

ADVANCED R&D AND TECHNOLOGIES

THE NAS OF UKRAINE



**TECHNOLOGIES
AND EQUIPMENT FOR EXPLORING,
ESTIMATING, AND EXTRACTING
MINERAL RESOURCES**

ADVANCED R&D AND TECHNOLOGIES

THE NAS OF UKRAINE

SPECIAL ISSUES

ENVIRONMENT AND NATURE PROTECTION

FOOD INDUSTRY

FUEL, LUBRICANTS,
AND TECHNOLOGIES

INDUSTRIAL AGRICULTURE
AND LANDSCAPE GARDENING

INFORMATION AND SENSOR SYSTEMS
AND DEVICES

INFORMATION TECHNOLOGY

MACHINE-BUILDING
AND INSTRUMENT ENGINEERING

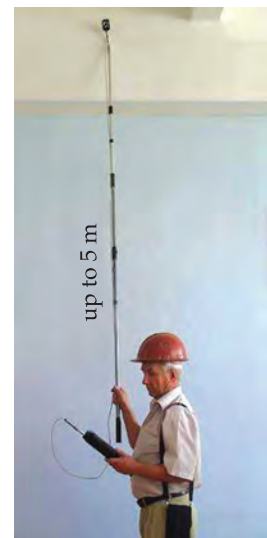
MEDICAL PRODUCTS
AND MEDICAL DEVICE ENGINEERING

POWER ENGINEERING
AND ENERGY EFFICIENCY

TECHNOLOGIES AND EQUIPMENT FOR EXPLORING, ESTIMATING, AND EXTRACTING MINERAL RESOURCES

TECHNOLOGIES FOR CONSTRUCTION
AND FUNCTIONAL MATERIALS

APR-2 PORTABLE MINE ANEMOMETER



Complete set of APR-2 anemometer (left), measurements at a height of up to 5 meters (on right)

Areas of Application

The device is to be used for measuring average velocity of air streams in remote places with high content of dust, moisture, and explosive gases, and average weighted velocity and amount of air in mines of all categories, including dangerous ones in terms of gas or dust content, as well as in gas pipelines, tunnels subways, control systems, industrial ventilation systems, degassing systems, etc.

Specification

Measurement range of air flow speed, m/s	0.15 – 20.0
Absolute measurement error, m/s:	
within the range of 0.15 – 1.20, at most	$\pm(0.03 + 0.02V)$
within the range of from 1.20 to 20.0, at most	$\pm(0.10 + 0.05V)$
Limit flow rate, m/s, at most	50

* V is measured velocity, m/s

Stage of Development. Suggestions for Commercialization

IRL9, TRL9

APR-2 anemometers are available for sale, upon request.

Maintenance and repair of anemometers and calibration services as required by the applicable legislation are provided for the whole service life

Advantages

The APR-2 anemometer parameters exceed those of world counterparts based on the same principle. The device is suitable for use in remote locations at a height of 5 meters from the floor and has a wide measurement range with one primary transducer that is easily replaced and does not require any additional calibration

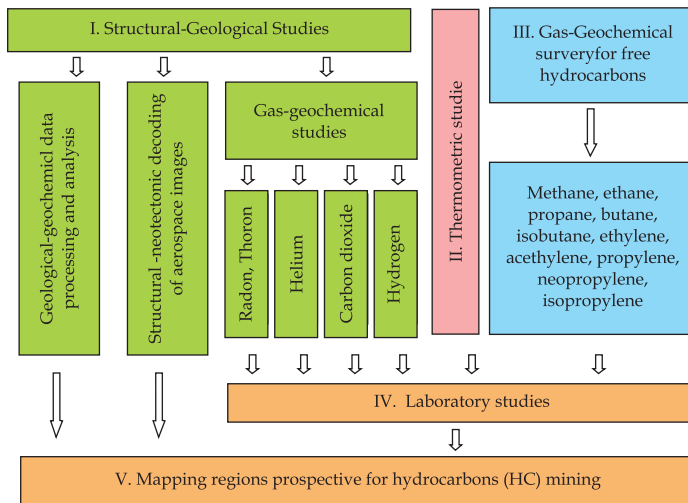
IPR Protection

IPR1, IPR3

Contact Information

Mykhailo M. Dudnyk, Institute of Geotechnical Mechanics named by N. Poljakov of the NAS of Ukraine; +38 095 256 54 94, +38 0562 462 425, e-mail: dudnik1963@gmail.com

COMPREHENSIVE METHOD FOR STRUCTURAL-THERMO-ATMO-HYDRO-GEOCHEMICAL RESEARCH (STAGR)



STAGR flowchart

Areas of Application

The method is to be used for forecast of oil and gas promising areas; predictive estimates of areas for arranging well fields under conditions of crystalline rocks and sedimentation mass

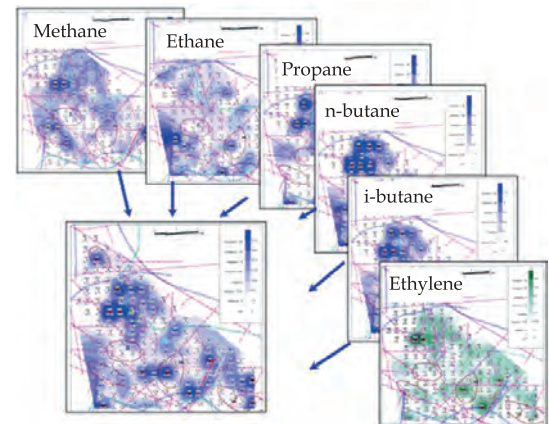
Specification

A forecast map of oil, gas, and underground water promising areas is built based on comprehensive analysis of geostructural and geophysical materials and on structural neotectonic interpretations of satellite imagery and gas-geochemical and emanation thermometric survey results. New special hardware designed for research in marine waters has been used

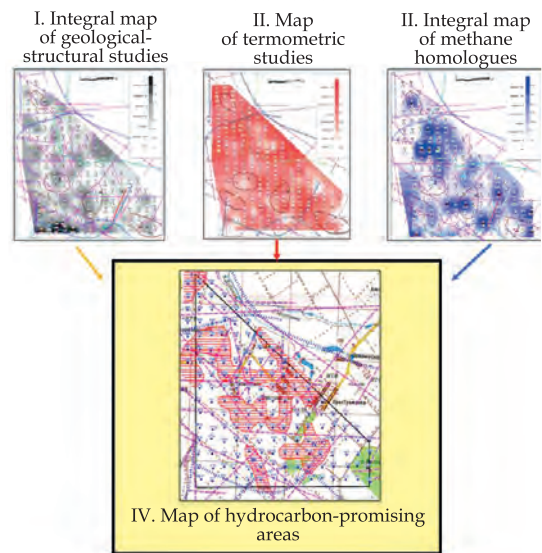
Stage of Development.
Suggestions for Commercialization

IRL5, TRL9

The method has been implemented at many enterprises. Thermo-atmo-hydro-geochemical surveys of oil and gas promising areas are carried out upon request



DISTRIBUTION MAP OF TOTAL VALUES OF METHANE HOMOLOGUES



Advantages

The method provides promptness and reliability of results of field and laboratory surveys due to the use of optimal complex of near-surface indicators

IPR Protection

IPR3

Contact Information

Ruslan B. Havryliuk, Institute of Geological Sciences of the NAS of Ukraine;
+38 044 239 74 16, e-mail: gavriyuk.ruslan@gmail.com

