia, Chelyabinsk Oblast.

According to the most research, Chelyabinsk's meteorite belongs to the rare class of ordinary chondrites – LL5 (S4, W0) [3, 4, 5]. Only 2% of the total registered meteorites' amount belongs to the class of ordinary chondrites. We investigated the meteorite's fragments that were oblong-rounded shaped, angular, isometric rounded and also irregular angular fragments with rounded corners (fig. 1a-e). Size of these fragments (by long axis) was ranging from 0.5 to 2.2 cm, and as for weight it may varied from 0.6 to 4.31 g. All fragments were wholly or partly covered with a black or dark-brown vitreous melting crust with an average thickness about 0.5 mm. Chondrules (which are sometimes distinguishable clearly even on an rough surface), size of 0.2-1.8 mm are usually compose from 20 to 35% of meteorites' surface. Some fragments of the meteorite slightly attracted to a magnet. Not radioactive.

The author, Lobastov B., took part in a conference in honor of the anniversary of meteorite Chelyabinsk, "Meteorite Chelyabinsk – a year on Earth" in 2014. As a part of this conference, Boris had an opportunity not to only see the biggest fragment of the meteorite, which is presented in Chelyabinsk's state museum of local lore, but also to participate in memorial monument's opening on the lake Chebarkul. At the conference the Ministry of radiation and environmental safety of Chelyabinsk's region had donated to the Institute of Mining, Geology and Geotechnologies SFU sample of Chelyabinsk's meteorite weighing 216.6 grams. You can see that piece in the geological sector of SFU's Museum.

Meteorite Sikhote-Alin

Fall date: February 12, 1947, 10:38 AM.

Coordinates: 46 9,600 N 134 39,200 E, Russia, Sikhote-Alin Mountains, Primorsky Krai.

It is an iron meteorite weighing 23 tons, which was the part of a meteor shower (by the way, the total mass of the fragments is estimated at 60-100 tons). Sikhote-Alin is one of the biggest meteorites on the Earth. In pursuance of chemical analysis, Sikhote-Alin meteorite consists of 94% iron, 5.5% nickel, 0.38% cobalt and small amounts of carbon, chlorine, phosphorus and sulfur (IIAB chemical group) [1, 2]. According to its' structure, it is relates to a very coarse octahedrite. Sample, presented in our collection (fig. 1i), has length of about 4 cm. Surface is sculpted into various kinks and had distorted a lot, i.e. covered by regmaglypts. Meteorite is colored into dark-gray, sometimes there are orange-brown rust stains. Attracted to a magnet. Not radioactive.

Sikhote-Alin meteorite had exploded in the atmosphere and had broke into pieces, so the iron rain had fell in the forest on an area of 35 square kilometers. The rain's individual parts had scattered throughout the forest in an area of an ellipse scattering with the major axi's length of 10 kilometers. At the head of the scattering ellipse, an area of about a square kilometer, now known as crater's field, was discovered 106 craters with a diameter from 1 to 28 meters, with the greatest crater's depth of 6 meters.

Meteorite Campo del Cielo

Fall date: about 4 600 years ago.

Found date: 1576.

Coordinates: 27°28 S 60°35 W, Argentina, Chaco Province and Santiago del Estero Province

Campo del Village is an iron meteorite, it weighs 44 tons. Chemical composition: 92.6% Fe, 6.68% Ni, 0.43% Co and 0.25% P; Iron IA-Og type [1, 2]. Our collection includes small

pieces (no more than 2 cm) dark gray, almost black. There are a large number of kinks (fig. 1g). Attracted to a magnet. Not radioactive.

This meteorite was discovered by the Spaniards in 1576, but this one was already known to the indigenous peoples of the area. In 1803, in the vicinity of the Campo del Cielo was accidentally discovered meteorite weighing about a ton. The largest fragment, weighing about 635 kilograms in 1813, was taken to Buenos Aires. Later this meteorite sample bought Englishman Sir Woodbine Derish and presented to the British Museum. The largest crater on the site of meteorite falling is 115 m in diameter and 2 meters deep.

Meteorite Canyon Diablo

Fall date: 20 000-40 000 or 50 000 years ago.

Found date: 1891.

Coordinates: 35°3 N 111°2 W, United States, Region Coconino County, Arizona

It is an iron meteorite, it weighs about 30 tons. Was found in the 3-4 miles from the Canyon Diablo, Arizona, USA. Chemical composition: 90.3% Fe, 7.1% Ni, 0.46% Co, 0.26% P, 1% C, 1% S [1, 2]. The meteorite belongs to the IAB-MG and is considered coarse octahedrite. This meteorite samples of 2 cm in length and weighing 4 grams. in our collection. This fragment flattened, covered with a layer of iron hydroxides with an uneven, rough surface (fig. 1h). In some places, looked through a steel-gray native iron. Attracted to a magnet. Not radioactive.

Canyon Diablo meteorite fragments are found in many museums around the world. With the fall of the meteorite are associated with the formation of the famous crater Berringer: earthen bowl with a diameter of 1,200 meters and depth of 180 meters.

