OIL & GAS HORIZONS IX

9th INTERNATIONAL YOUTH SCIENTIFIC AND PRACTICAL CONGRESS
OIL AND GAS HORIZONS

ABSTRACT BOOK

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ГУБКИНСКИЙ УНИВЕРСИТЕТ
GUBKIN UNIVERSITY

Gubkin Russian State University of Oil and Gas
(National Research University)
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Dear Participant / Guest,

Welcome to the 9th International Youth Scientific and Practical Congress Oil and Gas Horizons!

Oil and Gas Horizons is annual international congress organized by Gubkin University SPE Student Chapter. Traditionally, over a hundred students and young specialists from universities and companies all over the world take part in it.

Interest in the Congress this year was really great. Organizers received 184 applications from 29 counties. For participation, the most well-founded scientific works and high-motivated students were selected.

The Congress represents a solid basis for students and industry professionals to share their knowledge and experience.

We consider it as a possibility for students to present their views on the current challenges and prospects of the domestic and global petroleum industry, issues regarding professional training and internationalization of education as imperative for sustainable development as well as any other issues which they would consider as important.

The aim and objectives:

- creating a basis for young experts to provide and exchange ideas, experience and technologies;
- strengthening scientific collaboration and business communication between Russian and foreign experts;
- defining of probable tendencies of scientific and technical development in fundamental oil and gas trends.

In fact, the Oil and Gas Horizons Congress is the biggest international youth scientific and practical event in the oil and gas industry in the Russian and Caspian Region. Year after year the amount and the geography of participants continuous to grow. Alongside with that the amount and the diversity of the abstracts grows too, that leads to the rising amount and quality of the selected works.

Oil and Gas Horizons is not only scientific event. Pleasant, friendly atmosphere and informal communication are integral parts of the Congress. So the participants can not only exchange their knowledge, experience and improve their skills, but also have a talk in an informal atmosphere, we organized excursion tours around Moscow, different evening events and conference Gubkin Talks. As even a regular transfer from hostel to the University can be a hall adventure if you are accompanied not only with your colleagues but with a true friends!

Conquer the Horizons of Your Opportunities!

Yours,
Organizing Committee

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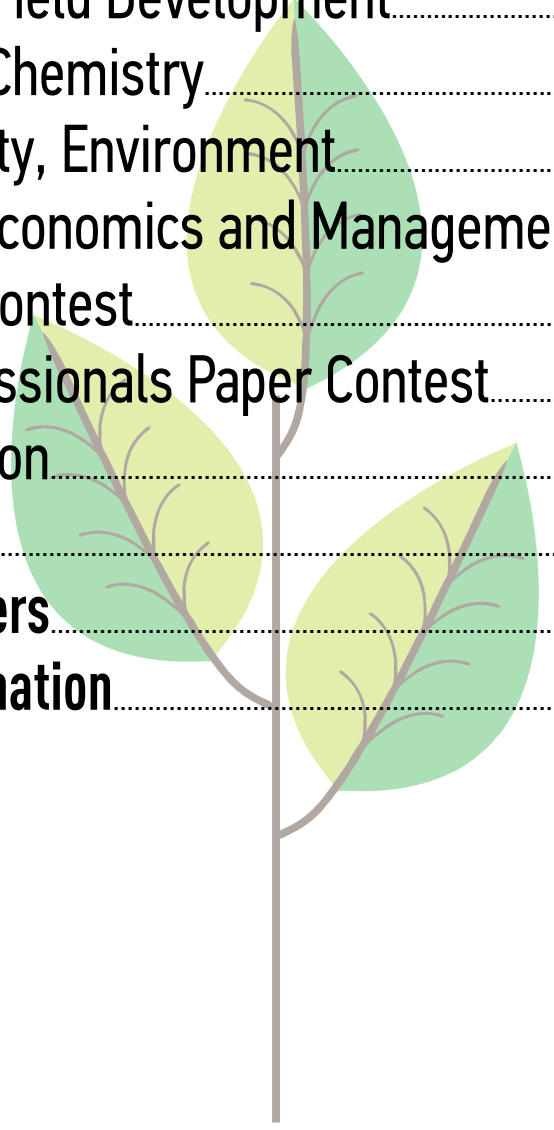

ABSTRACTS

GEOSCIENCES

TECHNICAL PROGRAMME

Judges:

Evgenia Bileva, TOTAL, Reservoir Geologist
Alexandre Belousov, Gubkin University, Ass. Professor, Dept. of Exploraion Geophysics
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Assel Salimova, Baker Hughes, Geoscience and Petroleum Engineering Manager
Ilya Romanov, Baker Hughes, Geoscientist
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IDENTIFICATION OF GEOLOGICAL STRUCTURES USING MATHEMATICAL EQUATIONS ININTERPRETATION OF MAGNETIC SURVEY DATA, CHU-SARYSU

Author: Alisher Saduov*
Mentor: Taikulakov Y., Ms'c

Key words. First derivative, second derivative, filters, Gradient Operator, magnetic survey, interpretation, Chu-Sarysu.

Introduction. Currently, there are many methods of modern interpretation of magnetic survey data fordetermination of geological structures and their shape, depth of occurrence. As an example, the area where thedetailed magneto-prospecting was carried out was chosen, by Chu-Ili party in 1978-1981.

Aim. To identify geological structures using mathematical equations in interpretation of magnetic survey data.

Materials and methods. To interpret the data in the study area, the following methods were used: first vertical derivative, second vertical derivative, calculation of Gradient operator, and low and high frequency filters.

Results. The results of a comparison between interpretation data and data that were obtained by observations of scientists were demonstrated, and as a result, it was revealed that the data of both maps practically coincide with each other.

Conclusions. Thus, it is proved that these methods of interpretation of magnetic prospecting are effective in the detection of geological structures.

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ADVANCES IN COALBED METHANE RESERVOIRS CHARACTERIZATION AND HYDRAULIC FRACTURING FOR IMPROVED GAS RECOVERY IN KARAGANDA COAL BASIN, KAZAKHSTAN

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Mentor: Aleksandr Ivakhnenko, PhD

Key words. Coalbed methane, hydraulic fracturing, magnetic susceptibility, permeability.

Introduction. Coalbed methane (CBM) fields in Karaganda Coal Basin are characterized by geological and structural complexity. Majority of production zones have high methane content and extremely low permeability of the coal seams that lead to reservoir stimulation problems.

Aim. In order to understand this complexity we applied integrated reservoir characterization using probe permeability measurements of core samples collected from the wells, magnetic susceptibility measurements, maceral analysis and desorption studies. We also estimated potential influence of these parameters on hydraulic fracturing (HF) to propose successful HF program.

Materials and methods. We carried out probe measurements of magnetic susceptibility and permeability profiles for different CBM reservoir intervals and micro-profiling of coal samples. The empirical results of magnetic susceptibility and permeability of formations were compared with each other andgraphs were plotted. The relation between the potential production rate and type of the fractured coal interval was estimated based on the permeability variation in the coal sections. Gas production rate graph was plotted and analyzed.

Results. Integrated coalbed reservoir characterization indicated that at least two types of coal reservoir heterogeneity are present. First coal reservoir (P–permeable type) is characterized by lower negative magnetic susceptibility and highto very high cleat system permeability. The second coal reservoir (LP–type with low permeability) is characterized by more negative magnetic susceptibility and low permeability.

Conclusions. Integrated reservoir characterization leads to the following findings:

1. Method of using magnetic susceptibility characterization leads to determination of coal reservoir`s so-called “sweet spots” and high gas absorption zones, identification of the targets for hydraulic fracturing. The most productive sections of the coal reservoir have high permeability and the low magnetic susceptibility values.
2. The production rate graph displays the distinctive case when migration of fines closed off perforation ports for gas migration and that leads to low gas production.
3. Two coal reservoir types lead to different behavior in reservoir stimulation. In order to achieve better performance after the implementation of HF the most suitable coal reservoirs are of P type. This coal type is highly permeable, tends to produce much less fines compared to LP type during HF and thereforewill be more responsive to HF.

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MECHANICAL EARTH MODELING OF WEAK CARBONATES FOR CRITICALLY STRESSED FRACTURES ANALYSIS

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Mentor: Dr. Ivan Deshenenkov

Key words. Borehole images, geomechanical analysis, critically stressed fractures, conductive fractures, permeability variation.

Introduction. Geomechanical properties analysis and wellbore stability have gained particular importance in the last decades as a response to the increasing exploration and development of complex areas. This analysis presents a solution for several major engineering challenges in drilling and production. The paper investigates how the fracture conductivity affects drilling and production performance in situations, where fracture instability is mainly driven by stress concentrations. It is well-known that fractures and faults in rock masses often serve as primary conduits for fluid flow having a strong influence on bulk permeability.

Aim. The main goal of the work is to distinguish these conductive natural fractures in the weak Lower Permian carbonate formation from Timano-Pechora Region in Russia, composed of limestone with high matrix porosity. Previous studies have shown that shear displacement and dilation of fractures can be sources of mechanical instability as well as significant fluid migration. The analysis of mechanical properties in combination with fracture identification and stress orientation will provide ultimate understanding of fracture stability.

Materials and methods. The orientation of maximum principal horizontal stress was validated by observations of borehole breakouts and drilling induced tensile fractures interpreted from borehole images in vertical wells. The pore pressure was higher than hydrostatic pressure was constrained by a combination of compaction trend line, mud weight and modular formation dynamics tester data. The minimum horizontal stress gradient was estimated from leak-off tests. The post-injection data were interpreted to support pore pressure and flow regime identification. The unconfined compressive strength and the mechanical properties were calculated with wireline logs and calibrated with the core data. Wellbore stability modeling was constrained by the drilling events and mud weight.

Results. Coulomb failure function with 1D mechanical earth modeling were used for the analysis of the frictional failure on pre-existing natural fractures. The results of this modeling were further applied to address a range of borehole stability issues, such as determining optimally-stable wellbore trajectories and optimizing reservoir productivity. In the production lifecycle of a reservoir, absolute permeability at any given location may change in response to localized changes in stress within the rock pore system from depletion of the reservoir rock. The geomechanical model was coupled with the reservoir dynamic model to predict changes in total stress due to reservoir pressure changes through time. The displacement, compaction and volumetric strain were obtained to evaluate their effects on permeability and porosity. Variation of reservoir properties is due to changes of individual grains' positions and shapes, slippage, rotation and fracturing of the grains.

Conclusions. Existence of stress-dependent fracture transmissivity and permeability have a significant effect on the performance of an individual well and the reservoir. Permeability variations can be used for delineation of sweet spots with better permeability. Modeling the increase in the magnitude of effective stress at post-production conditions could indicate fracture reactivation and the reduction in permeability.

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SELECTION OF THE OPTIMAL RECORDING EQUIPMENT FOR PPOBLEMS OF SEISMIC MONITORING OF HYDROCARBON DEPOSITS

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Key words. Seismic monitoring, deposits safety, seismometers, seismic sensors.

Introduction. The long-term process of the hydrocarbon deposits development is often accompanied by the rock deformation of the reservoir, which in turn causes significant economic and ecological losses. The deformation processes are accompanied with the seismic activity that determines the seismic risk. Seismic monitoring allows to detect the hazardous zones of potential seismic risk and to control the dynamics of seismic activity of the reservoir.The seismic monitoring of deposits is primarily aimed at recording weak signals from local earthquakes. Thus the sensitivity of the recording equipment are more demanding than in the case of seismic survey or seismological monitoring. Seismic recorders should have a low level of the self-noise and sensors should have sufficient sensitivity of ground motion and a suitable frequency range. Incorrect selection of the equipment leads to errors in the results of monitoring and misjudging of the seismic hazard.

Aim. Improvement of the technology for organization and implementation seismic monitoring of hydrocarbon deposits by selection of the optimal hardware solutions.

Materials and methods. I carried out the series of laboratory experiments to evaluate the noise distribution of different models of seismic recorders, including obtaining their frequency response and measuring self-noise in the target frequency range. The seismic sensors were tested on a piezoceramic vibrating stand (development of IPGG SB RAS) which generates oscillations in the form of an SWEEP signal in the frequency range from 0 to 300 Hz. The design of the stand allows testing sensors of any spatial orientation. Data were used to compare the results of laboratory studies with real seismic records from the current seismic monitoring network of the hydrocarbon deposits, which includes a surface system of seismological stations and an observation well.

Results. The results of the experiments showed a significant difference between levels of self-noises in various models of seismic recorders.The results of mass testing of sensors on a vibrating stand demonstrated the stability of the metrological characteristics of electrodynamic seismometers. The comparison of measured and theoretical responses allows estimating the permissible angles of inclination of vertical and horizontal sensors, which is especially important for installation in wells.

Conclusion. The complex of methods described in this paper makes possible to evaluate the suitability of recording equipment for specific problems of seismic monitoring of hydrocarbon deposits and recognition of the seismic risk.

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THE FIRST DATA OF THE COMPOSITION AND MATURITY OF DISPERSED ORGANIC MATTER IN SANDSTONES OF UPPER-TRIASSIC-LOWER-JURASSIC SERIES (THE SECOND RIDGE OF THE CRIMEAN MOUNTAINS)

Author: Rina Gumerova*
Mentor: Prof. Nikolai Kuznetsov.

Key words. Crimea, sandstones, DOM, source rocks, Rock-Eval.

Introduction. Structural basis of monoclinal overlying Cretaceous, Paleocene and Eocene layers of the Second ridge of the Crimean mountains is significantly composed by deformed early Mesozoic formations. Upper-Triassic-Lower-Jurassic formation (Taurian series) is considered to be the most ancient of them and it is regarded as its stratigraphic equivalent of Eski-Ordinskaya series by some researchers. Taurian series is presented by rhythmically alternating sandstones, siltstones and mudstones, which is closed to typical flysch formations. In contrast, Eski-Ordinskaya series is characterized by clear signs of chaotic structure and it is characterized as wild flysch.

Aim. The purpose of this study is to obtain the first information about physical characteristics, contents and degree of maturity of dispersed organic matter (DOM) in the sandstones of Eski-Ordinskaya series.

Materials and methods. The object of the exploration is sandstones of Eski-Ordinskaya series found in the outcrops of surroundings of Trudoljubovka valley, Bakhchisaray district of the Republic of Crimea. The study of the material characteristics of the DOM in sandstones (samples GR-16-001/B and GR-16-002/B) of Eski-Ordinskaya series, the definition of its content and maturity were made with Rock-Eval method. For more detailed information the lithological study of the sandstones was made under the microscope.