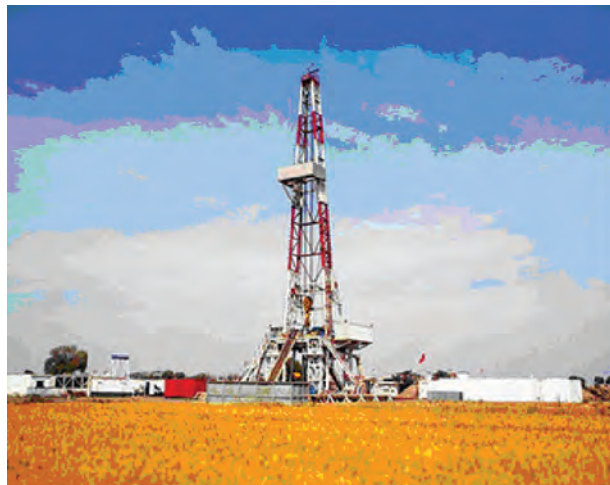
COMPREHENSIVE TECHNOLOGY FOR TEMPORARY SHUTOFF, DEVELOPMENT, AND SUSPENSION OF OIL WELLS UNDER CONDITIONS OF HIGH-PERMEABILITY RESERVOIRS AND ABNORMAL ROCK PRESSURE

Areas of Application

The technology is to be used for oil well control and suspension under normal and abnormal conditions of operation and repair works

Specification

The technology uses environmentally safe reagents based on phospholipids. It includes a special method for preparation of invert dispersions with a density within $490 - 2860 \text{ kg/m}^3$ and a method for oil well control (development, suspension) under abnormal rock pressure



Advantages

The invert dispersions surpass the world counterparts in terms of flexible control of density, stability, and rheological properties of killing fluids, affinity to well hydrocarbon products, protection of well equipment against corrosion, and high ecological properties. The comprehensive technology has no counterparts in post-Soviet countries

Stage of Development.

Suggestions for Commercialization

IRL5, TRL6

A trial sample of invert dispersions is produced and tested on customer's well, upon request; recommendations on organization of production of dispersions and technology for their application are provided

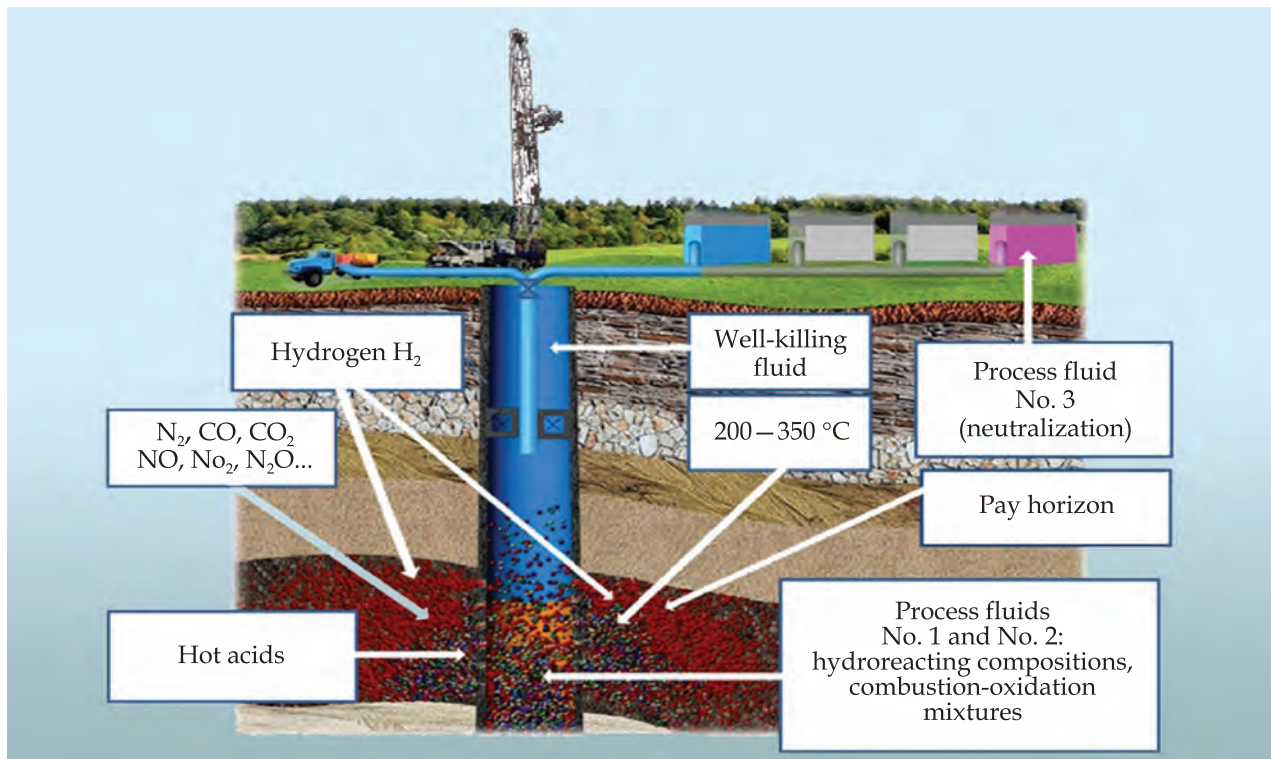
IPR Protection

IPR3

Contact Information

Grygorii S. Pop, Institute of Bioorganic Chemistry and Petrochemistry of the NAS of Ukraine; +38 044 559 60 59, e-mail: gpop@bpci.kiev.ua

INCREASING THE YIELD OF MARGINAL WELLS



Areas of Application

The technology is to be used for increasing the hydrocarbon production from marginal oil, gas and gas condensate wells whose production rate has dropped because of bottom-hole zone contamination with bridging agents

Specification

A controlled multistage thermal-gas-chemical process in the well bottom-hole zone results in the formation of active gases, primarily, hydrogen and acids that ingress into the interstitial space. Due to this, the bottom-hole zone is cleaned effectively from bridging agents, and the production rate increases

Stage of Development. Suggestions for Commercialization

IRL7, TRL8

Upon request, compositions for well treatment are selected and produced, production procedures are developed, and engineering support of activities is provided

Advantages

High effectiveness of the technology is achieved by using chemically active hydrogen. Besides, as compared with other methods for intensifying the hydrocarbon production, the technology offered is an integrated one. It combines both thermal, acid, and hydrogen impacts on the bed. The technology can increase a well production rate 1.5–10 times depending on cause of its drop

IPR Protection

IPR3

Contact Information

Halyna O. Deparna, A. Podgorny Institute of Mechanical Engineering Problems of the NAS of Ukraine; +38 057 349 47 64, +38 067 957 06 94, e-mail: ozis@ipmach.kharkov.ua

INFORMATION TECHNOLOGY FOR CONTINUOUS MONITORING OF HORIZONTAL RIDE QUALITY OF MINE HOISTING VESSELS IN VERTICAL SHAFTS WITH RIGID REINFORCEMENT

Areas of Application

The technology is to be used in digital electronic complexes for continuous monitoring of dynamic interaction of hoisting vessels with rigid reinforcement of mine shafts

Specification

The technology is based on automated processing of data from digital controllers for the measurement of vibration accelerations of mine skips, cages, and counterweights of hoisting plants. The technology includes methodology and software installed on hoist operator's workstation. Hardware technical support is provided by *Alliance-D* (Ukraine)