Thus, the author's collection includes samples of various meteorites' types that had been getting from all over the world. We would like to fill this collection up with meteorites of different types, as well as samples of well-known meteorites, for example, Seimchan one. As a result of the study, we can conclude that meteorites are not dangerous. Meteorites contain no radioactive or toxic elements. Meteorites are the keys to understanding the internal structure of the Earth. Hopefully, these research can help awake readers' interest in getting some knowledge of our world.

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УДК 42:669

HISTORY, PRODUCTION AND USE OF PRECIOUS METALS IN THE MODERN INDUSTRY BASED ON THEIR PROPERTES.

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Gold, silver ,and six metals of the platinum group-platinum, palladium, osmium, iridium, rhodium, and ruthenium belong to precious metals.

Why are some metals so much more valuable than other. Gold , silver and platinum have been highly valued for centuries because of their scarcity, beauty and high qualities. The result of the rush for these metals was death, blood and tragedy. When Christopher Columbus discovered the Americas in 1492, Spanish expeditions soon followed, and though they are much criticized for their cruelty, greed and treachery, the military achievements of the Conquistadors were remarkable. First they conquered Mexico and took away its valuable treasures. Seeking more land and wealth they invaded Peru, home of the Incas. Here they murdered the king and stole his vast hoard of gold- probably the greatest in the world. The natives were enslaved and set to work to win more gold. Later the Spanish conquered Chile and Bolivia, both of these countries being rich in precious metals, particularly silver.

To the metallurgists, the most exciting discovery made by the Spaniards was the finding of platinum in the silver mines of Mexico. At that time the new metal was regarded as more of a nuisance than of value. It could not be melted by any known method, though it was possible to make a very realistic imitation gold from it. Later it joined the group of precious metals and is now used for jewellery and in industry. Its high melting point makes it suitable for electrical contacts where the heat of sparks would melt other metals. In the chemical industries its resistance to corrosion is of great value.

Gold is the most malleable of all the metals. It can be hammered into sheets so thin that 250 of them would equal the thickness of a sheet of paper. It is also the most ductile metal. One gram of gold can be drawn into a wire 1.8 miles in length.

Gold, chemical element, a dense, lustrous, yellow precious metal has several qualities that have made it exceptionally valuable throughout history. It is attractive in colour and brightness, durable to the point of virtual indestructibility, highly malleable, and usually found in nature in a comparatively pure form. Gold is one of the heaviest of all metals. It is a good conductor of heat and electricity. It is also soft and the most malleable and ductile of metals.

Because gold is visually pleasing and workable and does not tarnish or corrode, it was one of the first metals to attract human attention. Owing to its unique qualities, gold has been the one material that is universally accepted in exchange for goods and services. In the form of coins or bullion, gold has occasionally played a major role as a high denomination currency, although silver has generally been the standard medium of payments in the worlds trading systems. Although golds official role in the international monetary system had come to an end by the 1970s, the metal remains a highly regarded reserve asset. Gold is still accepted by all nations as a medium of international payment.

Gold occurs mostly in the native state, remaining chemically uncombined except with tellurium, selenium, and possibly bismuth.

Gold often occurs in association with copper and lead deposits, and , though the quantity present is often extremely small, it is readily recovered as a by-product in the refining of those

base metals. Two types of deposits containing significant amounts of gold are known: hydrothermal veins, where it is associated with quartz and pyrite; and placer deposits.

The origin of enriched veins is not fully known, but it is believed that the gold was carried up from great depths with other minerals. Alluvial deposits of gold found in or along streams were the principal sources of the metal for ancient Egypt. Other deposits were found in Turkey, India, China, in Europe in Saxony and Austria. Russia became the worlds leading producer of gold in 1823.In the late 20th century four countries -South Africa, Russia, the United States, and Australia-accounted for two-thirds of the gold produced annually thoughout the world.

Because pure gold is too soft to resist prolonged handling, it is usually alloyed with other metals to increase its hardness for use inn jewelry, goldware, or coinage. Most gold used in jewelry is alloyed with silver,copper,and a little zinc to produce various shades of yellow gold or with nickel, copper, and zinc to produce white gold.The colour of these gold alloys goes from yellow to white as the proportion of silver in them increases;more than 70 percent silver or copper are used to make gold coins and goldware,and alloys with platinum or palladium are also used in jewelry. The content of gold alloys is expressed in 24ths,called karats;a 12-karats gold alloy is 50 percent gold, and 24-karat gold is pure.

Because of its high electrical conductiveity (71 percent that of copper) and inertness ,the largest industrial use of gold is in the electric and electronics industry for plating contacts, terminals, printed circuits, and semiconductor system. Thin films of gold that reflect up to 98 percent of incident infrared radiation have been employed on setellites to control temperature and on space-suit visors to afford protection. Used in a similar way on the windows of large office buildings, gold produces the air-conditioning reguirement and adds to the beauty. Gold has also long been used for fillings and other repairs to teeth.