Results. Microscopic study of these sandstones showed that these are silty sandstones which include shaped biogenic elements such as inclusions of carbonaceous matter (detritus of carbonaceous «wood»), covering up to 10% of the area of the sections. The results of the pyrolytic analysis show that the studied sandstones contain significant amount of total organic carbon (TOC) and can be considered potentially as source rocks. However, Tmax values show that the explored rocks have not experienced significant warming since their formation and up to the present time, and the DOM contained in them is not mature enough for hydrocarbons generation.

Conclusion. In this work only the first information about the DOM in sandstones of Upper-Triassic-Lower-Jurassic Eski-Ordinskaya series was received. Obviously, in order to consider the above-formulated conclusions about petroleum source potential of rocks justified, the obtained results are very poor. This is because they do not characterize the whole Eski-Ordinskaya series, but only sandstones participating in its structure. However, it is known that clay rocks, whose DOM has not been studied yet, play significant role in Eski-Ordinskaya structure.

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X-RAY COMPUTED TOMOGRAPHY METHOD IN GEOSCIENCES

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Mentor: Mikhail Koldaev

Key words. X-ray, Bouguer - Lambert - Beer law, integral Radon transform, capacity.

Introduction. X-ray computed tomography method has become popular in geosciences recently. X-ray computed tomography is the method of the layered reconstruction of three-dimensional image of the object according to the two-dimensional X-ray images.

Aim. We propose to estimate the local middle density of the color reconstructed three-dimensional image of the object.

Materials and methods. During working we used the integral Radon transform, the Bouguer - Lambert - Beer law. As the equipment used X-ray computer tomograph. The minimum linear dimension of the voxel of the reconstructed object of this installation is 0.2 mm. Resolving installation capacity, i.e. the minimum size of the voxel of the reconstructed image is determined, primarily, by two competing of two factors such as the size of the pixel X-ray screen and the size of the electron beam of X-ray lamp focus that defines the size of the X-ray source.

Results. Using the formula: , where
ρ - the density;
the value of is determined by the calibration curve the installation;
the value of can be estimated as the ratio of the middle density to the middle extinction coefficient for the sample.
As a result of estimating the local average density of the reconstructed color three-dimensional image of the object, the following result is obtained. By measuring the ρ_o = 2.6 g/cm^3 granite - porphyry waxing since with extinction coefficient μ, belonging to the interval (0.12; 0.14) 1/cm local average sample density ρ(x) was found to be 3 g/cm^3 .

Conclusion. The urgency of the use of X-ray CT method is that it allows you to get as much information for which the collection would require several methods. This method has some advantages as:
- minimum time (a few days);
- internal and external structure of the samples undergoes changes, which, in turn, allows the use of the same sample repeatedly;
- to study only one sample.

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DEVELOPMENT PERICLINAL PARTS OF HIGH-VISCOSITY OIL FIELDS

Author: Amir Ayupov*
Mentor: Yury Volkov, PhD

Introduction. Under the conditions of the observed significant reduction in the volume of industrial significant oil and gas reserves, especially in areas with falling production in the territory of the Eastern European platform, the actual question is to involving high viscosity oils into development. In the last decade, the method of Steam Assisted Gravity Drainage (SAGD) has proven itself well, but, like any technology, it has defined technological limitations: drilling horizontal wells is impossible in a thin layer. Key words. SAGD, high-viscosity oil, hydrodynamic modeling.

Aim. The current work is devoted to attempts solve the development problem of high viscosity oils in the lower part of the collectors.

Materials and methods. In this study used 3D geological and hydrodynamic modeling to evidence economic and technological effectiveness.

Results. Discussion, In our opinion, in periclinal parts of the high-viscosity oilfield expediently use technology of Cyclic Steam Stimulation Process, using hollow rods of the plunger pump (Patent No. 2235905). The peculiarity of this technology is the constant position of the pump in the well during the injection of steam, soak phase and the extraction of liquid from the well, which, to an extent, allows increasing the profitability of the technology. Naturally, it raises a question about how control development of the reserves. Due to the shallow depths of the horizon, it is proved to use land electro-geophysical methods. Using this method, it is possible to record depth (methods of VES, DES), and the production zone (SES and ZSBZ methods). The development reserves control method allows to accurately determine time of the hydrodynamic coupling formation between the wells, it will allow us to change the mode of operation from cyclic steam injection of the wells to the stationary production. It is necessary to say that the proposed technology is not separated with development method; this is an addition to the already implemented development system. This technology is recommended to be used with SAGD technology, due to a good warming of the arched parts of the reservoir by horizontal wells and an increasing the average temperatures in the reservoir.

Conclusion. The proposed technology is used for extracting high-viscosity oils using by cyclic steam injection in vertical wells to develop periclinal parts of the reservoir, where the development is already carried out by thermal methods.

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DRILLING & COMPLETION

TECHNICAL PROGRAMME

Judges:

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Roman Irkhin, Schlumberger, Senior Drilling Engineer

Olga Sharipova, Schlumberger, Drilling Engineer, Team Leader

Fabrizio La Vita, Gubkin University, Lead Engineer in Well Control Training Center

Ilya Novikov, Salym Petroleum Development, Operational Geologist

COMPARING THE HORIZONTAL WELL COMPLETION WITH TUBING SCREENS AND EQUALIZER

Author: Mohammad Hossein Hajati*, Abolfazl Zabihi Sahebi, Reza Ebrahimi Sheshki
Mentor: Dr. Siahvash Ashoori

Key words. Equalizer, horizontal well, completions, gas breakthrough.

Introduction. The primary objective of the Equalizer is to create a pressure drop between the tubing and the casing, therefore enabling to balance the bottom hole flowing pressure (i.e. and therefore the drawdown) along the wellbore.

Aim. In this particular case, the main objective is to reduce the impact of gas conning on the well behavior.In this paper, horizontal well completions with tubing screens and Equalizer are compared together.

Materials and methods. The simulated model includes two separate reservoirs, both containing a long horizontal well. Both reservoirs and wells are exactly similar apart from the interface between the tubing and casing space. The first model has a set of Equalizer installed whereas the second model has standard screens installed. In this model, the equalizers are placed on the base pipe and therefore “Annulus” option is selected in the well section.

Results. As a result of this case study, the gas production at the early stage of production is larger in the screen completion case. The oil production is higher at early stages of production on the screen completed well, due to the less critical pressure losses in the wellbore, however, as soon as the gas breakthrough, the oil production will be affected and the Equalizer completed well will produce more oil.

Conclusion. The cumulative oil production is illustrating the higher oil recovery achieved in this case when the bottom hole flowing pressure along the wellbore is controlled using the Equalizer completion.

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FAILURE RISK MANAGEMENT FOR MULTIPLEXED SUBMARINE BOPANNULAR PREVENTER USING RBI AND RCM

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Mentor: Gilberto F M Souza, DSc.

Key words. Rig equipment, BOP, risk management, risk basedinspection, reliability centered maintenance.

Introduction. After Macondo accident (USA, April 2010), with an estimated loss of US $ 62 billion, the BOP (BlowOutPreventor) failure risk analysis gained great importance in oil exploration and drilling projects. This work has deepened in annular preventer (one of BOP functions) risk analysis, mapping sensitivity of inspection and maintenance of its components in the probability of equipment don't succeed its designed mission, using the guidelines of RBI (Risk Based Inspection) and RCM (Reliability Centered Maintenance) techniques.

Aim. This work aims to contribute proposing a sensitivity analysis of the inspection and maintenance over life of the annular BOP (one of the existing preventers in BOP), based on the analytical reliability model proposed by Lukin (2015).

Materials and methods. In theannular BOP operating model, it is applied FMEA and FTA risk analysis techniques described in ISO 31,000 (2009) standard, which in turn subsidizes the construction of a reliability model (RBD). The construction of RBD considered the mathematical formulation in series and parallel components according to the consequences of their failures. It is also assumed that maintenance is ideal, having the effect of restoring the loss of reliability over time, as indicated by API 581 (2008)standard.Based on the reliability calculated over time, it is possible to calculate the mean time between failures (MTBF) and compare it with the results available in literature and measured in field operations.

Results. It was found that the failure rate predicted by the numerical model is coherent to annular BOP failures found on literature and observed in the field, although is valid for more than 200 accumulated operating days. It was observed on field failures that there is a mortality period for time intervals smaller than this, indicating that increasing maintenance frequency can introduce more failures in the system, probably due to lack of its quality. On the other hand, there was no increase in the failure rate along time, indicating that equipment overhaul is able to prevent deterioration by aging. It is discovered that the variation in the MTBF of some annular preventer components have greater effect on the system reliability rather than others. In particular, the insert (rubber seal) and solenoid valves have the most critical impact on the system MTBF. The criticality of these componentsisattributed to the fact that the first has no redundancy, while the second, despite having redundancy in another POD, it is present in multiple in series to trigger an annular BOP.

Conclusion. This work reached its aim by proposing a reability model for annular BOP and it provedto be coherent to field failures observations and literature data. The sensitivity analysis by numerical simulation shows that the best strategy to reduce the risk of failure of annular BOP is to improve inspections and preventive maintenance quality in BOP components.

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LONGITUDINAL VIBRATION ANALYSIS OF DRILLING TOOL IN THE PROCESS OF WELL CONSTRUCTION AND THEIR INFLUENCE ON FATIGUE FAILURE PROBABILITY

Author: Arthur Khusnutdinov*
Mentor: Ass. Prof. Aleksey Arkhipov

Key words. Longitudinal vibration, drill string, fatigue failure, weight on hook, rainflow-counting algorithm, Miner's Rule.

Introduction. Drilling tool takes up a number of dynamic loads in the process of well construction caused by heterogeneity of formations, sporadic changes of weight on drill bit, pressure pulsations. These loads intimately affect to the accidents initiation in drilling. It should be noted that accident statistics of Timan-Pechora Oil and Gas Basin show that 42% of all accidents while drilling are accidents with drill string breakdowns (in the 1971-2013 timeframe).

Aim. There are three types of vibrations: longitudinal, lateral and torsion (stick-slips). The aim was to estimate influence of longitudinal vibration on fatigue failure of drill string parts.

Materials and methods. Weight on hook was used as the bench-mark data of research work, so the electronic weight indicator was in the capacity of information provider. The whole data was handled by rainflow-counting algorithm, which is usually used in the analysis of fatigue data. Its importance is that it allows the application of Miner's rule in order to estimate the fatigue life of a structure subject to complex loading.

Results. After the four stages of rainflow-counting method were realized in Matlab software, output materials were used for Miner's rule calculations. It was found, that if we take into account only longitudinal vibrations without reference to other kinds of vibrations or, for example, amount of borehole inclination, effect does not seem to be extremely destructive.

Conclusion. Finally, it was considered to try using second source of information for vibration – accelerometer forming part of measurement while drilling system. That could be useful to analyze not only surface behavior of drill string, but also bottom-hole vibrations.

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TECHNOLOGICAL SOLUTIONS FOR HORIZONTAL WELL PROFILE CALCULATION ON PRIRAZLOMNOYE FIELD IN WESTERN SIBERIA

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Mentor: Vladimir Balitsky

Key words. Horizontal well, wellbore profile, Prirazlomnoye field, computer code for profile calculation.

Introduction. Due to the fact that many oil field in Russia are brown fields, there is great importance of extracting oil more efficiently. One of the best solutions of that is to drill horizontal wells. During designing horizontal well, accurate well profile calculations are required.

Aim. The aim of this work is to calculate well profile of horizontal well and assess its feasibility, try to create a general program for calculating well profile.

Materials and methods. General formulas were used during profile calculation, but algorithm which allows to calculate with limited data was created. Calculations were performed on MATLAB software and results were checked using Landmark COMPASS software.

Results. The program represented results of calculation on table and graph. Analysis of calculated profile showed that it is feasible because it doesn't have high deviation rates and can be performed by common drilling tools. Comparison between results of calculations by this program and Landmark COMPASS showed that accuracy of calculations is high and this program can be used to design horizontal well profile.

Conclusion. Program was created on MATLAB, which could calculate horizontal well profile and display it. Using this program horizontal well profile was calculated; accuracy of these calculation is high.

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REVISED TECHNIQUE OF SHALE PELLET CREEP FOR EVALUATING INHIBITIVE PROPERTIES OF DRILLING FLUIDS: DEVELOPMENT AND IMPLEMENTATION

Author: Maxim Mogilnichenko*
Mentor: Ass. Prof. Alexandr Losev, PhD

Key words. Mud, weak shales, inhibitive activity, pellet, creep curve, uniaxial compression.

Introduction. Drilling wells in weak shales often happens with critical accidents, followed to collapse of the rock in the well. The loss of borehole stability leads to stuck-pipe and, as a result, to the subsequent well abandonment. Shales' softening occurs due to mud filtration into complicatedly stressed volumes of rocks. Therefore, the challenge is the selection of drilling fluids which provide the most effective inhibitive properties.

Aim. The majority of testing techniques which evaluate evaluating inhibitive activity of drilling fluids are based on indirect determination of the mechanical properties of shales immersed in drilling fluid medium: wetting, swelling, slaking. Direct methods include strength tests with various schemes. In the drilling practice, due to the relative simplicity, the common method for determining strength and creep is a simple (linear) compression test.

Materials and methods. The proposed technique is based on the study of the behavior of the pressed shales under linear compression at constant load in a drilling fluid filtrate medium in thermostatic conditions. Parameters of preparation of compressed cylindrical pellets: fraction ≤ 160 micron; maximum hygroscopic moisture of shale; mass ≈ 5 g.; diameter = 20 mm; press load of 3,0 tonnes.

Results. Experiments were performed on a modified axial loading device GT 2.0.9. Linear load set in the range of 2-5% of the break-down point of model pellets. The results of the experiments are creep curves (relative deformation – time). Stages of swelling and destruction of samples were analyzed using these curves. Experiments were performed to assess the optimal concentration of the inhibitors, after which there is no increase in improving of inhibiting abilities of drilling fluids.