Advantages

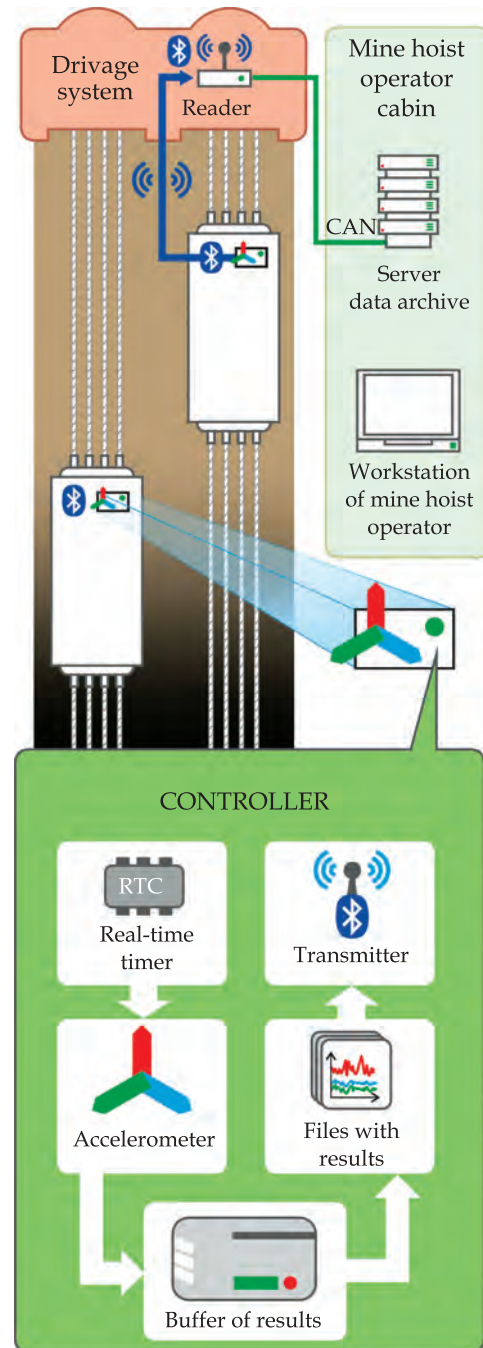
Unlike the similar technologies, this one enables continuous monitoring of the intensity of dynamic interaction of lifting vessels with shaft rigid reinforcement; localization of steps on the joints of conductors and local deviations from vertical orientation of conductors; monitoring of roller guides; localization of shock-cyclic load sections of higher-level conductors; monitoring of vertical oscillations of vessels and dynamic strains in main ropes; and automated generation of recommendations on the localization of reinforcement breaks at early stages of defect emergence

Stage of Development. Suggestions for Commercialization

IRL3, TRL3
The technology and equipment are provided and customized at user's site, upon request

IPR Protection

IPR1, IPR2

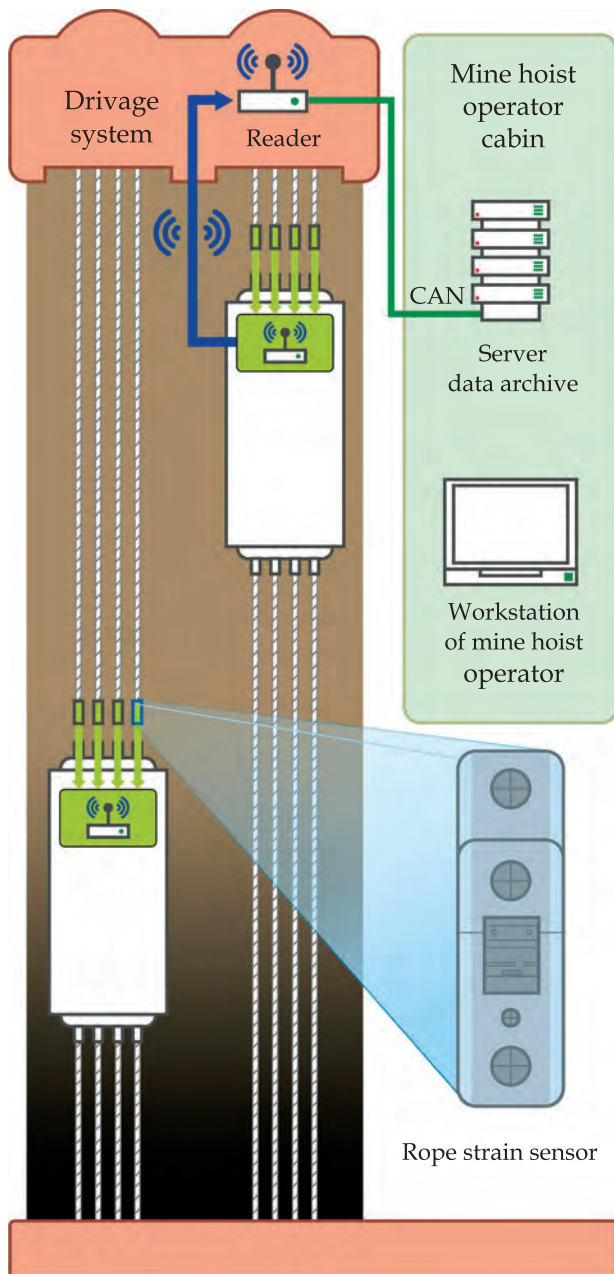


Flowchart of technology for continuous monitoring of horizontal ride quality of mine hoisting vessels in vertical shafts with rigid reinforcement

Contact Information

Serhii R. Ilyin, Institute of Geotechnical Mechanics named by N. Poljakov of the NAS of Ukraine; +38 050 582 62 59, e-mail: iljin_sr@ukr.net

INFORMATION TECHNOLOGY FOR CONTINUOUS MONITORING OF ROPE TENSION IN MULTIROPE HOISTING PLANTS



Flowchart of technology for continuous monitoring of rope tension in multirope hoisting plants

Areas of Application

The technology is to be used in rope tension digital monitoring systems

Specification

The technology is based on automated processing of data from digital controllers measuring the main rope tension in multirope hoisting plants. It includes methodology and software installed on hoist operator's workstation. Hardware technical support is provided by *Corum Group* and *Alliance-D* (Ukraine)

Advantages

Unlike the similar technologies, this one enables continuous monitoring of rope tension on both sides of hoisting plant, rope slips on the guide and angle pulleys, slip margin for each rope, and the total nonslip margin for all ropes in emergency situations; weight control of skip download and unload; calculation of adjustments of rope length and pulley groove radius; and automated issue of recommendations for adjusting the rope and pulley liner parameters to increase their service life

Stage of Development.

Suggestions for Commercialization

IRL3, TRL3

The technology and equipment are provided and customized at user's site, upon request

IPR Protection

IPR1, IPR2

Contact Information

Serhii R. Ilyin, Institute of Geotechnical Mechanics named by N. Poljakov of the NAS of Ukraine; +38 050 582 62 59, e-mail: iljin_sr@ukr.net

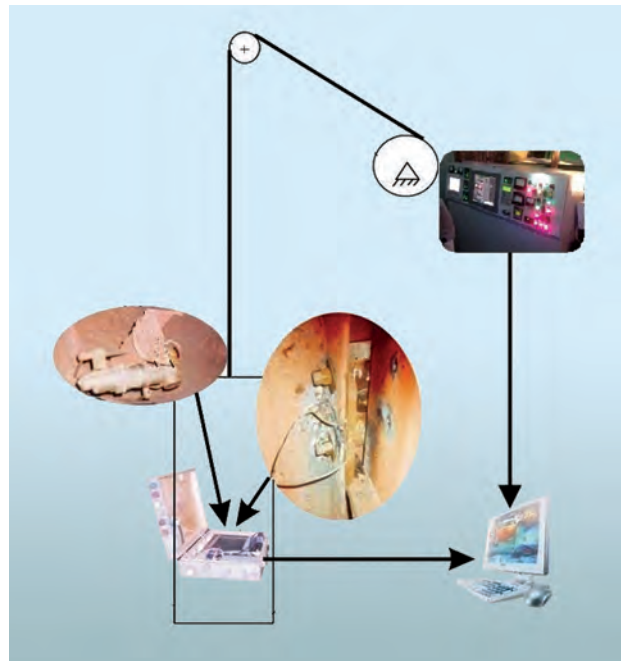
INFORMATION TECHNOLOGY FOR DIAGNOSTICS AND MONITORING OF TECHNICAL CONDITION OF HOISTING PLANT FACILITIES

Areas of Application

The technology is to be used for improving the technical condition of hoisting plant facilities in order to enhance their reliability and to increase hosting speed for escalating the quantity of minerals elevated to surface