Several organic compounds of gold have industrial applications, sometimes they are used in certain organic solutions for decorating glass articles.

Silver is similar to gold in many ways. Like gold, it is very malleable and ductile and so it is also used for jewelry. Silver differs from gold in that it is more reactive and tarnished when exposed to the traces of sulfur in the air.(Silver sulfide, a black deposit, forms on its surface). Pure silver is too soft and so it is usually alloyed with copper to increase its hardness and durability. Sterling silver is 92.5 percent silver and 7.5 per cent copper. Silver is used for coins and for photographic films because certain compounds of silver, such as silver bromide, reflect light. Silver is the best conductor of electricity known.

Platinum, chemical element, the best known and most widely used of the six metals of platinum group is a very heavy, precious, silver-white metal.

Platinum is soft and ductile and has a high melting point and good resistance to corrosion and chemical attack. For example, its surface remains bright after being brought to white heat in air, and though it readily dissolves in aqua regia, it is scarcely attacked by simple acids. Small amounts of iridium are commonly added to give a harder, stronger alloy that retains the advantages of pure platinum.

Platinum and its alloys are indispensable in the chemical laboratory for crucibles and dishes in which materials can be heated to high temperatures. Platinum is used for electrical contacts and sparking points because it resists both the high temperatures and chemical attack of electric arcs. The jewelry and dental alloys account for much of use; platinum-iridium is used for surgical pins. The electrical resistivity of platinum is relativity high and depends upon the temperature as a catalyst; platinum has many application, notably in automotive catalytic converters and in petroleum refining.

УДК 735.29

DEVELOPMENT OF TECHNOLOGIES FOR ULTRA-WIDEBAND IMPULSIVE DIAGNOSIS OF OIL PIPELINES

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One of the most actual and complex problems of oil pipelines operation is a problem of unauthorized inserts detection. Its consequences are environmental pollution, economic losses (penalties., costs of repair of pipes anol as a result the lost benefit) and increase in delivery time of fuel to consumers.

According to mass media reports Media of PETROGAS informs that degree of oil pipelines in Russia for transfer of hydrocarbons reached 221 thousand km. by February 22, 2015; It speaks about the biggest development of transfer of oil, gas, oil products in huge distances. For such power complex Strict control over transportation is necessary for avoidance of casual losses.

The purpose of work is opportunity of using a pulse superbroadband remote sounding for definition of unauthorized inserts and the second purpose is definition of hydrocarbons leak in invisible sites of the highway

For achievement of this purpose it is necessary to solve the following problems:

1. Studying of remote sensing technology
2. Studying of properties of the production technology of superbroadband impusny sounding
3. Research of operability of SShP for an opredleniye of inserts.
4. Conclusions and decisions for development of technology.

Now a large number of the methods based on various physical laws and the phenomena is developed for detection of inserts and leaks. For example sach as:

– a pressure decline method with the fixed or sliding setting;
– method of negative shock waves;
– method of expenses comparison ;
– radioactive method;
– ultrasonic method (probe);

– method of acoustic issue;
– laser gas-analytical method;
– visual method;
– method of pressure difference (probe);
– method of tracer gases;
– method of vortex currents;
– the combined electromagnetic control method;
– method of shock waves of N. E. of Zhukovsky
– and others.

Any of these methods of leaks detection doesn't satisfied completely all requirements imposed to them.

The method of SShP-sounding combines up-to-date developments in the field of generation of nanosecond impulses of big power, and also in the radiation, reception and processing of broadband signals. An electromagnetic wave, extending through Wednesday, experiences absorption and reflection. Two of these processes depend on a large number of parameters of the environment, such as dielectric permeability, conductivity, uniformity, humidity, polarizability.

The measuring complex consists of two antennas, the generator and the sensor of processing of a signal-ostsilograf.

Geophysical inspection by means of the SShP technology of sounding has the following advantages over location-based equipment:

1) Research depth in soil to 150 m, in concrete to 100 m

2) The signal well passes through clay wen and flood of the soil with high precision. Frequency 20 MHz

3) Possibility of carrying out detailed research of structure of object (diameter of a pipe, insert production material, the characteristic of soil - an aggregate state, definition of thawed snow. FROM the CATALOGUE BANK)

4) Higher reliability of results and specification of research. (opportunity to see through sinks and failures)

5) Noise stability. Researches are possible in the conditions of influence of the strong electromagnetic fields

6) Low cost

7) Nondestructive, remote nature of inspection. The method allows to survey remote elements.

8) Postrony 3-D models of the studied soil.