Conclusion. Investigation of real drilling fluids and shale cuttings from oilfields Kamennoe and R.Trebsa was performed as a part of the agreements with service companies «Baker Hughes» and ISC PetroEngineering. The results obtained in the research were used as the basis of the drilling program.

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INVESTIGATION INTO THE ULTRASONIC STRENGTH DETERMINATION OF WELLBORE CEMENTS

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Key words. Wellbore completion, cement testing, compressive strength.

Introduction. Cement represents an indispensable wellbore barrier and the cementing operation is one of the central activities in the process of completing a well. Independent of the age, the cement must have the ability to provide a hydraulic seal and to support loads applied to the casing. One important parameter in evaluating the hardening of the cement and its integrity is the unconfined compressive strength. Even though the destructive crush test is the most accurate strength determination method, the cement testing industry relies more and more on a non-destructive ultrasonic approach. Here, the unconfined compressive strength is computed through the ultrasonic pulse velocity in combination with empirical correlations. These correlations were developed in the 1980s by generating a large amount of data. Since then, no attempt has been made to improve the original empirical correlations.

Aim. The aim of the current study is to provide a more reliable prediction about cement performances over time. For this reason, common cement testing procedures conducted by the oil, gas, and geothermal industry were scrutinized to reveal improvement options.

Materials and methods. In this laboratory research study, the unconfined compressive strength of several API Class G cement compositions – the most common cement type worldwide – was tested over a period of 350 days. The compressive strength was determined using the two most common methods: the destructive crush test and the non-destructive ultrasonic pulse velocity measurement. Both techniques were applied to evaluate the accuracy of the ultrasonic approach and the corresponding empirical correlations. API specifications were taken as a basis for the experimental setup.

Results. The cement testing industry often experiences a relatively low exactness of strength measurements when using the original empirical correlations in combination with the ultrasonic velocity. In this laboratory research study, new formulas were developed for obtaining the unconfined compressive strength and higher accuracies were obtained.

Conclusion. Improvements in the determination of the compressive strength via the non-destructive method were achieved. Further experimental investigations are recommended to improve the accuracy of cement testing procedures. A more precise prediction of the cement behavior increases the chance of choosing the right cement compositions for a specific wellbore. In conclusion, a better well integrity and higher production rates can be achieved through advanced laboratory tests.

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OIL & GAS FIELD DEVELOPMENT

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THE DEVICE FOR SAMPLING WELL PRODUCTION

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Key words. Crude oil, sampler, sampling, well production, gravity separation.

Introduction. The watercut of well production in oil fields or the content of oil and water in the produced well fluid is the most important information parameter in oil producing enterprises. In the case of gravity separation of the production well before the sampling point on interlayers with different contents of oil and water fractions, there is a possibility that the selected sample will not match the composition of well production transported along the wellhead outflow line.

Aim. The purpose of the project was the development of a device that allows selection of a volumetric sample of well production at the wellhead outlet line in a short period of time, without waiting for a gravitational separation of oil and water.

Materials and methods. The technology, in which there is a socket-hole in the bottom of the sampling vessel with a closed valve, to which fixed the tube with a cut sample from the total capacity of the container, is described in the article by Chudin VI. "About the selecting exemplary samples from the production flow of the well" / Automation, telemechanization and communication in the oil industry.-2003.-No.12.-P.11-16. With this method, it is not necessary to wait a few hours to achieve separation of the selected liquid into oil and water. In the article there is no technical description of the junction of a cylindrical tube with an opening in the bottom of the container. Without solving this issue it will be impossible to seal the inner space of the tube from the external environment.

Results. A device was developed that allows, according to the above described technology, to make the sampling of a volumetric sample of well production at the wellhead outlet line. Solved technical problem of the need to create a junction of a cut-off tube with an opening in the bottom of a tank of a volumetric sample of oil well production. The device ensures the tightness of the junction and does not affect the component composition of the liquid in the vessel during the sampling and short-term storage, thereby increasing the representativeness of the sample.

Conclusion. The proposed sampling device enables oilmen to select a bulk sample of well production and evaluate its composition with minimal time costs, without gravitational separation into oil and water. In contrast to the prototype, a technical solution for sealing the liquid in the cutoff tube from the environment has been proposed, at the same time improves the representativeness of the cutted-off sample and increased service life of the device.

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ISOLATION OF THE FLOODED INTERVALS IN WELLS WITH BREAK OF WATERS ON THE FIELD ZHANAZHOL

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Key words. Water, isolation, flooded layers, packer.

Introduction. The large sizes of a deposit, complex geological structure, and also sharp variability of properties of productive layers on the area and a section belong to features of the field Zhanazhol. Low productivity of a collector caused need of application of special decisions, such as consolidation of two-three objects for joint operation by a single grid of wells. The oil-bearing horizons differ in unevenness on the area of the field; in this connection there are wells which opened as one of objects, and more, and in various combinations. Their joint development dictates need of control of a contribution of each horizon to production amount, and also amounts of pumping water on wells.

Aim. Find the most effective way to isolate flooded intervals in the wells with a breakthrough in the field in the Zhanazhol oil field of the Aktobe region.

Materials and methods. For cutoff of the flooded layers in wells with break of water the technology of installation of metal plasters with use of DORN technology was implemented. The technology provides pumping of cement mortars in an isolation interval, drilling of the cement bridge and study of a trunk of a well the hydraulic scraper with the subsequent installation of a plaster at the rate of overlapping of layer is 2-3 m lower also above a perforation interval. It should be noted that, despite labor input of transaction, success of these works made about 90%.

Results. About efficiency of technology it is possible to judge by work of the well specified in the drawing. After selective isolation of layer 2 water content of products changed from 95% (in case of Rzab = 165 atm) to 64% (in case of Rzab of =167 atm) in case of start, the current water content makes 69% with work of a well after carrying out IDN (in case of Rzab = 33 atm).

Conclusion. Thus, isolation of layers by descent of packer configurations will allow: — to increase oil recovery and outputs of a well due to additional involvement in development of low-permeability layers;
— to increase degree of a scope and intensity of development of the multisheeted field by separate involvement in development of separate thin different and permeable layers pro-layers;
— to intensify process of regulation of selections and downloading in time and on a well section;
— to increase the profitable term of mining;
— to provide accounting of the got products from each layer and the working agent downloaded in it;
— to manage quickly the field of reservoir pressures, to regulate the directions and speeds of filtering formation fluids
— to prevent harmful effects of solutions of muffling on PZP, to cut layers (to isolate borehole installation from layer) without negative technogenic impact on them.

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THE RATIONALE FOR CARRYING OUT THE EXPERIMENT ON EFFECTS OF ACIDIC COMPOUNDS ON CALCIFIED HARDLY PERMEABLE CARBONATE ROCKS

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Mentor: Dr. Eugene Krasnovidov

Key words. The core sample, hydrochloric acid, acetic acid, citric acid, calcified hardly permeable carbonate rocks.

Introduction. In the modern production of hydrocarbons and the depletion of easily extracted reserves, more attention is paid to the fields with complex geological structure of carbonate reservoirs which are subject to high temperature stratums and high salinity stratum waters. In such conditions acid treatment is applicable, as one of the methods for intensification of hydrocarbon production and increasing the productivity of wells.

Aim. Based on the fact that the previously conducted experiments with hardly permeable and calcified carbonate rocks did not study the effect of acid mixtures on them, the author aims to carry out the experiment on the use of a mixture of acetic and citric acids with a hydrochloric acid on the mentioned above rocks.

Materials and methods. In studies of acid treatments of carbonate rocks hydrochloric acid and (or) its blend with organic acids is used. Acetic acid and citriC acid is used very often as the main additive to hydrochloric acid which reduces the rate of reaction with the rocks.

The experiment which was conducted at the University of Adelaide (Australia) with the use of citric acid as a separate reagent calcite marble containing calcium carbonate - 99% showed that it is effective at elevated temperatures (500°C and above), while a high concentration (10% or more) increases the exposure area on the sample.

Laboratory analysis of the reaction of acetic acid with a concentration of 11.6% on limestone with permeability from 4.8 to 14.5 mD, conducted at the University of Texas at Austin (USA), showed that acetic acid can have the advantage over salt at elevated temperature of thestatum.

Results. Before the beginning of the experiment the porosity and permeability of the samples is to determine. The aim of the experiment`s main part consists in the saturation of acid composition under pressure with the help of samples extracted from hydrocarbons (saturation pressure 0.3 – 0.4 MPa) under conditions divided into three stages:

- Sample purified from mineral salts and dried at a temperature of 1050°C.
- Sample saturated with distilled water.
- Sample saturated with distilled water with dissolved salts similar to reservoir parameters in the field.

Conclusion. According to the results of the experiment significantly increased permeability in connection with the expansion of cracks and voids by acid composition is expected.

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THE DEVELOPMENT AND INVESTIGATION PUMP STAGES 2A SIZE

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Key words. 2A size, ESP, centrifugal pumpt.

Introduction. The rat hole drilling is developing very actively for intensification of oil production. More than 4,000 rat hole are operated today in Russia, according to expert estimates. The number of it grows at 800-1200 wells per year. The rat hole allows not only to rejuvenation oil production, but to increase the oil recovery index, also to build horizontal wells, the flow rate of which is increased by 3-4 times, and in some cases 17 or more times. On this, the demand for pumping units of small diameter will increase. However, centrifugal pumps have low efficiency when pumping gas-liquid mixtures with a high content of free gas, and reducing of radial dimension dramatically reduces the pressure and flow of ESP.

Aim. Based on the foregoing, the development of equipment, which does not have disadvantages of small-sized ESP system, is an important task.

Materials and methods. To achieve this aim were used such methods of scientific knowledge as an experiment and material modeling.

Results. Solution of low efficiency when pumping gas-liquid mixtures with a high content of free gas, reducing the pressure and flow of ESP with small radial dimension, was found in a pump with axial fluid flow. On this, the aim of work is research of the pumps operation with axial flow of the pumped fluid.

To achieve the aim were set and performed the following tasks:

1. To analyze scientific literature about the existing designs of small-size ESP,
2. To search type of axial pump, which can be used,
3. To develop and manufacture laboratory stands for research pump's work with axial flow of the pumped fluid.
4. To develop a program of laboratory research,
5. Manufacture laboratory models of the tested stages using additive technologies,
6. To perform laboratory researches of the developed pumps with axial flow of the pumped fluid,
7. To perform numerical simulation of developed stages,
8. To process and summarize the results of the research.

Conclusion. The performing of the tasks allowed us to conclude the following: the use of pumping units with axial flow in small-diameter wells will not only increase the production rate, but allow to use gas lift, which, consequently, will reduce the cost of produced oil per cubic meter.

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OIL & GAS CHEMISTRY

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SYNTHESIS OF CATALYSTS FOR THE HYDROGENATION OF AROMATIC COMPOUNDS USING MICROWAVE RADIATION

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Key words. Microwave radiation, aluminosilicate-halloysite, metal nanoparticals.

Introduction. At present, the development of catalysts is urgent, the use of which would allow combining in one process the advantages of both heterogeneous and homogeneous catalysis. Such catalysts can be systems containing metal nanoparticles, in particular, the platinum group (Pd, Pt, Ru, Rh).

Aim. The aim of this work is to obtain catalysts for the hydrogenation of aromatic compounds using microwave radiation for the synthesis of ruthenium nanoparticles on the surface of aluminosilicate nanotubes.

Materials and methods. In order to obtain effective catalysts for the hydrogenation of aromatic compounds, we propose a method for microwave synthesis of nanocatalysts based on natural aluminosilicate nanotubes. As an active component, we chose ruthenium, since it is an effective catalyst for the hydrogenation of phenol and benzene. During the synthesis we varied the following parameters: concentration of RuCl3 from 10 to 60 mg/g, reaction time from 1 to 5 minutes. It was found that microwave radiation for 3 minutes is sufficient for effective synthesis of ruthenium nanoparticles. The largest number of monodisperse ruthenium nanoparticles uniformly covering the surface of nanotubes was obtained at a ruthenium salt concentration of 40 mg/g.

Results. The catalytic activity of the developed systems was tested in the hydrogenation of aromatic compounds. The resulting catalyst is active in the phenol hydrogenation reaction. We also saw that with an increase in the phenol / ruthenium ratio, the conversion of phenol drops insignificantly up to a ratio of ~ 14,000. The hydrogenation reaction of benzene was carried out. The catalyst synthesized by us is more active in the phenol hydrogenation reaction than the nano-heterogeneous catalytic compound containing ruthenium based on dendrimers. With an increase in the benzene / ruthenium ratio, phenol conversion on the MW Ru catalyst falls slightly up to a ratio of ~12,000.

Conclusion. Using the methods of microwave synthesis, a catalyst was obtained with the dimensions of ruthenium nanoparticles 1-3 nm active in the hydrogenation of benzene and phenol.

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EVALUATION OF THE EFFICIENCY OF REMOVAL OF HEAVY STRUCTURAL COMPONENTS FROM OIL BY THE METHOD OF «COLD ROD»

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Key words. Cold rod, tar-asphaltene substances, paraffins, asphaltene output, heavy oil deposits, viscosity, emulsion, coolant.

Introduction. In present times, the extraction, preparation, transportation and processing of heavy oils are difficult because of their high viscosity, density, pour point and the abnormal rheological behavior. These problems are due to the presence of heavy components in oil - asphaltenes, tar, high-molecular paraffins and ceresins. In the fields, their negative influence can be prevented by the introduction of different reagents into the flow - additives for lowering viscosity, depressants and inhibitors of paraffin deposits.

Aim. The essence of this proposed work is the development and design of compact technology for removal of high-molecular components from oil with the aim of upgrading some of its exploitation properties.

Materials and methods. The physical method of oil treatment was used during research. The oil is placed into a cooling apparatus with four spaces after which the cold rod is placed into the spaces. On the apparatus, the temperature is being regulated and fixed to the need value.

Results. The result of the application of this technology consists in the processing of oil flow with cooled rods/plates, which is expected to decrease its viscosity, density, and removal of a part of the water phase, if the processing is subjected to the water-oil emulsion. A schematic diagram is introduced which allows to implement existing development in form of a separate industrial unit working in a continuous mode.

Conclusions. At the end of the research, the treatment by “cold rod” makes it possible to separate a portion of heavy oil. But its effectiveness largely depends on the mode of operation, on the composition of the medium to be treated. This is a question that requires further study in the future.