Specification

The hardware component is multitasking hardware and software system consisting of PC, multichannel controller with analog-to-digital converter, strain amplifier, contactless acceleration sensors, force measuring pads with contact sensors, and record remote controller. The software performs systematic data processing of measurements of reinforcement wear, spatial distortions of conductor profiles, vessel horizontal ride quality and vertical speed, and dynamic stress-strain state of conductors and spacers



Flowchart of technology for diagnostics and monitoring of technical condition of hoisting plant facilities

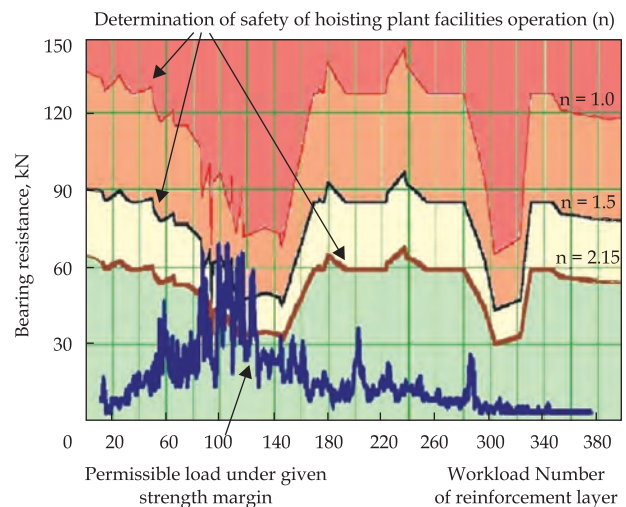
Advantages

Unlike the similar technologies, this one enables to control the dynamic interaction of all safety guides of the hoisting vessels with rigidly reinforced conductors and to assess the dynamic state and safety level of vessel–reinforcement system

Stage of Development. Suggestions for Commercialization

IRL8, TRL8

Upon request, the dynamic parameters of hoisting vessel–rigid reinforcement system of vertical shaft sections are surveyed and measured; recommendations on the improvement of their operating condition and safety are provided



Determination of safety of hoisting plant facility operation

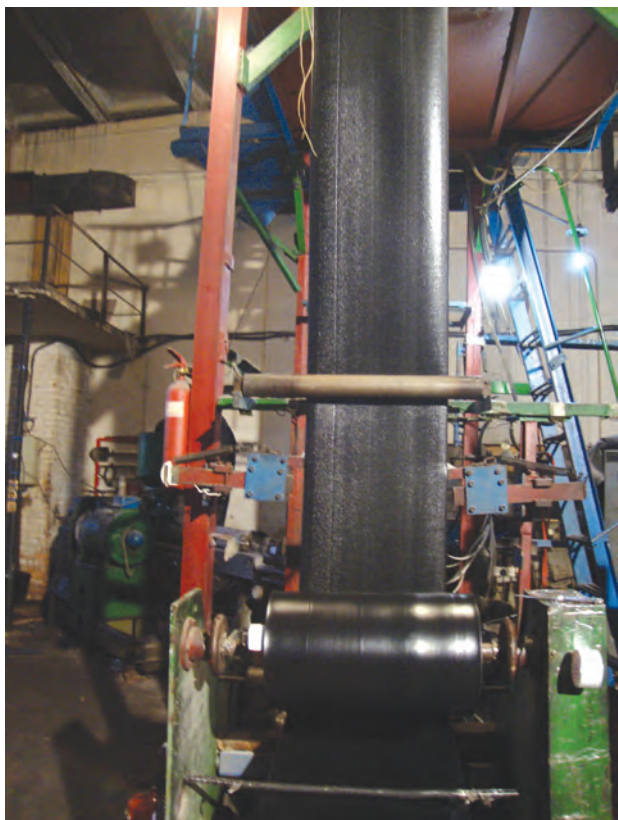
IPR Protection

IPR1, IPR2, IPR3

Contact Information

Serhii R. Ilyin, Institute of Geotechnical Mechanics named by N. Poljakov of the NAS of Ukraine; +38 050 582 62 59, e-mail: iljin_sr@ukr.net

INSULATION COATING FOR UNDERGROUND PIPELINES



Production of two-layer insulation tape

Areas of Application

Multilayer insulation tape for oil- and gas pipelines applied under base or field conditions

Specification

The coating consists of thermosetting primer and two-layered polyethylene film. Its technical parameters refer to the reinforced-type coatings and meet the requirements of DSTU 4219-2003.

The application procedure involves cleaning of the pipe, coating with thermosetting primer, wrapping of the tape around the pipe with a 50% overlap, and local heating of the tape (not the pipe surface) to shrinkage temperature.

The coating hazard class is 4

Advantages

The offered coating enables to repair the wrapping of active pipelines under conditions of complicated or prohibited pipe heating to 100–130 °C

Stage of Development. Suggestions for Commercialization

IRL6, TRL6

The technology for production and application of the coating is proposed

IPR Protection

IPR1, IPR3

Contact Information

Leonid M. Shkaraputa, Institute of Bioorganic Chemistry and Petrochemistry of the NAS of Ukraine; +38 044 559 66 47, +38 067 549 57 20, e-mail: shkaraputa@bpci.kiev.ua

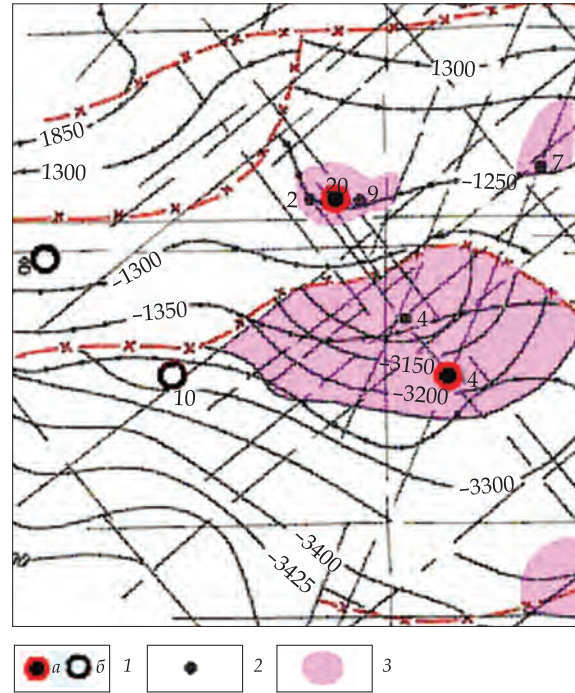
MULTISPECTRAL STRUCTURAL FIELD METHOD FOR PREDICTION OF OIL AND GAS DEPOSITS

Areas of Application

The method is to be used for prospecting hydrocarbon deposits using satellite methods in various geological and landscape conditions for solving the following tasks: to rank the oil and gas prospecting objects obtained with the use of various geological and geophysical methods by productivity criterion; to define more exactly the external contour of oil and gas presence; and to promptly estimate the oil and gas bearing capacity before prospect drilling

Specification

The method provides predictions of hydrocarbon deposits located at a depth of 1500–6000 m. The probability is 80%. The survey results are maps of anomalies caused by hydrocarbon deposits (at a scale of 1 : 50 000–1 : 10 000)



Technology approbation results: 1 – wells: a) gas wells, b) non-productive wells; 2 – productive wells drilled before anomalies detection; 3 – optical anomalies based upon survey results

Advantages

The method has no counterparts. It ensures prompt results, low costs, and highly verifiable predictions

Stage of Development. Suggestions for Commercialization

IRL7, TRL8
Satellite geologic surveys for oil and gas prospecting are done upon request

IPR Protection

IPR3



Derrick at well No. 8

Contact Information

Oleksandr I. Arkhipov, Scientific Center for Aerospace Research of the Earth, Institute of Geological Science of the NAS of Ukraine; +38 044 486 84 21, +38 066 098 02 91, e-mail: aiarh19443@gmail.com