9) Possibility of sounding both in stationary a state, and in the movement

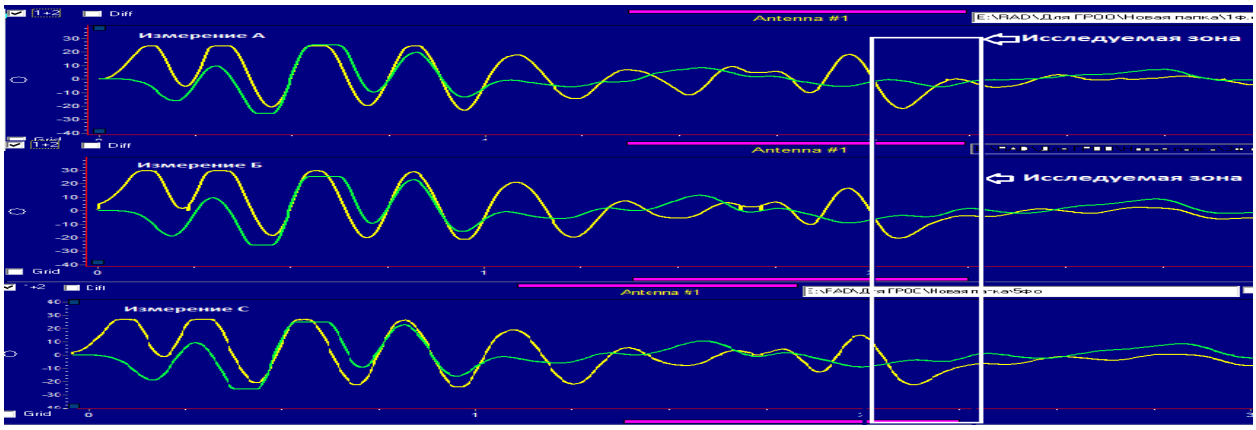
10) Use of the device allows to make research in unpretentious conditions of environment (-40-+40, snow, fog, a rain, a hail)

For development of this method it is necessary to optimize dimensional parameters and to create broad base. As a result of these works it is possible to create the device of broad application

Description of the ex-recop

Sounding of a sandy embankment by means of the SSHP AMY complex was carried out. For definition of a reference signal of a georadar of AMY SSHP the embankment without artificial objects - a state was probed And. After that modeling of a situation of search of metal pipes in soil was made. At distance 210mm from an antenna DM reception from the opposite side of an embankment horizontally metal pipe by diameter 50mm and long 700mm was dug and sounding is made – a state B. Daley from the party of an embankment, opposite to a georadar, the second

pipe by diameter 100mm and long near 700mm was laid on a surface of a heap vertically and sounding – a condition of Page is made. From Fig. it is visible that the signal in the studied area for measurements of B and With has difference from measurement And, and before the studied zone the behavior of signals has identical character. The executed experiment showed that depending on existence of metal pipes behind an embankment, the signal of a georadar of AMY SSHP considerably changes and allows to find surely these objects experimentally



Superbroadband method will allow to find broad application:

1. Definition of unauthorized inserts
2. To prevent oil Plunder
3. to receive extensive information on composition of soil
4. findings of minerals
5. Determination of integrity of the main pipelines
6. Research of layers of earth

In this work on the basis of the analysis of the sounding SShP EMI method which is precisely answering an objective was chosen. The description of operation of this device and its component is executed. Provedeny experience, showed on an example that it is possible to distinguish the studied states.The method is universal and can be applied to inspection and monitoring of a wide number of engineering and natural objects.Considering experience of application of AMY SSHP in other areas of engineering researches, it is possible to draw a conclusion on possibility of creation on the basis of this technology of a method of the guaranteed detection of inserts in oil pipelines.

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УДК 622

TERRESTRIAL LASER SCANNING – A BREAKTHROUGH IN MODERN SURVEYING

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In the last few years surveying is characterized by technological breakthroughs in the equipment development, and in particular, by innovative technologies for collecting, processing and supplying data.

Such types of innovative technologies in surveying as digital aerial photography and laser scanning are becoming more and more common. The advantage of using these technologies is providing complete, accurate and prompt information, and that is critical for on-line decision-making.

Innovative laser scanner is a measuring device, which measures the angle and distance to the laser reflection point by the laser radiation. A laser scanner performs high frequency measurements of spatial coordinates of the laser reflection points. The measurement frequency comes up to hundreds of thousands per second. In the result of laser scanning it is possible to obtain large data volumes and then to create a spatial digital model of the measuring object.

Laser scanning of the area of several thousand square kilometers using airborne scanners can be done in just two weeks, and we can get a digital three-dimensional model of the territory. To complete the measures using the classical procedure would take several months or even years, and it could not be managed without debilitating and costly expeditions. The efficiency of terrestrial scanning is also practically assured when dealing with complex objects and it provides a high level of detail.

In recent times, surveying services have been using a number of innovative ways of working. One of the most promising is implementation of 3D laser scanning technology for the spatial patterns of the measuring subject. Scanning density of points depends on distance and can be up to several tenths of a millimeter. Such work requires only a line of sight of the scanned surface.

Three-dimensional model is obtained by measurement data processing. The three-dimensional digital model of open-pit working helps do production tasks: to calculate the volume of overburden and ore in the process of mining operations; investigate the structure of the cutoff massif for occurrence of cracks, layers and failures; to monitor the massif deformation by comparing the digital models during the course of displacement.