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DEVELOPMENT OF A SOLID CROSSLINKER FORAQUEOUS POLYSACCHARIDE LIQUIDS FOR HUDRAULIC FRACTURING

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Key words. Solid crosslinker, hydraulic, fracturing, gels.

Introduction. At the present stage of the development of oil and gas industry, on the one hand, there is continuous growth in oil production, and on the other hand a decline in the flow rates of wells in the rolling stock and relatively low starting rates of new wells. To reach the planned level of production and its maintenance, new wells are being drilled and various technologies for enhanced oil recovery and intensification of well production are being applied. The technology of hydraulic fracturing of the reservoir combines both a comprehensive approach to these technologies, and economic feasibility in comparison with the construction of new wells.

Aim. In view of the prospects of the fracturing process, it is proposed to improve the technology of preparation of fracturing fluids by developing a solid crosslinker for aqueous polysaccharide linear gels. A solid granular crosslinker is designed to reduce the logistics costs for transportation and storage of chemical reagents, simplify the technological implementation of the process of hydraulic fracturing, while retaining all the advantages of liquid crosslinkers of prolonged action. The prolonged action of solid compositions is ensured by granulation of the reagent and, as a consequence, the stage of slow dissolution of the crosslinker granules in the aqueous polysaccharide gel.

Materials and methods. In the present work, a list of developed granular crosslinkers of different component composition is given. As a cross-linking agent, non-deficient boric acid was chosen, an alkalinizing composition based on organic and inorganic compounds provides the necessary alkalinity of the fluid environment for the fracturing fluid, and various water-soluble polymers act as binders for granulation of the product.

Results. Have good mechanical strength, dissolve in a linear gel for 3-5 minutes.

Conclusions. The Russian market of dry fluid crosslinkers for hydraulic fracturing is mainly represented by foreign products, therefore this research is extremely promising and has a high practical significance.

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ANTIOXIDANT ADDITIVIES AS METAL DEACTIVATORS ANDAS SUBSTITUTED PHENOLS

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Key words. Antioxidant additives, metal deactivators, Schiff bases, phloroglucinol.

Introduction. Antioxidant additives play a very important role in fuel storage. Chemical stability of fuels is one of the main requirements in the quality of petroleum products. Due to technological revolutions, it makes sense to develop new and more effective antioxidant additives replacing outdated butylatedhydroxytoluene.The presence of trace dissolved metals, such as copper, vanadium and iron in a fuel can accelerate the rate of oxidation. One of the type of antioxidants is metal deactivators. Metal deactivators are special phenolic antioxidants containing functional groups that enable them to complex with and deactivate metal ions, which can accelerate the oxidation. Other type of antioxidants is sterically hindered phenols.

Aim. We are going to make three substitutions by C=N group instead of carbonyl group in the structure of the molecule that will improve the properties of the additive.

Materials and methods. The synthesis of substances, the analysis of obtained compounds by IR, 1H NMR –spectroscopy and mass spectrometry.

Results. The result of our work is 1,1'-(2,4,6-trihydroxy-5-(1-(phenylimino)ethyl)-1,3-phenylene)bis(ethan-1-one), which combines properties of sterically hindered phenol and metal deactivator. Our molecule includes C=N group.It is known that Schiff bases are good antioxidants, because C=N group can link cations of metals in chelated complexes.In synthesis we can solve another problem-utilization of trinitrobenzene, because phloroglucinol is a product of chemical transformation of TNB.

Conclusions. We have developed synthesis method, have described physical and chemical properties of 2,4,6-triacetylphloroglucinol and also 1,1'-(2,4,6-trihydroxy-5-(1-(phenylimino) ethyl)-1,3-phenylene)bis(ethan-1-one) (not described previously). The structure of obtained compounds was proven by IR, 1H NMR –spectroscopy and mass spectrometry.

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NFLUENCE OF PIGMENTS BASED ON CHEMICAL MODIFICATION OF TNT ON THE PROPERTIES OF POLYUREA GREASES

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Key words. Chemical modification of TNT, pigments.

Introduction. Currently, the biggest problem is recycling ammunition with expired shelf life. They can be disposed of by explosion, the burial or filling of quarries.

Aim. In this paper we propose to use a chemical modification of TNT (trinitrotoluene) as a starting product to produce pigments, and then adding it in polyurea grease as one of the components of the thickener.

Materials and methods. To obtain the pigments, we carried out the reaction of diazoketone 2,6-diamino-4-nitrotoluene, obtained on the basis of modified trinitrotoluene (TNT).

Results. Polyurea greases are considered as promising lubricants for use in modern technology as a multifunction and universal greases. The most appropriate is their use in harsh environments due to its ability to maintain mechanisms in conditions of high temperatures and loads, contact with aggressive media and steam. However, they have a high enough grease tribological properties.

Conclusion. Introduction of pigments has improved its tribological properties, such as: dropping temperature, the colloidal stability and penetration.

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THE RESEARCH OF CYCLIC PROPERTIES OF ACETYLENE ALCOHOLS AS ADDITIVES INCREASE THE NUMBER OF GASOLINE OCTANE

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Key words. Anti-knock; oxygen-containing additives; gasoline.

Introduction. At the present time, due to the fact of toxicity of lead anti-knock and the high cost of manganese and iron supplements, has enhanced the search for organic anti-knock. These antiknocks include organic amines and oxygen-containin additives. Oxygen- containing additives presented esters, ethers monocarboxylicacids, higher alcohols, oxygenated hydrocarbons fractions containing a mixture of acids, alcohols and esters, ethoxylated compounds, such as methyl tertiary butyl ether. At the same time it has not yet been investigated antiknock properties of cyclic ertiary acetylenic alcohols, such as ethynyl cyclohexanol , ethynyl cyclopentanol.

Aim. Research and development of new oxygen-containing additives increase the octane number of gasoline - based tertiary acetylene alcohols is an innovative and highly relevant.

Materials and methods. Acetylenic alcohols obtained by condensation of cyclohexanone and cyclopentanone with acetylene under modified Favorskii reaction, under pressure in the presence of powdered potassium hydroxide in diethyl medium, petroleum ether. In order to develop new formulations of oxygen-containing automobile fuel compositions were prepared, fuel composition on the model mix of I-Octane : Heptane 70:30 and on the basis of straight-run gasoline CDU-AVT- 3 obtained from LLP Atyrau Oil Refinery.

Results. The test results showed a model mixture of 1.5% addition of ethynyl cyclohexanol increases the octane number of the mixture according to motor method to 81.5 in other words; it gives an increase of 23.2. And the presence of 4% ethynyl cyclopentanol increases the octane number of the mixture to 83.6 which means, that it gives an increase of 25.3. We were then tested naphtha CDU-AVT- 3 obtained from the LLP Atyrau Oil Refinery. Additives 2% ethynyl cyclohexanol increases the octane number of straight-run gasoline to 83.2 and gives an increase of 16.4 and allows you to get gasoline – 80 RON, and the presence of 1% ethynyl cyclopentanol increases the octane number of the mixture to 81.5 in other words, It gives an increase of 14.7, which also indicates the possibility of obtaining gasoline – 80 RON. Thus noticeable that ethynyl cyclopentanol increases gasoline octane in even smaller quantity.

Conclusion. Thus, it can be proposed that tertiary acetylene alcohol – ethynyl cyclohexanol can be used as an oxygen-containing additive, which will increase the production of high-quality marketable gasoline for automobile engines and ensure the cleanliness of the fuelsystem and fuel economy.

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DEVELOPMENT OF THE RETARDER FOR CROSSLINKING OF WATER POLYSACCHARID GELS FOR HYDRAULIC FRACTURING

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Key words. Delayed, crosslinking, hydraulic, fracturing, gels.

Introduction. Currently, for fluid fracturing at deep wells and process optimization, liquids based on reagents with delayed gel crosslinking are used instead of instantaneous crosslinking agents. This is primarily necessary in order to reduce the pressure loss due to friction when pumping the fracturing fluid through pipes of sufficient length and relatively small diameter. This approach allows to increase the productivity of pumps and their resource and to reduce the risks of premature stopping during operation.

Aim. To optimize the characteristics of the aqueous polysaccharide gel for hydraulic fracturing by introducing into its composition various retarders of crosslinking on the basis of polyhydric alcohols. Also, to investigate the effect of the structure of alcohols and the number of hydroxyl groups in the alcohol molecule at the time of crosslinking and the stability of the resulting cross-linked gels.

Materials and methods. In the compositions the crosslinking agent is a non-deficient boric acid in admixture with an alkalizing agent, sodium hydroxide. The finished crosslinker is an aqueous solution containing boric acid, caustic soda and a crosslinking retarder. The retarders of crosslinking are various polyhydric alcohols.

Results. Crosslinking formulations were obtained with a crosslinking time of 1 minute to 3 minutes. The dependence of the retarder's efficiency on its structure is observed.

Conclusion. This research, along with scientific significance, has practical perspectives connected with the necessity and importance of using a gel with adjustable parameters of the viscosity set. Using these retarders the hydraulic fracturing can run more efficiently.

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HEALTH, SAFETY & ENVIRONMENT

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SORBENTS FOR EMERGENCY FILLING OIL AND OF PETROLEUM PRODUCTS ON THE BASIS OF VEGETABLE RAW MATERIALS

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Mentors: Ass. Prof., Bulauka Yu., PhD,
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Key words. Oil, oil product, sorbent, emergency bottling, agricultural waste.

Introduction. The increased interest in cellulose-containing vegetable raw materials is conditional to the fact that cellulose has a complex supramolecular structure, the minimal structural elements of cellulose fibers are microfibrils, consisting of several hundred macromolecules of cellulose.

Aim. The purpose of research - to establish the possibility of oil spill response and oil using sorbent based on cellulose-containing plant materials (local crop waste).

Materials and methods. As the object of study selected sawdust and pine bark Pinussilvestris, barley husk, buckwheat husk, horsetail field straw cereals in the form of fuel granules (pellet) and the pericarp of rapeseed (Brassica napus) and radish (Raphanus).

For analysis the sorption capacity of selected oil products produced by OJSC «Naftan»: vacuum distillation of 4-th ring, diesel fuel and kerosene lighting with different density.

Results. Analysis of sorption ability in relation to oil and oil products established a number of regularities:

– for most of the samples established a linear relationship – an increase in the density of oil leads to an increase in sorption capacity;

– the absorption capacity of sorbents on the basis of wood waste correlate with pulp content in the sorbent, the higher the content of cellulose, the greater the degree of absorption of oil;

– cost-effective sorption capacity (more than 3.0 g/g) were detected in the sawdust, pine bark, meadow pine and barley husk. It is important to note that the oil-carrying capacity of refuse wood correlates with the content of cellulose in the sorbent. The higher the content of cellulose, the greater the degree of absorption of oil.

It was noticed that after the extraction with alkali sorption capacity compared to the diesel fuel oil and wood waste increased by 15-27%, and for straw and husk radish 1.6-3.2 times, this fact is probably related to the fact that chemical processing of vegetable raw materials allows to increase the proportion of amorphous zones cellulose which positively affects the increase of the specific surface and adsorption capacity of the material.

For all the studied samples of plant origin characterized by high rates of water absorption that is associated with the presence of a large number strongly polar groups such as HE, COOH, etc.. To eliminate this phenomenon it is possible to carry out surface treatment of the surface.

Analysis of buoyancy showed that most samples were limited buoyancy (3-72 h), but in the conglomerate with crude oil all samples have a high buoyancy (more than 72 hours).

Conclusions. Thanks ecological purity, wide raw material base, hydrophobicity and oil capacity at a relatively low cost sorbents based on waste wood and agricultural industries can successfully compete with industrial produced counterparts. The production of sorbents with the use of raw materials unskilled application will allow to expand the range of oil absorbers, reduce the burden on the environment and to obtain economic benefits.

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SAFETY BARRIERS FOR HAZARDOUS PRODUCTION FACILITIES (HPF)

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Key words. Safety barriers, hazardous production facilities, plan localization and liquidation of accidents.

Introduction. The procedures for ensuring safety of hazardous production facilities (HPF) of oil and gas complex is actively used method of "Analysis of safety barriers", which is used for qualitative or quantitative study and evaluation of the effectiveness of security measures. The barriers are technical (valves, fittings, partitions) and organizational (diagnosis, examination, training, production control) security measures [The order of Rostechnadzor from 11.04.2016 N 144].

Aim. Development of plan of measures on localization and liquidation of consequences of accidents (PMLA) as one of the tools of the system of safety barriers for hazardous production facilities of oil and gas complex III and IV hazard classes.

Materials and methods. Information about oil and gas organizations, Information about the hazardous production facilities (maintained technical devices, buildings and structures, the danger signs, the number of hazardous substances in production and storage, manufacturing process, number of staff, the surroundings, etc.)Methods of risk analysis and statistical analysis.

Results. Developed PMLA for 10 oil and gas organizations (only 22 HPF III and IV hazard classes) that are considered some accident scenarios. Next, the calculation of the affected areas in the implementation of the accident for the most dangerous accident scenarios and for the most likely accident scenarios. Schemes alerts with the implementation of an accident.

Conclusion. Typically, any oil and gas companies are HPF different hazard classes from I to IV and in order to ensure comprehensive security of the whole object it is more logical to develop PMLA on all HPF of the given enterprise regardless of their class of danger.Well-developed in the companies PMLA is one of the components of the system of safety barriers and ensures the safety of the whole object. Another important point is the practical application of this document and its timely updating and informing employees.

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CARBON DIOXIDE RECYCLE COUPLED TO ENERGY STORAGE THROUGH A BIOELECTROCHEMICAL APPROACH

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Key words. Carbon dioxide, Energy Storage, Bioelectrosynthesis, Methane.

Introduction. The reduction of CO_2 emissions in all over the world represent one of the main scientific and technological issue for the future environmental sustainability. An innovative approach for CO_2 conversion is represented by the utilization of autothrophic microorganisms that are able to convert the CO_2 into valuable products like methane and acetate. Recently, the possibility to control microrganisms methabolism in particular electrochemical devices have led the development of innovative bioprocess also named bioelectrochemical systems (BES). In a BES, the reducing power (electrons) necessary for CO_2 reduction is supplied to particular "electro active microrganisms" that are able to use an electrodes as electron donors for their metabolisms. In the bioelectromethanogenesis reaction, the microorganisms utilize the electrical current to reduce the CO_2 into methane. Biolectromethanogenesis provides a novel approach for carbon dioxide fixation and renewable energy storage into a chemically stable compound, such as methane.