NEUTRON GENERATOR BASED ON NTG-2M TYPE SMALL-SIZED NEUTRON TUBE AREAS OF APPLICATION



Areas of Application

The generator is to be used for pulsed neutron logging of wells while exploring and controlling the extraction of mineral resources from oil and gas deposits

Specification

Maximum energy of neutrons, MeV	14
Maximum activity of tritium, GBq	488.4
Minimum average neutron yield, s ⁻¹ :	
after manufacture	2×10^8
after 200 hour operation	5×10^7
Frequency of neutron bursts, kHz	0.05–20
Acceleration voltage, kV	100
Minimum longitudinal magnetic field, mT	20
Cathode glow voltage of ion source, V	1
Ion source B-supply pulse amplitude, V	<500
Voltage of deuterium-tritium mix storage heater, V	<6
Power consumption, W	<35
Operating temperature, K	283–423
Dimensions, mm:	
maximum tube diameter (without magnet)	29
high-voltage electrode diameter	19
length	155
Service life, years	2
Term of operation, hours	200

Advantages

This generator surpasses the TNT-1411 tube-based neutron generators manufactured in Russian Federation

Stage of Development. Suggestions for Commercialization

IRL4, TRL4
Prototype manufacture and tests in customer's operating environment are provided upon request

IPR Protection

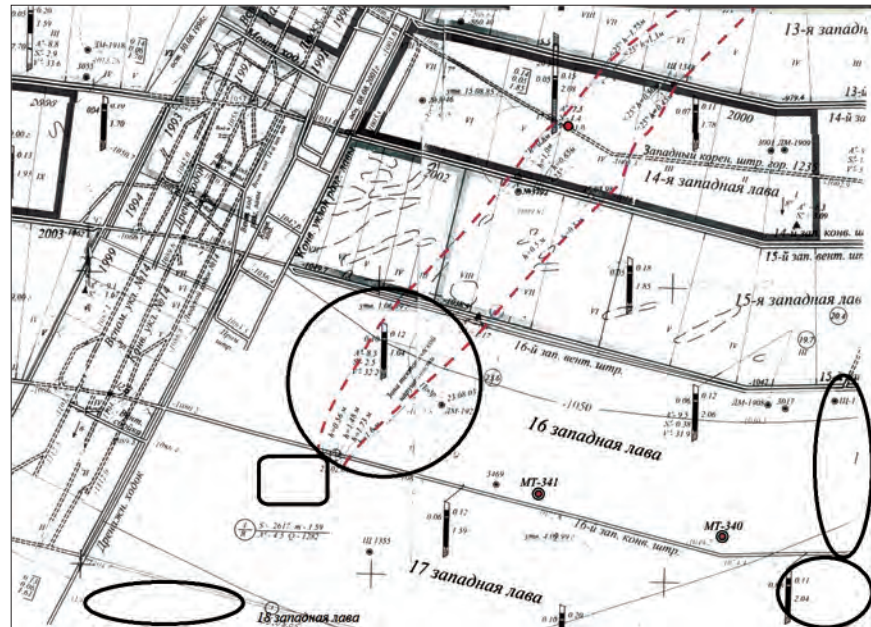
IPR1

Contact Information

Oleksandr V. Kovalenko, Institute of Nuclear Research of the NAS of Ukraine;
+38 044 525 26 14, e-mail: akovalenko@kinr.kiev.ua

PREDICTION OF METHANE OUTBURST RISK IN COAL-BEARING ROCK MASSIFS

Map of a coal bed with dangerous areas identified based on their gas dynamic manifestations:
 ○ – zones recommended for degassing; □ – zones not recommended for degassing



Areas of Application

The prediction is used to identify the dangerous areas in coal beds and exhausted mines and the zones suitable for coal bed methane degassing

Specification

Building of prognostic maps of local maximum gas-pay zones bearing unsaturated, saturated, and heavy hydrocarbon gases. The following parameters of coal mining horizon are defined and predicted:

- a) The operating mine:
 - Safe for mining after previous degassing (methane content is over 25% with the presence of saturated hydrocarbons);
 - Dangerous for degassing (heavy hydrocarbons, no saturated hydrocarbons)
- b) The depleted mine:
 - Safe for degassing (methane content is over 15% with the presence of saturated hydrocarbons);
 - Dangerous for degassing (heavy hydrocarbons, no saturated hydrocarbons)

Advantages

As compared with similar techniques, this prediction is made while sinking, developing, and partly abandoning coal mines. In the case of unexpected gas dynamic situations, it enables the localization of dangerous areas and their further monitoring until the gas condition of coal rock massif becomes safe

Stage of Development. Suggestions for Commercialization

IRL7, TRL6
 The works are performed at coal producing enterprises, upon request

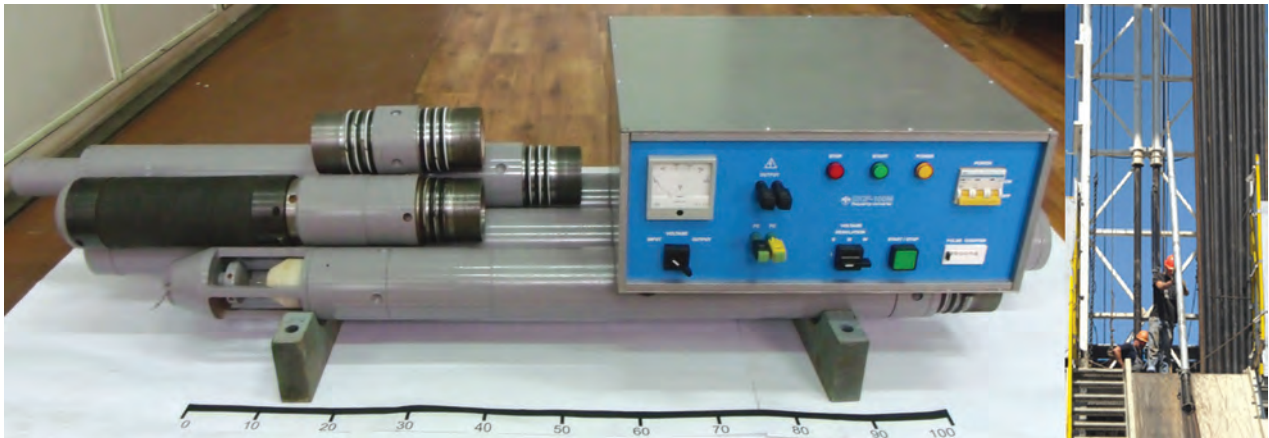
IPR Protection

IPR3

Contact Information

Ruslan B. Gavryliuk, Institute of Geological Sciences of the NAS of Ukraine;
 +38 044 239 74 16, e-mail: gavriyuk.ruslan@gmail.com

SKIF-100M ELECTRODISCHARGE DEVICE



Areas of Application

The device is to be used for treating the bottom-hole zones and for increasing the productivity of oil, gas, injection, and artesian wells

Specification

Power consumption, kW · h	2.0
Overall dimensions of the surface part, mm	555 × 500 × 245
Overall dimensions of the submersible part, mm:	
diameter	102
length, at most	4700
Weight, kg:	
the surface part	≤25
the submersible part	≤140
Working temperature, °C	<100
Hydrostatic pressure, MPa	<45
Power supply	380 ± 10% V, 50 ± 1% Hz

Advantages

Environmental safety, high efficiency, and high success rate of treatment (≈80%); aftereffect lasting from 10 to 24 months; selectivity of effect in the localized area of stratum; simplicity and reliability; minimum power consumption; multiple cyclic operation of set assembly. Having been implemented on several hundred wells in Ukraine, Kazakhstan, China, and in other countries, the device enables a more than 2 time increase in flow rate of oil or water

IPR Protection

IPR3

Stage of Development.