There is great opportunity to use this technology in mines for digital models of mining and basic surveying: the orientation of the shaft, surveying of inaccessible cavities of faces, calculating the volume of excavated rock, accounting of losses and dilution of minerals.

Currently, the experts of the surveying services use in their work surveying scanner Leica HDS8800, which can scan from a distance up to 2000 m and operate at the air temperature below 40° C.

Another example of using laser scanner in surveying is calculating the volume of ore reserves by the terrestrial laser scanner Riegl LMS Z420i.

Tacheometric and photo theodolite methods of surveying the surface before and after explosion are used to calculate the volume of stock and volume of exploded rock in quarries in

traditional surveying. Method based on the application of tacheometry involves surveying in scale 1: 2000 and building a digital surface model.

With the advent of laser scanners, labor-intensive process of surveying ore reserves by traditional surveying instruments are becoming a thing of the past. Now, most of mining companies have in their stuff surveying divisions and they use surface laser scanners in their work. The advantage of laser scanning is obvious, the calculation of volume requires prompt determining the geometry of blasted areas or ore stock in terms of rapidly changing situation in quarry and stock dump.

Using traditional surveying methods, surveyors face with the need to obtain approximating surface by the measured points. To get a more accurate approximation of the volume, they must have a large set of points. In practice, traditional methods of solving this problem are inefficient and time consuming. Moreover, the maximum accuracy of calculation in these methods is in the range of 3% of the theoretical value.

An example of using laser scanner in surveying is actually calculating the volume of stock by terrestrial laser scanner Riegl LMS Z420i in Kachkanarsky mine.

Terrestrial laser scanner Riegl LMS Z420i completed with tachymeter and a set of reflecting marks were used to determine the volume of blasted rock and calculate the volume of stock. The corresponding section of working was scanned before and after the blast to calculate the volume of blasted rock in the mine.

A set of reflecting marks were used to bind the scans, the coordinates of the marks (X, Y, Z) were obtained with tacheometer during scanning. Transformation of scans into the project coordinate system and the initial accuracy assessment was carried out promptly in the program Riscan Pro.

This program has built-in capabilities to create triangulated surfaces based on point clouds, allows linear measurements to calculate the surface area and allows the user to promptly calculate the volume (blasted rock, stock, pits and workings). The algorithm for calculating the volume is based on the use of the original (reference) plane with respect to which the volume is calculated. This plane may be located on the known starting points of the rectangular coordinates. Fixing this plane on the known coordinates, we have the opportunity to continue monitoring the situation in the site, in particular quickly calculate the volume of blasted rock in the quarry. The algorithm is based on conversion of data into a bitmap, which then generates a set of columns that approximate the original weight of the rock.

Some cranes move along the stockpile. It was decided to establish a laser scanner Riegl on one of them. The scanner was fixed on the crane and it was scanning the area with the width of about 180 degrees. Thus, in the result seven scan positions were obtained and they covered the entire area of the stockpile.

Advantage of laser scanning is that the obtained images contain extremely large amount of information. This redundancy provides opportunity of full automation of collecting information about the object.

In addition to high level of automation, laser scanning has the following advantages in comparison with other methods of obtaining spatial information: a) determining spatial coordinates of the object points in the field (the distance, the vertical and horizontal angles are measured the time of scanning), b) three-dimensional visualization in real time, allowing to determine "dead" zone on the stage of field work, c) non-destructive method of obtaining information, d) no need for scanning points of an object from two projection (state) centers, unlike photogrammetric method, e) high accuracy, f)safety and security in remote collecting of information in hard-to-get and hazardous areas, g) high performance.

The most important advantage of laser scanners is shortening the field work for creating digital models of objects. Therefore, this technology is more cost effective compared to others: the work can be done in any lighting conditions, i.e. day and night, as the scanners are active imaging systems; it has high level of detail; multi-purpose use of laser scanning results.

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УДК 622.

GLOBAL AND REGIONAL COAL DEMAND PERSPECTIVES

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Coal occupies a special place among all the minerals. It was the main kind of fuel in the early period of industrialization in the developed countries, when the technologies of liquid and gaseous fuels did not exist. It was coal that laid the foundation for modern technological civilization. But is it true to say that coal is the mineral of the last century, and its importance for the new century has decreased? Experts are not agreed on this point. In this paper we tried to compare different points of view on the role of coal in the modern technological world. So, what is coal? It is naturally occurring organic mineral of vegetable origin. To understand the origin of coal and the geography of its reserves in the world, it is necessary to analyze some facts of paleontology. First of all, the period of the Earth history called the Carboniferous period.