Aim. The aim of the proposed research is the study of a bioelectrochemical process for the CO_2 reduction into methane by using a continuous flow microbial electrolysis cell (MEC) aimed that is able to produce methane by utilizing the oxidation of organic matter as "electron producing" reaction.

Materials and methods. The continuous flow microbial electrolysis cell (MEC) consisted in two liter flat-configuration reactor composed by two chambers (i.e. the anode and the cathode) filled with graphite granules and separated by an ion exchange membrane (IEM); the cathode was continuously fed with a gas mixture of CO_2/N_2 while the anodic chamber was continuously fed with organic substrates to sustain the cathodic reaction. The MEC was operated in potentiostatic mode by a three-electrode configuration thanks to a reference Ag/AgCl electrode.

Results. The main results obtained by the study of the bioelectromethanogenesis showed the capability of the biocathode to convert mostly of the electricity generated by the anodic oxidation reaction into methane with an average cathodic coulombic efficiency (CCE) of 75%. In the operating condition explored, a higher methane production was obtained by using a proton exchange membrane instead the anionic one and by increasing the cathodic potential from -0.65 to -1.0 V vs SHE. The methane production strongly depends by the average current that flowed in the circuit.

Conclusion. The bioelectrochemical approach for the CO_2 fixation has been successfully demonstrated in continuous flow experiments with different operating conditions, the methane production depended by the average current that flowed in the circuit; on average, 75% of the current was diverted into methane during all over the condition explored. Finally, the study demonstrated the possibility to convert part of the electrical energy into methane, more easily storable and usable.

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HEALTH MANAGEMENT SYSTEM AND SAFETY IN OIL AND GAS SECTOR

Author: Joseph Barida Nafo*
Mentor: Bright Etim Eworo

Key words. Risk assessment, Indicator, operating standards asset integrity, incident reporting, occupational safety, health management system, and emergency handling, fitness to work, emergency management, reactive and proactive measures.

Introduction. Safety and health management is one of the vital constituents of Oil and Gas industry activities because most of the operational conditions, chemicals and end products (hydrocarbons and other compounds) associated with Oil and Gas production are well-known to pose serious safety and health threats to the workers. Over the years in the oil and gas sector there had been a lot of industrial and mining accidents as well as activities that had led to the degradation of the environment. At this time legislation and public opinion all favored management by the implementation of strategic methods that reduce high risk activities in the oil and gas sector. Thus, this paper studies the integration of health, safety and environment in the oil and gas sector with strategic methods of improving and achieving them.

Aim. The aim of this paper is to identify and assess safety and health hazards existing at the workplace and to define appropriate control and retrieval steps. An important aspect of the health management systems is continuous improvement that is assessed by monitoring performance using Indicators and measuring the performance of critical control systems.

Materials and methods. Business processes in Oil and Gas industry are very complex, hence it is essential that a systematized approach should be used for managing occupational safety and health hazards. Here are some health performance leading indicators: Health risk assessment and planning, industrial hygiene and control of workplace exposure, medical emergency management, management of ill-health in workplace, fitness for task assessment and health surveillance, health impact assessment, health reporting and record management, public health interface and health promotion. Identification of high risk activities in work place. Adoption of proactive safety measures rather than reactive measures.

Results. Occupational Safety and Health Management System (OSHMS) not only provides a systematic and synchronized proactive approach to managing occupational health and safety risks, but also helps in defining strategies for implementing control actions, performance substantiation, resource mapping and competency management. Moreover it also helps in enhancing organization's brand image in today's competitive scenario.

Conclusion. This paper considered a company's structure, responsibilities, practices, procedures and resources for implementing health management system, including processes to indentify root causes for poor performance, prevent recurrences, and drive continuous improvement. In other words we should be able to estimate the lets says probabilistically to effectiveness of the system even before any incident is likely to occur.

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USE OF SAWDUST IN THE REMOVAL OF HEAVY METALS FROM OIL AND GAS PRODUCTION WASTEWATER

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Key words. Sawdust, heavy metal ion (HMI), oil and gas production wastewater: (OGPW), adsorption, sorbent.

Introduction. During oil and natural gas production, so-called "produced water" comprises the largest byproduct stream. Removal of HMIs from waste water is a prominent issue faced by many countries, especially developing ones. Treated waste water can be re-used in many ways. However, most widely-used methods such as ion exchange and membrane filtration are expensive. This has led to an in-depth research on the potentials of relatively cheaper and eco-friendlier methods than the ones currently in use.

Aim. To analyze the potential of sawdust (a low-cost sorbent) in the adsorption of heavy metals from oil and gas produced wastewater and its advantages over other methods.

Materials and methods. Materials used in this research include: "Jihyun Lim et al, Removal of heavy metals from aqueous solution by sawdust adsorption, 27 Sept 2006"; "John Pichtel, Oil and Gas Production Wastewater: Soil Contamination and Pollution Prevention, 14 Feb 2016"; "Stefan Demcak et al, Utilization of poplar wood sawdust for heavy metal removal from model solutions, 1 Aug 2107". The methods involved: reading, research, performing adsorption experiments with sawdust using metal ion solutions prepared from salts of heavy metals such as Pb, Cu, Zn.

Results. Sawdust shows approximately 80%-98% efficiency for all model solutions. The amount of HMIs adsorbed increased with the increase in initial concentration and remained nearly constant after equilibrium. The quantity of HMIs removed decreases as pH decreases.

Conclusion. Firstly, sawdust is a promising adsorbent for removal of HMIs from OGPW. At these adsorption levels, a process using sawdust for the removal and recovery of heavy metal ions is potentially more economical than the current technology like ion exchange and membrane filtration. Secondly, adsorption of heavy metal ions depends on their initial concentrations, pH, temperature, and contact time.

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PETROLEUM ECONOMICS & MANAGEMENT

TECHNICAL PROGRAMME

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A NEW PERSPECTIVE ON MOTIVATION OF EMPLOYEES

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Mentor: Ass. Prof. Stolyarova Irina

Key words. Management, motivation, research, psychology.

Introduction. Today, humanity is on the edge of accepting the fact that traditional incentive methods are ineffective in modern realities. Some companies(including oil and gas) are already trying to find alternatives and develop other ways of motivating employees.

Aim. In this research we are going to find out why traditional methods of money-based motivation reduce productivity of employees and howemployees in 21 centuryshould be motivated.

Materials and methods. In this study, werely onexperiments of Dan Ariely, professor of Psychology and Behavioral Economics at Duke University, and Self-Determination Theory, which was developed by Edward L. Deci and Richard M. Ryan. Scientific analysis of these sources was carried out. Personal experience and connections with colleagues from oil and gas companies were used to determine what incentive methods could be applied there.

Results. The relationship between employees and companies should be based on social rather than monetary norms, as people tend to help more to their friends and not those who pay them for helping. If employers want employees to work hard and consider their job as part of their lives, theyhave to give them something in return, for example, good health insurance, company shares, corporate transport. Employees should also be provided with:

- Flexible working hours - employees should be able to independently manage their time, they don't need to come to the office every day;
- Internal training systems and awards for achievements;
- Activities to improve the corporate atmosphere and allow employees to know each other better;
- Connection between top management and ordinary workers.

Some examples, how these steps can benefit companies (Chevron Corporation, Exxon Mobil Corporation) are provided.

Conclusions. Thus, the new approach should be based on friendly relations between employees and the company, on the desire of employees to create something meaningful.

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LNG: IT'S IMPERATIVE ROLE IN NIGERIA'S ENERGY FUTURE

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Key words. LNG, natural gas, Nigeria, energy sources, liquefaction plant, receiving terminal, prospect.

Introduction. Nigeria is one of the top ten nations in the world with huge natural gas reserves. Nigeria's gas reserves was estimated at 188 trillion standard cubic feet of gas (tscf), with current production estimated at 8.24 billion standard cubic feet of gas per day (scfd) as of 2016. This is made up of 99 tscf of associated gas (AG) and 89 tscf of non-associated gas. The combined total of proved, probable and possible reserves is estimated at 300 tsc. The current gas supply is enough to support about 5 giga watts (GW) of power generating capacity. Gas development in Nigeria has been constrained by the absence of clear fiscal terms; gas pricing mechanism; legal and regulatory frameworks; and inadequate financing.

Aim. This paper aims to spell out the vital present and future role of the LNG industry in Nigeria, covering LNG plants, transportation and electricity production. It is also expected that this study will be helpful in demonstrating the present energy situation in Nigeria and her future energy projections with respect to world projections. Basic energy indicators such as population, gross generation, installed capacity, net energy consumption, import, export are also extensively analyzed.

Materials and methods. Materials include; Maximizing the use of natural gas in Nigeria - Dr. Chijioke Nwaozuzu, Substitution of natural gas for coal by Donald J. Wuebbles, Nigeria the political economy of oil by Kahn SA, current status and future projections of LNG demand and supply by Satish Kumar, The fuel of the future by Chuck Kowalski, Energy and sustainable development in Nigeria by Sunday Olayinka, Nigeria's oil and gas stategy in the next five by Diezani Allison-Madueke, NNPC Oil and Gas Statistics 2017, BP statistical review of energy 2017, IEA Market Report Series Gas 2017 etc. Methods include; close reading (articles, papers, reports, books etc), sequential text interpretation, sampling and survey interpretation.

Results. Nigeria's fuel of the future is natural gas.

Conclusion. Going forward, a number of issues have to be addressed; inadequate funding, appropriate pricing of gas, The Downstream Gas Act and the Fiscal Reform Act, the choice between continuing with the current subsidy regime to power plants and industrial firms and permitting the oil companies to produce and sell at market-driven rates. Resolving these matters would ensure that most of the power plants; operational and under construction would be able to obtain gas feedstock for their operations as well as effective electricity production. If the proposed actions by the NNPC are also carried out Nigeria will secure a lasting presence in international markets and become a regional hub for natural gas-based products.

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UPDATING BUDGETING SYSTEM FOR MODERN MARKET ENVIRONMENT

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Key words. Budgeting, agile, planning, controlling, accounting, finance.

Introduction. The knowledge economy is the highest stage of the post-industrial world development which is basic for developing a digital society. The Fourth Industrial Revolution starts since 21 century and includes the knowledge economy characterized high level of science and human capital assets. Formation of human capital by accumulation knowledges, habits and innovations are instruments for improving technology and intelligent development. Increasing of production level and creation of assets get determining advantages to invention a knowledge-intensive production and extremely improvement of the quality of life. Specific gravity of human capital in the highest developed countries already consist of 80% GPD.World major IT companies was first who recognized the importance of time - to - market speed and create conditions for high speed production from brainchild to products release. It forced to developing innovation technologies which give them top positions on competitive edge in the market. Using agile management methodologies, enable to increase speed of production, improve clarity of business process and achieve budgets without extra costs. Not only top markets companies like Google, Cisco, HSBS, Siemens showed success to use agile methodologies but government enterprises too. However, companies which integrated agile methodologies in business processes face problems with collaborated the new management system and the traditional budgeting.

Aim. The main goal is analyzing weaknesses ordinary budgeting systems, search problems and develop adaption methods for aim to upgrade planning and controlling systems.

Materials and methods. Jeremy Hope, Robin Fraser: «Beyond Budgeting: How Managers Can Break Free from the Annual Performance Trap»; Horvath & Partners: «Controlling system»; David J. Snowden, Mary E. Boone: «A Leader's Framework for Decision Making»; Prof Klaus Schwab: «The Fourth Industrial Revolution».

Results. Developed agility budgeting and controlling systems which to consider a dynamic market conditions to solve the business problem.

Conclusion. Workflows in companies used agile methodologies is extremely fast, and hard traditional budgets which ordinary approving at the firs of the year is outdate already after firs part of the year. The traditional budgets forms create interruptions for effective works under projects and accordingly doesn't achieve the main purpose – spreading recourses for achieve the strategic goals. Due to the fact, modern companies forced to adapt their budgeting system to conform a fast speed operational developing.

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COST-EFFECTIVENESS OF INTRODUCING ENERGY-SAVING INNOVATIONS ON THE BASIS OF ORENBURG OIL AND GAS CONDENSATE FIELD ON THE STAGE OF DECLINING PRODUCTION

Author: Olga Eremenko*, Anna Novikova
Mentor: Prof. Vladimir Shpakov

Key words. Innovations for energy efficiency in the development of hydrocarbon deposits on the stage of declining production.

Introduction. Oil and gas companies are characterized by energy-intensive industries. All production facilities necessary for production, gathering and transportation of hydrocarbons, require for stable operation, a considerable amount of energy. Particularly acute this problem manifested itself at the Orenburg oil and gas condensate field, which is developed at the stage of declining production. In these conditions, the reduction of the cost of conducting geological and technical measures and measures aimed at improving energy efficiency are key to maintaining profitability amid rising water cut of the field.

Aim. The aim of the study is to develop innovative energy saving technologies at the Orenburg oil and gas condensate field at a later stage of development.

Materials and methods. Methodological and theoretical basis of work are the method of analogies, expert ratings, comparisons and statistics, research in the field of energy management, feasibility analysis.

Results. During the analysis we found that the reason for the growth of energy consumption at the Orenburg oil and gas condensate field is the increase in operating costs due to high water-cut and the cost of maintaining reservoir pressure. Analysis of energy management has shown that in Orenburg can be classified as stable , but requiring optimization of energy consumption for the extraction of products from abandoned wells. Therefore, to create innovations appropriate to apply the binding, economic and energy reserve for the wells on the basis of the coefficient of hydrodynamic models. The advantage of using energy efficiency factor are simplicity and efficiency, a high degree of confirmation on the fields in late stage development, independence from geological and other risks. All types of risks taken into account in the evaluation of the effectiveness of the developed innovations in the form of risk premiums to the discount rate. According to the obtained calculated indices was formed by a conservation programme. In order to optimize energy consumption at the production facilities of the Orenburg oil and gas condensate field created a list of energy-saving innovations, the optimal sequence of actions based on the index of potential losses that takes into account indirect risks, the investment program subject to the investment restrictions. Economic and energy effect is for 15 years 1.124 billion dollars. Innovations aimed at reducing electricity losses in power transformers, repair and replacement of pumps, installation of devices of reactive power compensation, introduction of thyratron motors, optimization of pumping units. On the basis of expert assessments determined the risk premium in the discount rate for each innovation, which reflects the combination of traditional and specialized risks in oil and gas production while implementing energy-saving technologies ranging from 6% to 17%.