Suggestions for Commercialization

IRL7, TRL8

Manufacture, delivery and maintenance of the device through the warranty period, as well as personnel training are provided upon request

Contact Information

Serhii V. Petrichenko, Institute of Pulse Processes and Technologies of the NAS of Ukraine;
+38 0512 587 110, e-mail: iipt@iipt.com.ua

TECHNOLOGY FOR COMPREHENSIVE PROCESSING OF PEAT AND BIOMASS INTO COMPOSITE FUEL WITH EXTRACTION OF HUMIC SUBSTANCES FROM MILLED PEAT FOR FERTILIZER PRODUCTION

Areas of Application

The technology is to be used in peat processing industry of Ukraine; for producing biofuels and fertilizers from raw peat materials. It enables resource saving and diversification of peat processing works

Specification

This technology foresees integrating the technology for humic substances extraction from peat into production cycle of briquetting factory. The technology is used depending on seasonal demand (for fertilizers or for fuel). The upgraded peat briquetting factory with a 4-month annual production cycle and with the use of 3 % humate solution gets a 4 times higher profit.

The heat engineering properties of composite briquette are as follows:

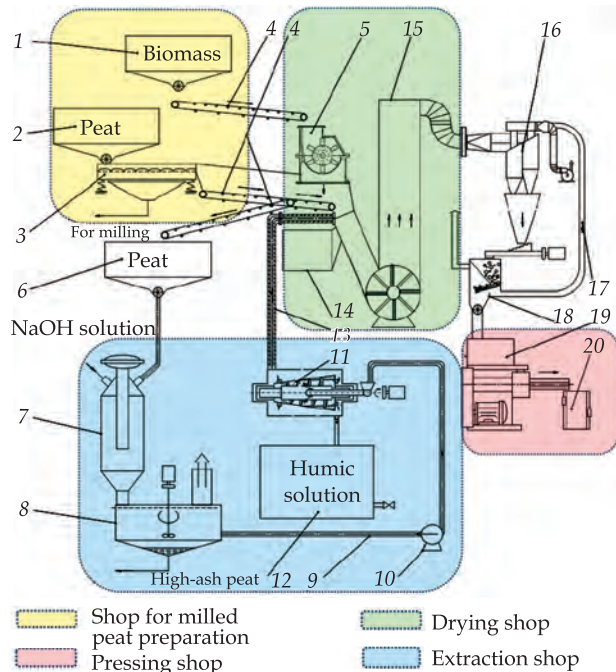
moisture, %	12
peat content, %	60
ash content, %	10
combustion heat, MJ/kg	17

Stage of Development. Suggestions for Commercialization

IRL3, TRL2
Feasibility study and design documentation for upgrade of existing production facilities are developed upon request

IPR Protection

IPR2



Flowchart of technology for comprehensive peat processing:
1 – bunker for biomass; 2 – bunker for milled peat;
3 – separator; 4 – transporter; 5 – hammer crusher;
6 – bunker for milled peat of extraction section;
7 – cavitation extractor; 8 – collector of pulp; 9 – pipeline;
10 – pump; 11 – centrifuge; 12 – collector of humic solution;
13 – screw feeder; 14 – heat generator;
15 – aerodynamic dryer with mill; 16 – cyclones; 17 – steam supply line; 18 – bunker for heat-moisture treatment; 19 – impactor press; 20 – bunker for finished products

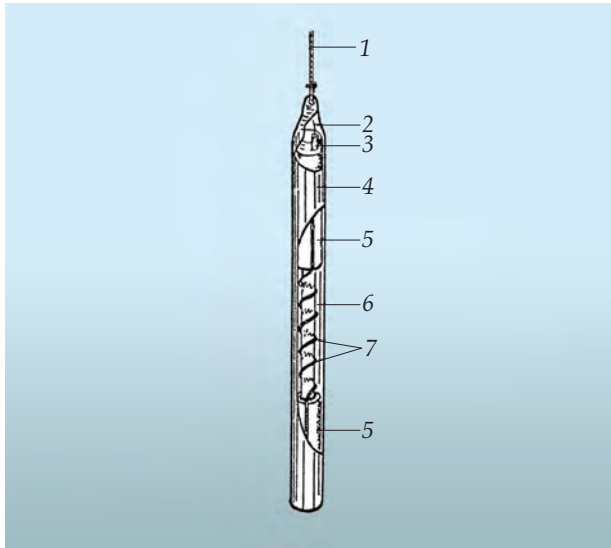
Advantages

The use of integrated technology for peat processing enables to reduce humates production costs 4.5 times as compared with those at individual enterprise, whereas the briquetting cost remains unchanged

Contact Information

Alexander I. Chaika, Institute of Engineering Thermophysics of the NAS of Ukraine;
+38 044 456 93 81, e-mail: chaika@ittf.kiev.ua

TECHNOLOGY FOR ENHANCING THE OIL WELL PRODUCTIVITY



Sectional torpedo: 1 – electro-physical cable; 2 – electric wire; 3 – triggering facility; 4 – case; 5 – explosive matter; 6 – spindle; 7 – detonating cord

Areas of Application

The technology is to be used for raising the yield of oil-gas producing and injecting wells, which has lost their productivity as a result of long-term operation and have the following parameters:

Well configuration: with uncased and cased bore;

Diameter: from 114.3 mm and more;

Depth: up to 5.5 km;

Thickness of workable beds:

1.0–20.0 m and more

Advantages

There are no counterparts in Ukraine.

The use of proposed technology increases 1.5–2 times the yield of oil wells and 3–10 times that of gas wells.

The effect sustains for 1.5–3 years



Pumping method of oil production

Specification

The technology is based on improving the filtration abilities of bottom-hole formation zone of oil-gas-bearing beds as a result of dilatancy of container rock massifs caused by inhomogeneous impulse action produced by explosion of sectional torpedo. The use of torpedo on ongoing basis has been authorized by the State Committee of Ukraine on Supervision over Labor Protection and the technology has been tested on marginal wells of *Naftogaz* of Ukraine NJSC

Stage of Development.

Suggestions for Commercialization

IRL8, TRL8

Sectional torpedoes are manufactured and author's supervision of works is provided upon request

IPR Protection

IPR3

Contact Information

Volodymyr P. Nagorny, S. Subbotin Institute of Geophysics of the NAS of Ukraine;
+38 044 234 09 91, e-mail: vgv_nagorny@ukr.net

TECHNOLOGY FOR RECOVERING PRODUCTIVITY OF WATER SUPPLY WELLS



Debit recovery of water supply well No. 3754 located in Bucha



Debit recovery of water supply well No. 3754 located in Irpin

Areas of Application

The technology is to be used for recovering industrial water supply wells up to 200 m depth, the debit of which has decreased as a result of long-term use

Specification

The technology is based on initiating the detonation of propane-oxygen mix in gas generator. The gas generator is dipped in water supply well at the level of filter. This leads to generating a regulated pressure pulse (40–500 atm) and a prolonged phase of attenuation after the front of blast pressure wave that cleans the well filter from contamination

Advantages

As compared with other technologies, this one enables a wider adjustment of pressure pulse amplitude and a protracted phase of attenuation, which affect the well filter. Using this technology for industrial water supply wells makes it possible to recover their debit up to the initial level



Gas generator

Stage of Development. Suggestions for Commercialization

IRL7, TRL6
The works on recovering the productivity of water supply wells are performed upon request

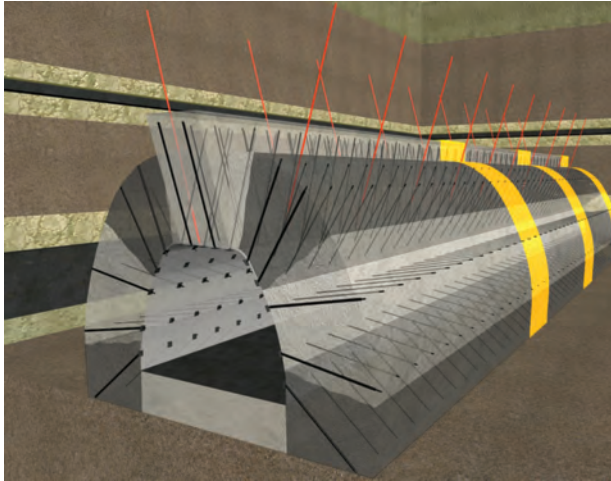
IPR ProtectionI

IPR2

Contact Information

Vladimir O. Polykovskiy, S. Subbotin Institute of Geophysics of the NAS of Ukraine;
+38 068 355 97 58, e-mail: polykovskiyvo@nas.gov.ua