The main coal reserves were acquired in the so called evolutionary "window" when ancient plants had evolved the ability to form solid trunks, and a variety of fungi, mold and other saprophytes had not acquired the ability to decay wood substance. That was the end of the Carboniferous period of the Paleozoic era. Paleozoic wood of trees and shrubs was somewhat different from their present day form: they contained less cellulose and more lignin, the polymer organic compound consisting mainly of carbon, hydrogen and oxygen. The trees in Carboniferous period were covered with thick bark and consisted mainly of lignin, they could not decompose naturally. On the site of ancient forests, huge masses of dead wood were buried underground. As soon as their chemical composition changed, the organic structure was decomposed without oxygen, they turned into coal, and the most deeply buried by tectonic processes organic substance turned into anthracite. Lignite formed from small marsh plants and continues to be accumulated from peat buried underground. Tracing the history of the coal origin makes it possible to understand the geography of its occurrence. Coal basins are formed at the site of ancient forests and swamps where tectonic processes have led to their lodging. The largest coal reserves in the world there are in the most technically developed countries, the United States, European countries, Russia, China. In contrast with coal, oil principal reserves on the planet are concentrated in climatically inaccessible, politically unstable regions in developing countries. All the mighty powers of the modern world have their own reserves of coal.

Metallurgical industry began to develop first in the areas of coal basins because of the proximity to the energy supply. In the XIX and the first half of the XX century these regions became centers of the industrialized world. Later, when the use of coal decreased in a number of industries, metallurgy and steam power industry still used this resource.

Currently, metallurgy and steam power industry use coal as the main raw material. One third of electricity and heat in the world are generated by burning coal.

The United States of America ranks the first in proven reserves of coal (30% of global deposits), Russia ranks the second (20%), and China ranks the third (15%). At the same time China is far ahead in the world in terms of coal mining, which makes up 3.6 billion tons per year; US is the second, and Russian only the sixth. This imbalance is due to the fact that the Russian Federation and the United States have access to large quantities of cleaner fuels as natural gas and petroleum products. China suffers shortage in gas and oil that is why it has to abandon the widespread use of these fuels in industry and use coal instead. Coal is extensively used in China (including the Fischer-Tropsch process in which hydrocarbon fuel is obtained from carbon).

However, in the Russian Federation and the United States, and especially in Europe there are trends not to use coal as a fuel if possible. The reason is that coal is one of the most environmentally damaging fossil fuels; when burned, it releases gases with the highest percentage of harmful impurities, the main product of coal combustion is pure carbon dioxide (unlike hydrocarbons, which produce a mixture carbon dioxide with water vapor). Only two types of fuel are even more "dirty" when burning: brown coal and peat. Therefore, the above mentioned countries use technologies that replace coal to natural gas (methane); natural gas is the main raw material for thermal industry in Europe now. Most experts predict sharp decrease in fuel consumption for the decade and shutdown of many coal mines.

The rapid technological growth makes the Chinese industry rely more on coal. The US has the widest access to oil and gas reserves, and the country still holds an interest in coal and even purchases it in other countries, despite its own giant deposits. This strategy is dictated by economy of natural resources: the enormous needs of the country can not be met if they are completely transferred to gas and oil. In the case of the global adoption of these fuels, as American ecologists predict, the end of the world oil and gas reserves will come very soon. At the same time, the coal reserves on the planet, according to their calculations, is sufficient to support modern industry for hundreds years. Russian scientists have similar opinion. According to the monograph "The mineral resource base of the Eastern Donbas coal", the currently situation (50% of the fuel balance of the country is natural gas, 30% - oil and only 12% - coal) is not sustainable, and it will be impossible to maintain the balance while the sources of hydrocarbon fuels will be imminently exhausted.

Thus, there is a need in coal as a source of fuel, but it is deliberately replaced by the fuels which produce less harmful emission when burned. Both the use coal and hydrocarbons are dangerous to the Earth to some extent. Are there any technological solutions of this problem?

Such technologies exist. For example, ways of cleaning and decarbonization of fuel gases. They can significantly improve the ecological situation in all types of industrial enterprises that consume hard coal or ligneous coal. There is a variety of such technologies. The simplest of them is to separate carbon dioxide, then cool and liquefy it. This gas (commonly known as carbon) can be liquefied under pressure at room temperature and easily stored and transported as a liquid.

More advanced is the so-called Oxy-Fuel technology, in which coal is burned in pure oxygen. Thus, the complete combustion of coal is achieved and a minimal content of incomplete combustion (carbon monoxide etc.).

Another example is pre-combustion technology. This is a better way of coal gasification than its processing into water gas. In this method, the energy of coal is used to separate oxygen from water and turn it into hydrogen, which is a perfect clean fuel, while coal is converted into carbon dioxide, which is easily liquefied and separated.

The leading role in development ways of decarbonization of coal combustion belongs to Germany. Since 2008 the two major German companies RWE and Valtenfall have been developing coal power plants with zero emissions of carbon dioxide and other harmful products of coal combustion. These technologies can be used for safe burning both hard coal and ligneous coal.

German experts believe that the technology developed by German companies have global significance. Their implementation in various countries of the world can low fears about the environmental hazards of burning coal, reduce excess demand for hydrocarbon fuel and prolong energy stores for technical civilization. As for the coal mining industry, this means long-term and stable development prospects.