Conclusion. The study revealed reserves of increase of the time cost-effective field development, cost reduction and growth in hydrocarbon production due to the introduction of energy-saving innovations.

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ECONOMIC EVALUATION OF INTRODUCTION OF ALTERNATIVE SOURCES OF GENERATION AS MAIN POWER SOURCES

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Key words. Diesel generator, alternative power generation, fuel savings, electricity sales, operational safety, reliability of supply, economic efficiency.

Introduction. In 2017 in Europe, renewable power supply cover 32% of electricity generated. Most energy is produced at solar and wind stations. In the future, on the concept of "energy transition" by 2025, the amount of energy received on the solar-wind power stations will grow up to 40-45%,and by 2035–to 55-60%.

Aim. The calculation of the basic technical-economic indicators of renewable energy in the European energy (including smart grids).

Materials and methods. In the programming language C++ program was developed which is based on economic technical calculation.

Results. The developed program allows evaluating the effectiveness of the implementation of alternative sources of generation to replace diesel generators. Given the probabilistic nature of the alternative generation, the program allows you to define periods of time when there will be dips and peaks of energy production based on which is the amount that must be expended on electricity from the external network or the cost of fuel for diesel generators. Determined by the cost of kWh generated on a virtual station based on which calculates the profit that can be obtained through the sale of energy generated by alternative energy sources in the external network. In addition, the program produces graphs of co-generation and alternative diesel generation, periods of charge – discharge batteries, periods of excess energy production. This program received a patent for a useful program.

Conclusions. With the help of this program, designed a project of replacement of diesel generators with solar-wind to power the emergency gate valves of the main pipeline connecting the field TAAS – Yuryakh in Sakha (Yakutia) and pumping station No.18 ESPO pipeline. When implemented, this initiative will annually save about 200 thousand liters of diesel fuel. So when capital investment is 61 million rubles payback period of approximately 5-7 years depending on the discount rate.

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COMPLEX INNOVATIONS THAT IMPROVETHE EFFICIENCY THE FUNCTIONING OF THE ORENBURG GAS CHEMICAL COMPLEX

Authors: Anna Novikova*, Olga Eremenko
Mentor: Prof. Vladimir Shpakov

Key words. Innovations aimed at improve the efficiency the functioning of the gas chemical complex.

Introduction. Orenburg oblast has long been one of the main areas of hydrocarbon production for the needs of the Soviet and then Russian economy. Even today, despite a sharp drop in the volume of recoverable hydrocarbons at the Orenburg oil and gas condensate field, the region is strategically important in connection with the presence in the bowels of the significant oil and gas reserves, well-developed transport and processing infrastructure, proximity of markets. In terms of a natural transition to the final stage, possibility of implementation of the strategic scenario is only the introduction of new technologies that will effectively extract and use hydrocarbon feedstock.

Aim. To form the complex of innovative technologies for the extraction and processing of hydrocarbon raw materials in the framework of the Orenburg petrochemical complex.

Materials and methods. This article used methods of analysis, synthesis and prognostic studies. For economic analysis of marginal wells used the methods of calculating the profitability of the wells, according to which all wells are divided into profitable and unprofitable on the principle of cost recovery.

Results. At the current stage, the field is at the late stage of development and its exploitation is accompanied by a decrease in reservoir pressure in the zones of separate installations of complex gas treatment, confinement to substantial reserves of low permeability reservoirs, active water sources, salt deposits, aggressiveness and toxicity of the gas. Every year the number of medium and high capacity wells is reduced, and the number of low productivity grows because of lack of reservoir energy to achieve conditions of removal of liquid from the well.The share of low-margin wells was 12%, and unprofitable wells – 26%. Reduced capacity utilization of plants for the processing of raw materials, decreasing the depth of processing in the supply of raw gas from Kazakhstan. All these issues form the need for technology.

We have studied the materials of the geological studies, confirming the presence of large reserves of unconventional oil. Thus, the paper presents the results of calculations of options for the development of these reserves and reconstruction of the Orenburg gas-processing and helium factories. Selected range of products, most cost effective, competitive and demanded in the market.

On unprofitable wells formulated innovations to increase production of hydrocarbons. These technologies represent cost-effective ways of restraining the natural decline in production, extending the life of wells and increase recovery rates. Their choice was guided by the principle that effective are not only innovations, leading to further production of hydrocarbons, but reducing the pace of its fall.

Conclusions. Overall, the range of introduced technologies will allow to increase operating efficiency of the Orenburg gas chemical complex, will have a positive impact on increasing the duration of the cycle of field development and increasing the productivity of wells.

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PHD PAPER CONTEST

TECHNICAL PROGRAMME

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Yury Bayukansky, Schlumberger, Senior geologist

MATHEMATICAL MODELLING OF SAFETY INSTRUMENTED SYSTEM FOR PIPELINE INFRASTRUCTURE PLANNING

Author: Daria Golyzhnikova*
Mentor: Shcherbanin Yu.A.

Key words. Reliability theory, safety requirements,multiobjective optimization, risk reduction.

Introduction. Beforeimplementing any operations, the organitioal structure must be designed first. Ignoring safety issues in infrastructure planning can result in significantly great losses due to the damages.

Aim. The main objective of this research is to develop a comprehensive approach to mathematical modelling of safety systems functioning for the purpose of optimizing the systems design from the reliability and economic perspectives.

Materials and methods. This work develops a framework of economically efficient safety systems design based on mathematical modelling of those system and their interaction with hazardousindustrialfacilities. It is considered very important to analyze the petroleum production infrastructure; analyze and assess risks and address the issues of mitigating those risks. The risk management theory, reliability theory and safety concept have become an essential part of infrastructure planning. The project implements optimization of safety-instrumented system design with the help of genetic algorithm in multi-objective application. This optimization is basedonsafetyandreliabilityindicators along with lifecycle cost. The problem addresses the safety in parallel and series systems. The requirements forsafety integrity areaddressed in accordance with internationalstandards IEC 61508, IEC 61511.

Results. In this work, there was developed a methodology of evaluated both costs and reliability characteristics for safety systems for the processes involved in petroleum production. This methodology can be used for both engineering solutions and economic evaluation for petroleum production infrastructure design purposes. It allows to evaluate a particular specification and chose the optimal once in a timely manner. This approach is based on trade-off between costs of risk reduction measures and achieved level of safety.

Conclusions. Novel contributions include implementation of modelling by Markov Analysis with flexibility for evaluation of multiple solutions; a model for quantification the reliability characteristics for each particular subsystem; and the integration of system modelling with optimization by multi-objective genetic algorithms with lifecycle cost assessment. Thus, this work intends to contribute to the state-of-the-art in modelling for a particular alternative of SIS specification and solution of multi-optimization of design and testing of safety systems with Genetic Algorithms based on principle of compromise between the costs of risk reduction and the achieved level of safety.

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SOME PROBLEMS OF ECOLOGICAL INSURANCE IN RUSSIAN OIL AND GAS INDUSTRY

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Key words. Ecological insurance, mathematical modeling, environmental pollution, oil and gas industry.

Introduction. The problem of environmental protection in Russia is rather serious,especially in oil and gas industry. The key to the solution of this issue may be found in using ecological insurance – economic tool for the environmental protection. One of the problems in the implementation of environmental insurance mechanisms is the lack of statistical data on environmental pollution that would allow insurers to assess the probability and scale of losses correctly and develop adequate insurance tariffs. Therefore, an urgent task is to assess the extent of pollution during an oil spill using economic and mathematical modeling.

Aim. The aim of the research is to develop recommendations for the insurance of environmental risks in the oil and gas industry in Russia on the basis of an economic and mathematical model that allows us to assess the scale of environmental pollution by oil products

Materials and methods. For obtaining estimates of spatial and temporal scales of pollution a method of mathematical modeling of processes of spreading and transformation of petroleum hydrocarbons in the environment is used. In order to verify the model, there was written a program, that carries out the calculation of oil spills model scenarios.

Results. There was developed and presented economic-mathematical model for calculating the area and depth of contamination of the underlying surface by oil during an accident at an oil pipeline or during the flowing of a well. Recommendations for estimating the amount of coverage and insurance premium have been worked out; the problem of the lack of statistical data on the frequency of accidents and the magnitude of losses from environmental pollution in case of accidents in the oil and gas industry is solved by mathematical modeling of the accident, which allows to estimate the radius and depth of contamination of the underlying surface.

Conclusions. The mathematical model made it possible to find the contamination radius and the depth of penetration of oil into the underlying surface at a certain time of elimination of the leak. This allows us, without reference to oil companies that hide or give incomplete information on the actual scale of pollution, to make an independent adequate assessment of the amount of pollution in order to establish fines for oil companies that have made an accident and find the size of the insurance premium more accurately.

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A NEW APPROACH TO OBTAINING A LIGHTWEIGHT EXPANDING CEMENT FOR THE WELL-CONSTRUCTION IN COMPLEX GEOLOGICAL CONDITIONS

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Key words. Well cementing, expansion, fiber.

Introduction. The successful isolation of formations with low fracture gradients requires the use of lightweight cement slurries. Conventional lightweight slurries usually have a high water-to-solid ratio, which results in the increased distance between cement hydrated crystals, leading to bulk shrinkage. In the worst-case scenario, the shrinkage can lead to the debonding of the cement-casing-formation contact.

Aim. In this study we will focus on increasing the expansion values of the lightweight cement, using additional structural elements during the hardening process. The main idea of this study is that the pressure, created by expansive additives in the pore structure, is transferred to the hardened products through a structural fiber framework. This is essential for the lightweight cements that have an increased pore size due to a high water-to-solid ratio, and which results in the decrease of the expansive additive efficiency.

Materials and methods. The methods used for measurement were based on API standards. To measure the expansion pressure, a special device was designed and patented. The interaction of the expansion additives, fibers and cement matrix was assessed by electron microscopy. The phase composition of the hardening products was investigated by X-ray diffraction.

Results. The increase of the water-to-solid ratio of the cement slurries inevitably reduces the value of the linear expansion coefficient of the cement stone due to an increase in the distance between cement hardening products. The highest values of expansion, in comparison with other types of fi-ber, are provided by polypropylene fiber, and the expansion in the amount of fiber in lightweight cement increases the expansion of cement stone. It has been experimentally shown that the addi-tion of fiber by 30-50% increases the sedimentation stability and improves the basic physical and mechanical properties of the resulting stone, increasing the strength under compression by 8-12%, bending by 15-35%, stretching by 20-100%; increasing longitudinal deformation by 50-70% and lateral deformation by 40-50% in case of compression failure; increasing the impact resistance by 30-75% (specific impact viscosity), and by 2-4 times increasing the linear expansion coefficient of the cement stone during hardening.

Conclusions. The role of reinforcing additives (fiber) - transferring pressure from expanding additives to the cement matrix in lightweight cement slurries and increasing the stone expansion effect in compar-ison with conventional cement recipes has been established. The proven increase in the expansion and shock resistance of cement stone improves the integrity of the wellbore sealing and the strength of cement contact with the steel casing and rock. The improvement of the properties of the cement slurries provides efficient primary cementing.

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SUSTAINABILITY OF A MULTIPHASE PIPELINE ACCORDING TO FLOW PARAMETERS

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Key words. Modeling, Multiphase Flow, Slug.

Introduction. This study investigates the features of multiphase pipeline's operations of the oil and gas gathering system in the conditions of the Novoportovskoye field of LTD "Gazpromneft-Yamal". It is well known that, under certain operating conditions, a slug multiphase flow could be established, leading to vibration, pipes' relative displacement and destruction of the pipeline elements.

Aim. Multiphase flow numerical model development and investigation of its Impact on mechanical stability of pipeline components; characterization of parameters that ensure trouble-free operation of the pipeline, taking into account oil, gas and water profiles

Materials and methods. A literature review of existing multiphase flow models in horizontal pipelines was done. The slugging mechanisms were discussed. Pipeline's trajectory was analyzed and specific areas were identified, where liquid slugging and subsequent hydraulic shock on the pipeline wall might occur. Modeling in a dynamic multiphase flow simulator as well as modeling with new proposed. A physical monitoring of slugs' movement was performed in order to verify the hydrodynamic model.

Results. A simple mathematical model of slugs' impact on the pipeline has been developed by combining hydrodynamic and mechanical models. As a result of the simulation, multiphase flow maps have been calculated for typical sections of the pipeline, depending on various technological conditions.

The PVT and the hydrodynamic model in the simulator are matched with an operation history of the oil and gas condensate field's pipeline. Recommendations are developed for maximizing of pipeline's mechanical stability under multiphase flow conditions with regards to the current design and to the new pipelines.

Conclusions. A mathematical model of the multiphase media inside a pipeline has been developed, with respect to formation of liquid slugs, affecting the walls of the pipeline and leading to the relative movement of the pipeline along the fixed static point. Coefficient of mechanical stability of the pipeline is derived depending on the pipeline's operation mode.

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JUSTIFICATION OF THE NUMERICAL SIMULATION APPROACH OF THERMAL GAS TREATMENT ON BAZHENOV FORMATION

Author: Arthur Shakhmaev*
Mentor: Prof. Petr Pyatibratov

Key words. Water, isolation, flooded layers, packer.

Introduction. The large sizes of a deposit, complex geological structure, and also sharp variability of properties of productive layers on the area and a section belong to features of the field Zhanazhol. Low productivity of a collector caused need of application of special decisions, such as consolidation of two-three objects for joint operation by a single grid of wells. The oil-bearing horizons differ in unevenness on the area of the field; in this connection there are wells which opened as one of objects, and more, and in various combinations. Their joint development dictates need of control of a contribution of each horizon to production amount, and also amounts of pumping water on wells.

Aim. Find the most effective way to isolate flooded intervals in the wells with a breakthrough in the field in the Zhanazhol oil field of the Aktobe region.