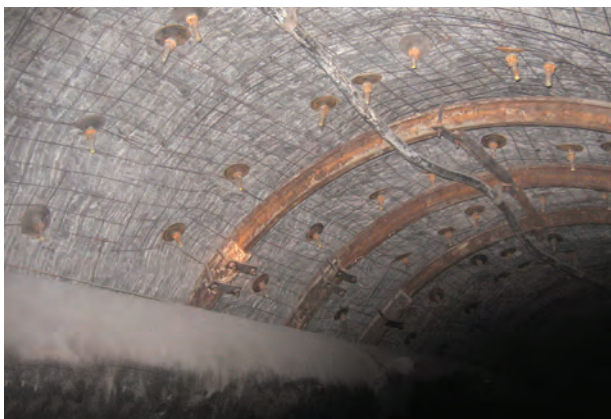
TECHNOLOGY FOR ROOF-BOLTING SUPPORT OF MINE ROADWAYS, INDUSTRIAL AND CIVIL ENGINEERING UNDERGROUND AND SURFACE FACILITIES



Roof-bolting support scheme



Roadways with roof bolting (upper) and frame (lower) supports



Areas of Application

The technology is to be used for implementing new resource-saving supports in the mine roadways while building different underground and surface facilities to radically improve stability, reliability, and safety of their structure and operation and to significantly cut the costs for their protection and maintenance

Specification

Mine cross section, m ²	9–30
Rock strength, MPa	8–90
Metal anchors:	
diameter, mm	22–28
length, mm	1500–3000
Cable anchors,	
length, mm	4000–8000
	and more, if needed

Advantages

Implementation of the advanced roof-bolting supports in mine roadways speeds up 1.4–2 times the period of roadway construction and reduces 1.5–3 times the costs of roadway drivage and repair in comparison with conventional frame supports that significantly increase the coal cost

Stage of Development.

Suggestions for Commercialization

IRL8, TRL8

Upon request, geotechnical survey of mine roadway, underground and surface facilities is carried out; roof-bolting supports are designed; and recommendations on their assembly and installation as well as personnel training are provided

IPR Protection

IPR1, IPR2, IPR3

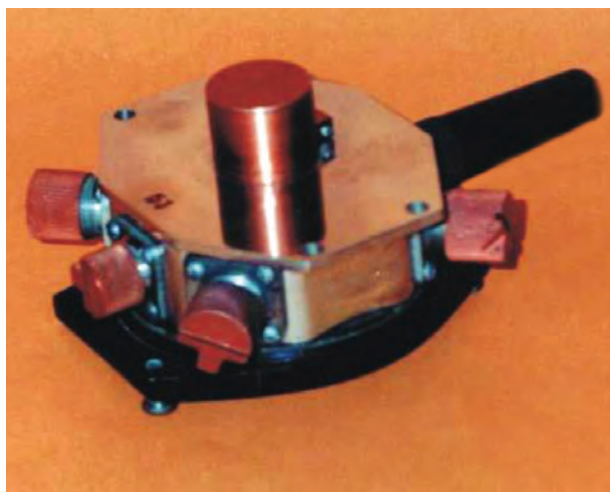
Contact Information

Oleksandr P. Krukovskiy, Institute of Geotechnical Mechanics named by N. Poljakov of the NAS of Ukraine; +38 050 837 21 08; e-mail: igt@ukr.net

THERMOELECTRIC COOLING SENSOR (TCS)

Areas of Application

The device is to be used for analysis of rocks in deep well drilling. It can be used on interplanetary stations to determine the elemental composition of soil of the Solar System planets, as well



Specification

Energy resolution, at least, eV	600
Isolation resistance between disconnected electrical circuits, max Mohm	20
Power consumption in the supply circuit of thermoelectric cooler, W	40
Warm-up time, at most, min	10
Supply voltage of thermoelectric cooler, V	12 ± 5
Pressure inside thermoelectric cooling sensor, at most, mmHg	5×10^{-3}
Cooling at an ambient temperature of 0 °C, at most, °C	-100
Weight, at most, g	1500
Operational life in continuous operating mode, at most, hours	2
Operational life at periodic operating mode, at least, hours	30
Probability of failure-free performance, at least, %	99.9
Time of depressurization of thermoelectric sensor, at least, min	5

Advantages

The device provides an energy resolution of about 600 eV for energy of 5.9 keV, which enables determination of element concentration in soil of down to 10^{-6}

Stage of Development. Suggestions for Commercialization

IRL6, TRL6

The product is manufactured and supplied, upon request

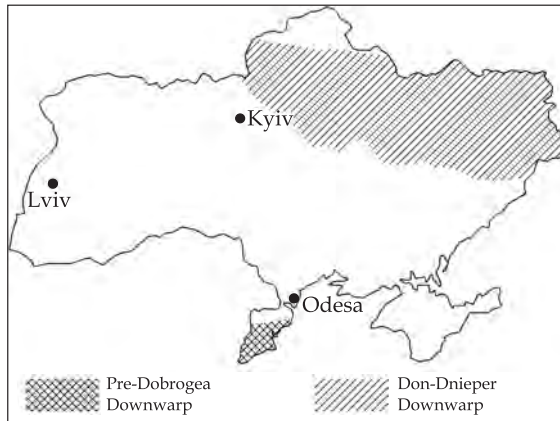
IPR Protection

IPR3

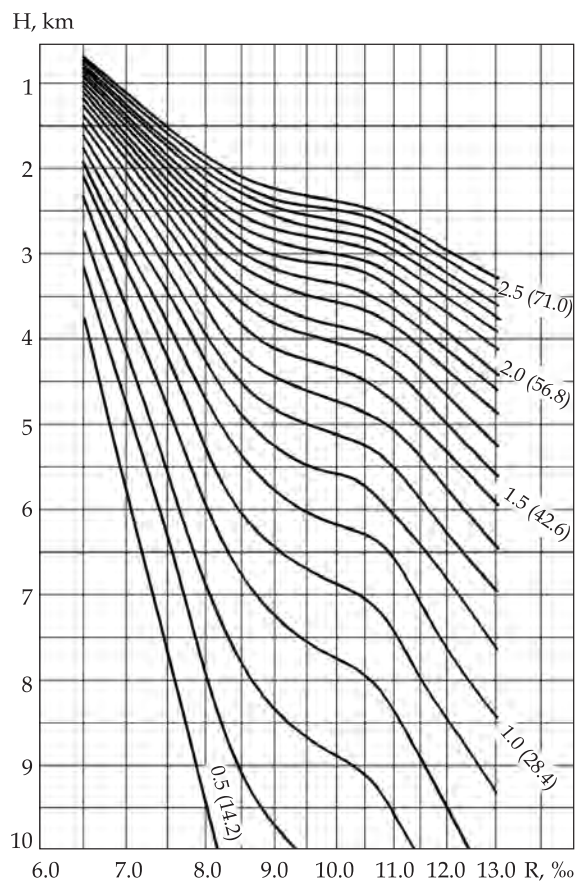
Contact Information

Pavlo D. Mykytiuk, Institute of Thermoelectricity of the NAS of Ukraine and the Ministry of Education and Science of Ukraine; +38 037 22 4 44 22, e-mail: anatyck@gmail.com

VITRINITE THERMOMETRY AS A TOOL OF PALEOGEOTHERMAL AND PALEOTECTONIC RECONSTRUCTIONS AREAS OF APPLICATION



Map of coal-bearing regions (the Don-Dnieper and the Pre-Dobrogea Downwarps) of vitrinite thermometry method tests