УДК 338.46

TRANSLATING PROCESS IMPROVEMENT USING ONE OF THE QUALITY CONTROL TOOLS – DMAIC

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Do you know what quality management is? Nowadays almost everybody whose field concerns economics, management or even production knows about quality methods and employment of these methods in their organizations. In 1980s – 1990s many companies decided to implement Quality Management System. But it concerned just industrial enterprises. Today it is getting more popular to implement quality improvement methods in different companies, including services. In spite of this Quality Control tools have such strong roots in manufacturing that many people in services either think these tools do not apply to their situation or think they are simply too complicated [1]. That is why the problem of using quality improvement methods is such an actual topic to discuss.

Service is the same sale activity like any other company that produces what a customer wants to buy. The only difference between service and manufacturing is that we can't feel the service, which we purchase, but as for the product we can feel. That is why service company managers as well as managers of other branch have to employ different means increasing their performance. To prove that any quality control tool is applicable even for service sphere, I would like to show the example how to analyze and to improve the providing services process with the one of the quality improvement methodology.

There is such improvement way like *Lean Six Sigma* (LSS) among others TQM tools. *Lean Six Sigma* is a methodology that relies on a collaborative team effort to improve performance by systematically removing waste [2], combining lean manufacturing/lean enterprise and Six Sigma to eliminate the waste.

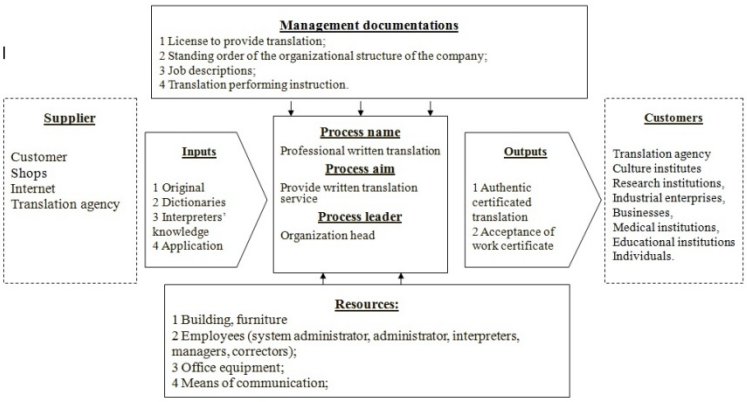
Most Six Sigma projects follow a basic procedure known by its abbreviation DMAIC (Define-Measure-Analyze-Improve-Control). DMAIC is a problem-solving strategy, which can be applied to any process or system. In general, DMAIC is used in processes that already exist, but need to be improved in order to meet customer requirements for a product or service [3]. For LSS to work best, managers at all levels must invest in the resources to initiate, promote, actualize and support the process. It is decisive that management provide employees with training, resources, knowledge, authority, and time to solve problems and complete the LSS project.

Why do we need in continuous improvement? Firstly, it is needed because the level of process indicators is getting lower in length of time, if it is not being maintained. Secondly, if we don't progress, it would be done by our competitors. And the last issue, which necessitate the continuous improvement, is rapidly growing customer requirements. As an example of DMAIC employment it was decided to analyze written translation process within the translation agency. The whole project takes about six months and demands many tools in each phase of DMAIC. I would like to introduce only part of the project just main issues.

The first stage – *Define* – was started from the renewal of a project regulation. This part of the stage includes the description of a business situation, existing problems and opportunities; project group principals definition; plan development. Then the project group should determine customer wants and needs and translate them into specifications. The tool "VOC Plan" was used for the second part of the stage. For the customer requirements analysis the tree diagram was used. It shows the division of requirements between several identified types of potential customers: culture institutes, research institutions, industrial enterprises,

businesses, medical institutions, educational institutions and individuals. Each of them has both similar needs and special ones. The final part of the stage consists in the process documents creating – definition of crucial process steps and process diagram creation. There are two main tools – qualigram and SIPOC.

And the first tool to analyze the process is SIPOC. It stands for Suppliers – Inputs – Process – Outputs – Customers – is an effective team method, a high-leveled process chart, which provides a process identification and determination of its interaction with other processes. So, the determination of translating process is represented on the picture 1.



Picture 1. SIPOC

After that we need to trace the process with qualigram. Qualigram is a process description in the form of a diagram, which shows who and what is doing during the process. It includes 5 people that take part in the process – an administrator, a project manager, an interpreter, a corrector and a customer. Each of them has his own actions, that are shown at the qualigram. This diagram shows us the whole process of translation any work – from sending an application to getting a ready translated work. In addition to the qualigrams' rules we needed to identify just 5 main participants and their actions. So, this part of the first stage – *Define* – let us analyze the features of a translation process in details.

After that it is needed to proceed the project work within the next stage – *Measure*. This stage demands using many tools and takes the largest amount of time in comparison with other stages. It also requires working with a large number of digits and committing complicated calculations. That is why I would like to pass this stage – within the introduction of the whole project in the article –as a routine and long-term part of the work and move to the following phase - *Analysis*.