Materials and methods. For cutoff of the flooded layers in wells with break of water the technology of installation of metal plasters with use of DORN technology was implemented. The technology provides pumping of cement mortars in an isolation interval, drilling of the cement bridge and study of a trunk of a well the hydraulic scraper with the subsequent installation of a plaster at the rate of overlapping of layer is 2-3 m lower also above a perforation interval. It should be noted that, despite labor input of transaction, success of these works made about 90%.

Results. About efficiency of technology it is possible to judge by work of the well specified in the drawing. After selective isolation of layer 2 water content of products changed from 95% (in case of Rzab = 165 atm) to 64% (in case of Rzab of =167 atm) in case of start, the current water content makes 69% with work of a well after carrying out IDN (in case of Rzab = 33 atm).

Conclusions. Thus, isolation of layers by descent of packer configurations will allow:

— to increase oil recovery and outputs of a well due to additional involvement in development of low-permeability layers;

— to increase degree of a scope and intensity of development of the multisheeted field by separate involvement in development of separate thin different and permeable layers pro-layers;

— to intensify process of regulation of selections and downloading in time and on a well section;

— to increase the profitable term of mining;

— to provide accounting of the got products from each layer and the working agent downloaded in it;

— to manage quickly the field of reservoir pressures, to regulate the directions and speeds of filtering formation fluids

— to prevent harmful effects of solutions of muffling on PZP, to cut layers (to isolate borehole installation from layer) without negative technogenic impact on them.

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YOUNG PROFESSIONALS PAPER CONTEST

TECHNICAL PROGRAMME

Judges:

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Aizhana Jussupbekova, North Caspian Operating Company, Lead Reservoir Engineer

Ravilya Safieva, Gubkin University, Expert

ABANDONED MINE METHANE – BRIGDE BETWEEN OLD AND NEW

Author: Wojciech Labuda*
Mentor: Jacek Hendel, MSc

Key words. Abandoned Mine Methane, Monte Carlo, natural gas, profitability analysis.

Introduction. Transition from coal-based economies to renewable energy sources becomes a fact. One of the effects of this process is closing more and more underground coal mines all around the globe which results in many socio-economic problems for post-mining areas. However, there is very little consciousness of a significant and unexploited potential hidden behind this process – Abandoned Mine Methane (AMM). This type of reserves of natural gas can be interpreted as a threat of explosion or for climate but also as a source of energy and economic improvement for regions struggled be crises.

Aim. The aim of my research is to examine whether production of methane from abandoned gobs through a well and its utilization for production of electricity, heat, CNG or injection to a pipeline in conditions of Polish Upper Silesian Coal Basin (USCB) can be profitable.

Materials and methods. To determine this I used both deterministic and probabilistic approach applied to a sample project in different scenarios of methane utilization. Firstly, I built a profitability model based on commonly used methods – NPV, IRR and DPP, which included many non-deterministic variables like energy prices, gas reserves and mine depth. Then I made a Monte Carlo simulation to get final distributions of examined variables. I used @Risk 6.2.0 from Palisade Decision Tools for making this research.

Results. Conducted analysis indicated that the most profitable way of AMM utilization is production of both electricity and heat for own demand of the investor. CHP unit during 20 years can generate USD 6.3 million which means 130% IRR and repayment in 1 year. Other scenarios are less profitable with the worst one – assuming injection to a pipeline which has 60% probability of loss. What is more, sensitivity analysis proved that gas reserves and prices of electricity and heat are the most important factors.

Conclusions. Present global annual production of methane from abandoned mines amounts to only 0.5 billion m3 and even if full potential is utilized it will not increase more than a few times. But the gas can change local economies where it is needed the most. Coal-producing countries like the US, China, Russia and Poland should look for something that make a step from old to new energy systems easier. Usage of AMM in profitable way could become this factor. My research can help to find the best method of its utilization and also methodology of profitability analyses of such projects. Under Polish conditions the most profitable is producing electricity and heat in CHP unit. The investment is mostly affected by the amount of gas thus the key factor is a good recognition of geological conditions.

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JURASSIC SEQUENCE STRATIGRAPHY OF THE MIDDLE CASPIAN BASIN

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Key words. Middle Caspian, sequence stratigraphy, Jurassic, seismic interpretation.

Introduction. The Middle Caspian offshore is one of a few provinces of Russian shelf with not only explored and proved petroleum resources but also where active production is taking place. Main oil and gas bearing complexes are Jurassic terrigenous-carbonate and Cretaceous terrigenous. Jurassic deposits contain 88% of petroleum resources within the Sarmat-Kvalyn anticline zone which is a part of Prikum-Central- Caspian system of anticlines and troughs.

Aim. Current level of exploration gives reasonable level of confidence to identify large and medium structures. New profitable prospects are believed to be found in structural-tectonic and nonanticline traps.

Materials and methods. Due to good seismic coverage, irregular distribution of drilled wells, long distances between some of zones and lateral changes of thickness and lithology of Jurassic deposits application of sequence-stratigraphy analysis is necessary.

Results. With application of sequence-stratigraphy Jurassic deposits were divided into sequences of 2nd and 3rd order and parasequences for the first time in area of Middle Caspian.

Conclusions. Identification of system tracts allowed to describe character of sedimentation in Jurassic basin and to define reservoirs and potential seals and their distribution.

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VECTOR MEDIAN FILTERING AND ITS APPLICATION FOR ATTENUATING SEISMIC NOISE USING DATA FROM OFFSHORE NAMIBIA

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Mentor: Adam Booth

Key words. Vector median filter, frequency-offset vector median filter, time-frequency-offset vector median filter, noise attenuation, random seismic noise, swell noise, Namibia.

Introduction. Random noise and in particular swell noise in seismic data complicates the identification of reflections in common midpoint gathers and decreases the quality of the seismic images. This study introduces two new methods, based on vector median filters, to attenuate random and swell noise in the complex domain. The frequency-offset vector median filter (Fx-VMF) and the time-frequency- offset vector median filter (TFx-VMF).

Aim. The aim of this work is to develop a vector median filter in the complex domain to attenuate seismic noise which is considered to be present in a limited frequency range which might change with time. The filter should not remove all amplitudes in the frequency range and should preserve signal amplitude content in the same frequency range.

Materials and methods. The frequency-offset vector median filter and the time-frequency-offset vector median filter are an extension of the conventional vector median filters operating on real numbers into the complex domain. The Fx-VMF is a filter in the frequency-offset domain that allows removing incoherent noise while preserving coherent events. The TFx-VMF is a time-variant filter in the time-frequency- offset domain that allows the modification of filter parameters with time to take into account that seismic noise varies with both frequency and time.

Results. When comparing these methods with a conventional Fx filter, it was found that the Fx-VMF and TFx-VMF filters eliminate more random noise while protecting the signal. The effectiveness of both the Fx-VMF and TFx-VMF filters is demonstrated using synthetic data with band-limited noise. They decrease the noise magnitude by 8 and 12 dB, respectively. In addition, results of applying the methods on prestack offshore data in Namibia demonstrate that the Fx-VMF and TFx-VMF filters are effective in practice. Noise magnitude decreases by 15 dB and 3 dB in the nosiest common offset section (offset: 2455 m) after application of the filters.

Conclusions. It was demonstrated, with synthetic and real data sets, that the Fx-VMF and the TFx-VMF filters are effective in removing incoherent seismic noise, that both filters attenuate more noise than conventional frequency-offset filters and that the filters preserve the signal in the filtered frequency band.

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SPECIFICS OF CONFINING STRESS APPLICATION TO THE CORE SAMPLES IN THE PROCESS OF POROSITY DETERMINATION UNDER FORMATION CONDITIONS

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Mentor: M.G. Gubaidullin

Key words. Core samples, porosity, core analysis, effective pressure (mean confining stress).

Introduction. Porosity is the main petrophysical parameter which is critical for reserves estimation, risk analysis, decision making during exploration period. The most effective method of porosity determination is the laboratory analyses on core samples.

Aim. The main idea of this article is to describe difficulties of formation conditions modelling during core analysis in laboratories. Core data obtained using different analysis methods on the same core samples are to be compared. As well the influence of lateral stress is the subject of interest.

Materials and methods. Analyses were performed on 241 core samples by liquid saturation method applying formation pressure and temperature, and by gas saturation method with application of pressure. Samples presented by well consolidated Cretaceous age limestone.

Results. The main method of porosity determination in formation condition is triaxial loading. It is necessary to take into account the factors of rock expansion caused by uniaxial compression, i.e. vertical and horizontal stresses. Therefore the determination of porosity using core holder with triaxial loading the vertical stress can't be equal to overburden pressure. But this issue is not taken into account by modern laboratories. The vertical and horizontal components include the pressure of the overlying rocks and horizontal loads. Mean stress can be expressed by vertical and horizontal loads. According to the results obtained for the method with application of thermobaric conditions and saturation of pore space by formation brine, porosity changes within the range of 65.58 - 95.60%. Changes mainly depend on the value of the initial value of porosity and the value of applying mean pressure. For the method which is accompanied by gas saturation of pore space and applying of confining pressure only the following results were obtained. A porosity change varies within the range of 94.02 - 95.60%. In comparison to the first method the intensity of the change decreases significantly: from 65.58% (1) to 94.02% (2). It becomes obvious that the difference in the compressibility of the gas and water in the pores creates a significant effect. Two methods can produce the same results for the samples with initial porosity higher than 15%.

Conclusions. Lateral stress has to be integrated into calculations during usage of 3 axle core holders for porosity determination under formation conditions. If confining pressure is taken equal to vertical stress that will cause the pessimistic results. Pore volume compressibility is depends on initial volume of pores. Maximal changes are presented for the samples with low porosity value. Liquid has to be used for pore pressure simulation instead of gas. Absence of liquid causes abbreviation for pore volume changes for samples with porosity less than 15%.

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POSTER SESSION

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CALCULATION OF GAS LOSSES THROUGH DAMAGE IN A PIPELINE

Author: Nikita Kondrahin*
Mentor: Dr. Michael Lurye

Key words. gas leaks, natural gas, trunk pipelines, depressurization.

Introduction. Gas leaks represent a source of economic damage to gas transportation enterprises and environmental damage. At pressures used in trunk transport, the use of perfect gas models can lead to inaccuracies in determining the amount of the lost product, which in turn entails losses for the enterprises, incorrect determination of insurance payments, fines and reimbursements.

Aim. The main purpose of this work is to improve the methodology for calculating the process of natural gas outflow, as well as software implementation of the improved technique for further practical calculations.

Materials and methods. When considering the process of the outflow of a real gas, the heat capacities vary with temperature and pressure, and the equation of the adiabatic process differs from the classical Poisson adiabatic equation. Therefore, the Bernoulli equation must be solved in conjunction with the adiabatic equation of a real gas, i.e. Solve a system of differential equations with the initial condition $T = T_0$ for $p = p_0$. Russian gas dynamics researchers Chaplygin's and Charny's transactions were used. Computational experiment was set.

Results. The existing technique for determining the amount of leaking gas was considered and modified, a programm for performing calculations was developed and the error of approximate calculating method was estimated. From the obtained data, it follows that calculations using the refined method gives higher leakage rate than for an ideal gas. With an increase in the initial pressure and a decrease in the initial temperature, the magnitude of the error increases, since the properties of the gas differ more and more from the properties of the perfect gas.

Conclusions. Gained results shows, that existing methods for calculating gas leaks give wrong results and the use of the refined method provides more accurate data. Further studies for increasing calculation pricision are reccomended.

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RELATIONSHIP BETWEEN STATIC AND DYNAMIC ELASTIC CHARACTERISTICS

Author: Nikolay Ravilov*
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Key words. Core, static modules of elasticity, dynamic modules of elasticity, Poisson's ratio.

Introduction. In the scientific literature, relationship between the static and dynamic elasticity modules of rocks is often considered. Various authors have studied this issue both for productive oil and gas bearing rocks, and for concrete and ground, used in construction. This, in turn, underscores the importance of these studies. In this paper, we propose our own version of the dependence between the static elastic modules and dynamic modules.

Aim. Obtaining a relationship between static and dynamic elastic characteristics.

Materials and methods. 40 core samples were selected, which represent the XV, XVa (intergranular) and XVI (cracked) horizons. On the model simulating the reservoir conditions, the modules of elasticity of the samples were obtained, which together with the values obtained by other authors in previous studies made it possible to propose a new relationship between these parameters. In this paper, we also underline general concepts of elastic parameters (Young's modulus and Poisson's ratio) and represent methods for their determination, comparing the data obtained in a static and dynamic way.

Results. As a result of the studies, a relation was educed between the elastic module obtained by static and dynamic methods. This relationship has a high correlation coefficient and can be used to recalculate the dynamic Young's modules into a static one, to construct a geomechanical model. The relationship between the static and dynamic Poisson's ratio was not revealed. Perhaps, this relationship exists, and should be sought in the nature of the fractured constituent of the rock. The relationship of elastic characteristics to the coefficient of open porosity was revealed.

Conclusions. tudies (at ultrasonic frequencies), the fluid does not have time to drain and takes on a portion of the external voltage. The pore pressure in this case can reach a significant part of the applied load. This phenomenon is particularly noticeable in the nature of the Poisson's dependence curves. With increasing porosity, the static Poisson's ratio decreases, and the dynamic coefficient practically does not react. For Young's module, the picture is slightly better, because the value of the density associated with the porosity affects it. The equation obtained from the comparison of the dynamic and static elastic modulus can be used to recalculate the dynamic modulus of elasticity into static.

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THE RESEARCH OF THE POSSIBILITY TO USE THE BARIUM-CONTAINING MINING WASTE AS A WEIGHTING AGENT OF DRILLING FLUIDS

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Mentor: Dr. Galina Teptereva

Key words. Barite, drilling fluids, weighting agents.

Introduction. Barite is used as a weighting agent for drilling fluids in oil and gas exploration wells to constrain high formation pressures and prevent blowouts. Oilfield service companies spend amounts of money to purchase great volumes of barite. (It is especially noticeable when drilling deep exploration and production wells where 90-110 tons of barite are used on single well). In this regard, it is necessary to take measures to reduce the cost of materials used as weighting agents in drilling fluids, specifically, to consider the use of cheap barium-containing mining waste.

Aim. Research of the possibility to use the barium-containing mining waste as a weighting agent of drilling fluids.