Nomographic chart of VRI dependence on depth with various parametric coefficients

Areas of Application

The method is to be used for determining the paleogeothermal and paleotectonic parameters of tectonic structures and catagenetic zoning of rocks to make a forecast of oil and gas content and a detailed reconstruction of paleogeothermal conditions for the formation of sedimentary rocks complexes of different regions

Specification

The method provides a computerized processing of vitrinite reflectance indices (VRI). The reference paleogeothermal section is used as a model. The algorithm is based on the normalization of VRI data for different depths using the paleotemperature function with further determination of paleogeothermal and paleotectonic parameters oriented to direct appraisal and exploration works

Advantages

The method has no analogs. It has been tested on the carboniferous sediments of the Don-Dnieper and Pre-Dobrogea Downwarps. For the depths with a lack of actual data the VRI is estimated by extrapolation. For structures that have a fairly complete stratigraphic cut it is possible to determine the geological time of maximum thermal penetration into rocks

Stage of Development. Suggestions for Commercialization

IRL2, TRL3

The degree of catagenesis, paleogeothermal gradients ($^{\circ}\text{C}/100\text{ m}$), paleodepths, and inversion amplitudes of tectonic structures for prediction and oil and gas occurrence are determined upon request

IPR Protection

IPR1, IPR3

Contact Information

Ruslan B. Havryliuk, Institute of Geological Sciences of the NAS of Ukraine;
+38 044 239 74 16, e-mail: gavrilyuk.ruslan@gmail.com

TECHNOLOGY READINESS LEVEL (TRL) SCALE

Stage	TRL	Interpretation	Definition and Description
Invention	TRL1	Basic principles observed	Basic scholarly research is translated into potential new basic principles that can be used in new technologies
	TRL2	Technology concept formulated	Potential areas of application of basic (technological) principles, including the technological concept are identified. Basic manufacturing principles are elaborated and potential sales markets are identified. A small research team is established to assess the project feasibility
Concept validation	TRL3	First assessment of concept and technology effectiveness	Based on preliminary study, actual research is conducted to assess technical and market feasibility of the concept. This includes active R&D works at the lab and first negotiations with potential customers. The research team expands. Market feasibility is assessed
	TRL4	Prototype validation at lab	Basic technological components are integrated to assess early feasibility by testing in laboratory environment. Manufacture options are studied with basic manufacturing principles identified. Key markets are researched to study demand. The organization is ready to scale up, possible services are analyzed. Comprehensive marketing analysis is made
Prototyping and incubation	TRL5	Prototype testing in user environment	The system is tested in user environment with broader technological infrastructure involved. The actual use is tested and validated. Production-support works and pre-production tests are done in lab environment. Trial batches of prototypes enter the key markets. The organization starts activities to further distribute the prototypes and to enter the sales markets
Pilot production and demonstration	TRL6	Pre-production, including tests in user environment	The product and manufacturing technologies are completely ready for launch of a pilot line/pilot plant (low-scale manufacture). The product and manufacturing technologies are assessed and finalized. This may include additional R&D works. The early products and manufacturing technologies are tested in the key markets with simultaneous organization of manufacture (marketing research, logistics, production facilities, etc.)
	TRL7	Low-scale pilot production demonstrated	The product manufacture is fully operational at low rate. Actual commercial products are manufactured. The final products are verified in the key markets. The organizational component is completed (comprehensive marketing strategy, all components of manufacturing activities). The products are formally launched in test markets
Initial market introduction	TRL8	Manufacture fully tested, validated, and certified	The manufacturing flow charts, product final version, production organization, and marketing tools are completed. The full-scale manufacture has been launched. The final product is sold in majority of domestic and international markets
Market expansion	TRL9	Manufacture and products fully operational and competitive	The full-scale manufacture is sustainable, with the product gaining new markets. Minor modifications and improvements create new versions. The technology and product output are optimized through implementing innovative concepts on manufacturing process. The product is fully customized to the key markets

INNOVATION READINESS LEVEL (IRL) SCALE

IRL	Innovation Readiness Level	Definition
IRL1	Inventor or team with a dream	The lowest level of readiness where the intention transforms into an idea of space system application or the space technology transforms into a business venture
IRL2	Paper studies produced	Once the basic ideas have been formulated, they are put down on paper in studies and analyses of business opportunities
IRL3	Experimental evidence of business opportunity	Active research and development are initiated, including analytical / laboratory studies to validate predictions regarding the market, the competition, and the technology
IRL4	Capability to implement limited-scope programs with project teams	Basic technological and business components have been developed to establish that they will work together; an initial business plan is available
IRL5	Capability to support project engineering development and design (no product, no revenues)	The basic technological and business components have been integrated with reasonably realistic supporting elements. The business plan is credible, but still needs to be validated against the final product characteristics
IRL6	Capability to support development and design with a market-driven business team (product, no revenues)	The representative prototype system has been tested in a relevant environment. The business team is still incomplete and the venture is not yet ready for commercialization. A full business plan including the market, the operational, the technological, and the financial aspects is available
IRL7	Capability to support limited production; full business team in place (product and limited revenues)	The business can run on a limited scale. The full team is in place
IRL8	Capability to advance to full production and distribution (product and revenues)	The technology has been proven to work and the venture structure has proven to be able to support growing market shares
IRL9	Fully articulated business with appropriate infrastructure and staffing (growing market share)	The offering incorporating the new technology has been used in operational conditions and the business is running with a growing market share

Intellectual Property Rights Protection¹ Levels

IPR codes	Protection Level
IPR1	Technical solutions are know-how ²
IPR2	Applications for copyright protection of IPR objects are expected to be or have been submitted
IPR3	The copyright protection of IPR objects as established by the applicable law of Ukraine has been obtained and is kept in force
IPR4	International industrial patent application(s) (according to the PCT system, etc.) has (have) been submitted. Application(s) for industrial patents has (have) been submitted in foreign country(ies) under national procedure
IPR5	The industrial patent(s) in foreign country(ies) has (have) been obtained and is/are kept in force

¹ The IPR protection measures are implemented by R&D institutions in accordance with the applicable legislation of Ukraine and the requirements of paragraphs 5, 8, and 9 of the Regulations for the use of intellectual property objects at the NAS of Ukraine as approved by Resolution of the Presidium of the NAS of Ukraine No.15 of January 16, 2008, on the Structural Units Responsible for Technology Transfer, Innovation Activities, and Intellectual Property (as revised)

² Know-how is technical, organizational, or commercial data obtained with the use of experience and upon trials of technology and its components, which are: closely held (not a part of general knowledge or available for public) on the date of license agreement; essential, i.e. important and useful for manufacture of products, manufacturing process, and/or provision of services; and elaborate i.e. detailed and complicated enough to verify their compliance with the criteria of being never-before-known and essential (Clause 1 of the Law of Ukraine on the State Regulation of Technology Transfer Activities)

Reference book

THE NATIONAL ACADEMY OF SCIENCES OF UKRAINE

**R&D
AND TECHNOLOGIES**

THE NAS OF UKRAINE

IN 11 SPESIAL ISSUES

Issue

TECHNOLOGIES
AND EQUIPMENT FOR EXPLORING,
ESTIMATING, AND EXTRACTING
MINERAL RESOURCES

Compiled by
I.A. Malchevskyi and S.A. Bepalov

Translated, edited, and proofread
by O.A. Zagorodnia

Art work by
Ye.O. Ilnytskyi

Technical editor
T.M. Shenderovych

Desktop publishing by
V.M. Kanishcheva, N.M. Kovalenko,
and S.V. Kubariev

Illustrative materials prepared by
N.M. Kovalenko

Signed to print 18.05.2018.
Format 60 × 84/8. Font: Book Antiqua.
Conventional printed sheets 2.44. Published sheets: 1.93.
Circulation 100 copies. Order № 5268.