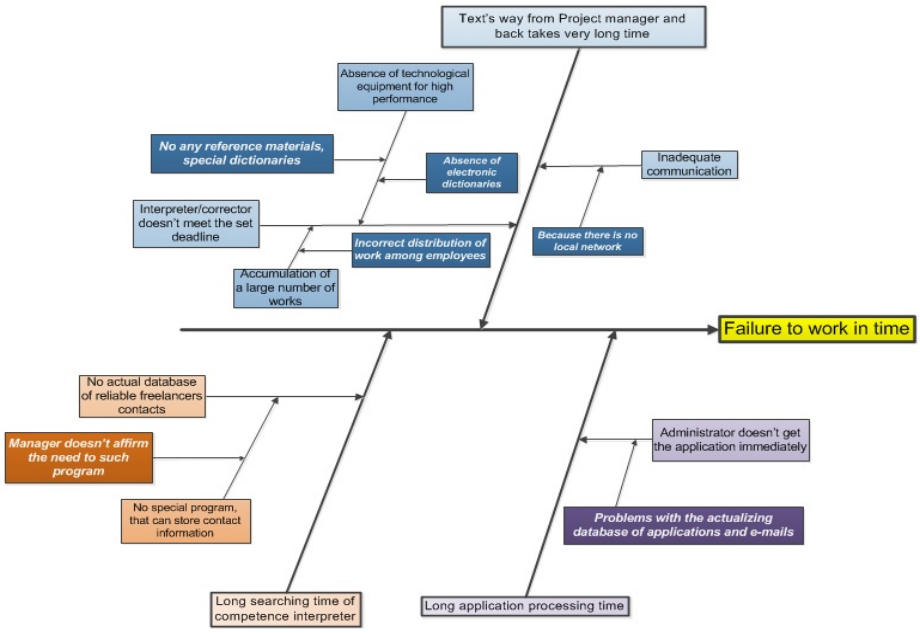
The third stage consists of three phases: research, hypotheses forming, determining the causes. Every phase has its own tools. The research is provided with Pareto chart, control charts or a bar chart. The hypotheses forming is conducted by brainstorm, cause-and-effect diagram or linking diagram. Such tools like scatterplot or stratification are used to determine the causes of problems.

As we identified the problems – process defects – it was needed to classify them. Using Pareto chart, the project group has a possibility to detect a few problems, that cause the largest profit loss. According to Pareto rule, 20% of our efforts give us 80% of results. That is why this phase – the determination of the most influential problem – is such important step. Since our project group is not the translation agency employees, we could just suppose the problems of the agency and their frequency of occurrence during this process. And so, among these problems are the following:

- failure to work in time;
- selection of an incompetent interpreter;

- freelancers are not in charge of;
- uncontrolled "rare" specialists;
- database loss;
- dishonesty customers;
- false test by a "potential customer" of a translation agency.

We detected the most often appeared one – failure to work in time. And then it was needed to determine the causes, that influence the detected problem. The method of seven simple tools – “5 whys” method – showed us those causes. And the cause-and-effect diagram structured understanding of the interaction between the many possible causes of the problem. This method let us understand the root causes, that the company should remove to eliminate the problem – not meeting the deadline.



Picture 2. Cause-and-effect diagram

As we see at the diagram on the picture 2, the company should eliminate:

- circumstances, when managers don’t claim to set required computer programs;
- an absence of local net;
- an absence of reference materials, special dictionaries;
- an absence of electronic dictionaries;
- an incorrect distribution of work among employees.

At the fourth stage – *Improvement* – the project group generated many possible solutions to eliminate above challenges, using brainstorm. After that the nominal group technique helps to rank all ideas about solving the problem. The next phase for implementing is organize every component in conformity with the related sets of tasks with tree diagram. In real situation a company should launch a pilot to test, whether the chosen solution helps to remove the defects in the process. But in our case we can just propose which of the solutions is the best for solving the determined problem. As all the solutions are launched, the project group should provide measurements, comparing them with each other and verify the realization and effectiveness of the solution. Then a company should make a decision about the implementation within the whole organization.

The correct work during the previous four stages determine the successful conclusion of the fifth stage – *Control*. The main task of this stage is revealing of ways to retain critical input variables within the acceptable difference in the long run. The team can use such tools like control charts and process management charts. The basic actions, that should be done within the stage, are discipline setting, documentation of changes, current process condition measurement and management process plan creation.

To summarize the ideas, I would like to say that for complete understanding how to apply quality management tools and methods, particularly DMAIC, it is enough to show just several stages of this project. So, according to the above project description, any service sphere can apply DMAIC within the Lean Production and Six Sigma projects. There are no so many quality management tools, that companies often use for their service production. But such as DMAIC or Quality Function Deployment can help to make their processes more successful. Today there are many companies in service, for example Sberbank or RZHD (Russian Railways), that make the activity more successful due to Lean Production and Six Sigma, naturally the DMAIC too. Any process needs improvement, no matter how perfect it was originally. As Henry Ford said, «Everything can always be done better than it is being done».

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