Materials and methods. The barium-containing mining waste (BCMW) from Quartzite Sopka, Kemerovo Region (Russia) was used. The BCMW's elemental composition was explored by X-ray fluorescence (XRF). XRF showed in the BCMW the presence of a large number of sulfur compounds (48.99%), while the content of barium, in terms of barium elemental did not exceed 30%. Therefore, the test sample of the BCMW was rinsed under hot water and then dried to reduce the sulfur compounds, as well as sieve analysis (0.14 mm and 0.9 mm sieve sizes) to remove large fractions. Repeated XRF analysis showed that the BCMW's test sample conforms to the standards (API RP 13K). The research of the possibility to use of BCMW as a weighting agent was implemented on water-based drilling mud (water, 3% bentonite, 0.2% bioxane) with the addition of the BCMW's prepared test sample in an amount of 10% to 60% by weight.

Results. The results of the research of the weighting agent properties of the BCMW showed that the addition of the BCMW into the drilling fluid increases the density from 1.09 kg/m 3 at 10% to 1.63 kg/m 3 at 60% by weight, the funnel viscosity decreases by 15.85%. The filtration rate (API) and pH fluctuate at the same level: 12.1 ml and 7 respectively. In addition, the filter cake slickness ratio increases from 0.0262 at 10% to 0.1881 at 60%.

Conclusions. The research has proved the possibility to use the barium-containing mining waste as a weighting agent of drilling fluids after the preliminary preparation (water rinsing and sieve analysis).

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MICROSCANNERS: COMPREHENSIVE ANALYSIS, APLICATION AND INTERPRETATION

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Mentor: Maria Srebrodolskaya

Key words. Microscanners, image, interpretation.

Introduction. Scanning methods of geophysical well logging which enable to determine the physical properties of rocks with a high accuracy are becoming more relevant. Microscanners take a special place in a series of high-resolution methods of geophysical studies. Microimaging tools display fine details of thin planes, fractures and faults, can indentify structural dips, strikes of bed, dip azimuth, determine fracture opening and theirs density. Obtained formation data can also aid in geosteering, especially in an area where the formation dip may be unknown or significant changes are present within geological structure.

Aim. The aim of this paper is consisted in comprehensive and detail comparison of different types of microscanners, in study case and interpretation of density images to show the potential of microscanners.

Materials and methods. Generally, the articles of scientific journals, manuals of microimaging tools and data of three wells were used to write this scientific work.

Results. Microimaging tools are divided into two types according to logging conditions: WireLine microimaging tools and LWD microimaging tools. 2D visual displays of rocks physical properties along borehole measured with a microimager are called images. Images are classified according to the physical characteristics of microimagers into the following types: resistivity images, conductivity images, images of transit time and amplitude, density images, images of PEF, images of Gamma Ray logging. Interpretation of the image density in several wells was produced in order to evaluate the potential of azimuthal gamma-gamma density logging (GGK) recorded during drilling. Processing and interpretation of image data was done manually using special software. The results of this processing allowed us to determine dip angles and azimuths (mainly clays and sandstones) and disjunctive dislocations (faults and fractures). Selected geological objects is presented in the form of sine waves and vectors (“tadpoles”). Also image data allows to specify the lithological column.

Conclusions. The paper discusses log examples from a variety of environments, calculation and visualization of complex density and resistivity images, achievable resolution and image quality, as well as log quality control and comparisons with high-resolution wireline imaging logs. Comprehensive analysis of each type of microimagers and comparison of WireLine and LWD microimaging tools are carried out in this paper. The advantages, disadvantages, operating restrictions research of each microimaging tool and the results of interpretation are shown.

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OFFSHORE FIELD DEVELOPMENT IN RUSSIA: SUBSEA PRODUCTION SYSTEM

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Key words. Subsea production system (SPS), Subsea X-mas Trees, import substitution, offshore.

Introduction. Proven hydrocarbon reserves are decreasing every year, this consequently leads to a decline of oil and gas production rates. At the same time, it should be noted that there are many territories with huge resources that will allow us to reach a new level of oil and gas production (gas condensate) in the short term but to develop these territories, competitive and own innovative Russian technologies in the field of subsea production are needed.

The use of subsea production systems (SPS) – one of the promising methods for development of deposits on the shelf. SPS is currently the most commonly used technological solution for the development of oil and gas fields offshore. SPS is a modern and is recommended technology – it is safe, reliable and economically feasible.

The introduction of sanctions in 2014 deprived Russia of the opportunity to use foreign technologies and equipment for the development of some fields, in particular the shelf regions.

The creation of domestic technologies for oil and gas extraction will help to solve a number of strategic tasks in the development of the shelf regions, including the Arctic and will also increase the volume of oil and gas production.

Aim. Import substitution of critical component of subsea production systems, for example: subsea X-mas trees as well the creation of domestic technologies for subsea production of hydrocarbons.

Materials and methods. TRussian and foreign regulatory documents were used to solve the set target.

Results. Outlining all advantages of the proposed new technologies and technological solutions for use in the development of the shelf and the possibility of domestic production of subsea X-mas trees. Determination of tasks needed to be solved, for the successful implementation of import substitutions. Engineering and technical characteristics analysis of foreign manufacturers and suppliers of subsea X-mas trees leading to give recommendations for the creation of competitive products.

Conclusions. Presenting new technical and technological solutions proposed for use in the development of the Russian shelf. Proposed technology includes domestic subsea equipment and an automated process control system. This subsea equipment is able to ensure the extraction of hydrocarbons on the shelf.

SPS are complex engineering structures with a high degree of automation, built with minimal human interactions to the main components, which in turn makes its maintenance more difficult and requires increased specifications in terms of environmental and technological safety. By 2022 it is planned to present domestic prototypes for subsea production systems.

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GEOPOLITICAL ANALYSIS OF THE INFLUENCE OF AMERICA BECOMING THE 2ND LARGEST LNG EXPORTER IN 2022 ON RUSSIAN GAS MARKET SHARES IN EUROPE

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Mentor: Terenteva Natalia Aleksandrovna

Key words. Gas market, sanctions, LNG, Russia.

Introduction. It is indisputable that Russia is a respectable oil rich nation and her role in the Energy supply especially in the oil and gas market is beyond crucial, being one of the world's largest producers of oil and the supplier of more than one-third of Europe's total energy consumption. Despite the long-lasting limitation held bound by the collective sanctions from the United States, Canada, Australia and the EU as a result of Russia's annexation of Crimea, Russia has been able to maintain a relatively rigid stance with its economy despite the harsh plummet of Rubble against Dollar.

Aim. To analyze the influence of the presence of US LNG on the Russian gas market shares in Europe in the Energy supply cloud of Europe.

Materials and methods. The following materials were used in the realization of this work: International Energy agency (IEA), 13 July 2017, "IEA sees global demand rising to 2022 as US drives market transformation"; BP statistical review of energy 2017; Reuters, 13 March 2017, "Russia's Gazprom delays Baltic, Sakhalin LNG projects"; Financial times, 3 August 2017, "US and Russia step up to fight to supply Europe's gas"; Harvard international review, 2 september 2015, "The Geopolitics of oil"; presentation by Oxford institute of for energy studies March 2017. The method of realization included: project work/research, reading, lectures/presentation.

Results. Sanctions keep hitting the Russian economy from the US and EU. The number of LNG consuming countries has been on the increase from 15 in 2005 to 39 this year as a result of increased energy consumption in countries due to increased standard of living and developments. 52% of Russia's revenue finds roots in Oil and Natural gas, Russia's export to to Europe Remains on the rise through her energy giant Gazprom, with over 80% of total export in 2016 being from Russia and increase in the annual exports in the first six months of this year. The US current work on 3 new terminals at the Texan coast doubles the current number of her functional LNG terminals in preparation for the 2022 challenge. The monopoly of Gazprom the Russian energy giant approaches an end with Novatek and Rosnefts actions to produce and export.

Conclusions. Although Russia remains confident through Gazprom's home advantages of vast reserves, low production costs, and fresh agreement between BP and Rosneft for 2019 to uphold the market, Politically inflicted restrictions will lead to an increment in the cost of the energy resources in the market coupled with fall in production in the Netherlands and UK which will keeps Russia ahead. The appearance of the US in the European energy market tends to take an overtly edge politically and painful choices of price and supply might be the options for the Russian energy giants if sanctions reach the ongoing construction of Gazprom's Nord stream 2 pipeline to Germany, hence a likely fall in the Market dominance.

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DEVICE FOR DETERMINING THE THICKNESS OF THE OIL LAYER ABOVE WATER

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Mentor: Ass. Prof. Denislamov Ildar

Key words. Sampling device, oil pollution, sample, water cutting, gravity segregation, thickness of the oil spill.

Introduction. Crude oil and refined petroleum products nowadays are the main water contaminators. In order to avoid huge ecological problems in case of emergency oil spills from a pipeline or a crude oil tank, some prompt measures should be taken, in particular, the evaluation of oil pollution degree of the water surface. In order to evaluate pollution degree of natural reservoirs by oil products, that is, to determine spilled oil volume, only two parameters need to be known: an oil spill area and the thickness of oil film. Nowadays fairly accurate determination methods exist. However, devices that are currently used to define the thickness of oil film have a number of demerits, such as insufficient accuracy, inconvenience of use and expensiveness. These drawbacks have a substantial influence on measurement accuracy.

Aim. The purpose of this work was to improve the sampling device that estimates the thickness of oil above water taking into consideration existing developments. The new device should provide a higher accuracy of estimating the thickness of an oil layer above water regardless of its thickness, as well as ease of operation. In addition, selection should be made in a shorter time.

Materials and methods. Materials used in conducted experiments was: vessels of different capacities, pump (Aspirator AM-5), shutoff device, separating funnel, different sized tubes, organic solvent, plastic bottles, crude oil

Results. The result of this work is the creation of a new sampling device that meets the above requirements. The technical task is carried out using a device for sampling an oil sample from water surface. The apparatus contains an oil shutoff device placed above water and a pump for supplying solvent to the oil. The oil shutoff device has a conical head with a detachable plug, which, in its turn, has a hermetically sealed tube with two shut-off valves. One of these serves for feeding organic solvent into the cavity of the device, and the second one is connected by a tube with a separating funnel, in whose cavity vacuum is created in order to transfer liquids
from the shutoff device to the separatory funnel.

Conclusions. The tests showed that the proposed device exceeds the characteristics of the given rototypes and, in fact, is the final version of the series of devices for determining the thickness of the oil layer above water. It should be noted that this device can also be applied to estimate the percentage of oil in high water-cut well products after sampling 1-3 m^3 of oil well fluid.

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DEVELOPMENT OF THE CLOUD APPLICATION FOR SELECTING THE OPTIMAL TECHNOLOGY FOR WELLS DRILLING

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Mentor: Prof. V. V. Sidorov

Key words. FiCloud technologies, drilling, information.

Introduction. Extreme drilling conditions have become normal. Given the increasing geological uncertainty and complexity, hydrocarbon exploration and production companies face the challenges of increasing costs, unproductive time and risks. Choosing the right drilling technology is becoming an increasingly important task.

Aim. The process of wells drilling covers many different aspects, which leads to the collection and storage of a large amount of information that must be processed and stored in a data warehouse.

Materials and methods. During the research, a comparative analysis of cloud platforms of the largest IT companies was conducted with the aim of choosing the best solution for building such a system.

One of the variants is a system, based on cloud technologies, is considered in this paper. In the modern world, all information about the process of wells drilling must be stored in a voluminous and complexly structured database. Cloud computing leads to significant changes in business and organization of work processes. The availability of cloud services continues to grow with each passing year.

Results. Problems solved by the author:

1. Formation of a common information space in the frame of drilling process.
2. Choosing the best IT systems for application development.
3. Collecting and processing large amounts of information. Data storage and access to it.
4. Increase the speed of processing and transmission of information.
5. Data presentation for making managerial decisions.
6. Selection of optimal drilling parameters for specific fields.

Conclusions. The paper considers various technologies for drilling wells, noted the convenience of using cloud technologies, made the choice of the optimal application development environment, and presented a variant of the running program.

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FROM TRASH TO GAS: IMPLEMETATION OF LOW COST TECHNOLOGY FOR BIOGAS GENERATION FROM ORGANIC WASTES AS AN ALTERNATIVE TO RENEWABLE ENERGY

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Mentor: Barisovich Stanislav Vladimirovich,

Key words. Biogas, Electricity, Generate

Introduction. According to the American Biogas Council, in their report published on the 5th of June, 2009, "Biogas is typically composed of 60% methane and 40% CO_2 . It is similar to natural gas which is composed of 99% methane. Biogas is a clean and renewable energy that may be substituted to natural gas to cook, to produce vapour, hot water or to generate electricity"

Aim. Gas, because of its clean burning nature, has become a very popular fuel for the generation of electricity. In the 1970s and 1980s, the choices for most electric utility generators were large coal or nuclear powered plants. However, due to economic, environmental and technological changes, gas has become the fuel of choice for new power plants built since the 1990s. In fact, the Energy Information Administration (EIA) stated that between 2009-2015, 96.65 gigawatts (GW) of new electricity capacity was added in the U.S. Of this, over 20 percent, or 21.2 GW, was gas additions.

Materials and methods. Methods.There are many reasons for this increased reliance on gas to generate our electricity. While coal is the cheapest fossil fuel for generating electricity, it is also the dirtiest, releasing the highest levels of pollutants into the air, thereby causing a great effect as relating to the depletion of the ozone layer. The electricity generation industry, in fact, has traditionally been one of the most polluting industries in the Africa. Regulations surrounding the emissions of power plants have forced these electric generators to come up with new methods of generating power, while lessening environmental damage. New technology has allowed gas to play an increasingly important role in the clean generation of electricity.

Results. Gas can be used to generate electricity in a variety of ways. The most basic natural gas-fired electric generation consists of a steam generation unit, where fossil fuels are burned in a boiler to heat water and produce steam that then turns a turbine to generate electricity. Gas may be used for this process, although these basic steam units are more typical of large coal or nuclear generation facilities. These basic steam generation units have fairly low energy efficiency. Typically, only 33 to 35 percent of the thermal energy used to generate the steam is converted into electrical energy in these types of units.

Conclusions. Conclusion.Technologically far more challenging is the first stage of the generator set: the combustion engine using the biogas as fuel. In theory, biogas can be used as fuel in nearly all types of combustion engines, such as gas engines, diesel engines, gas turbines and Stirling motors etc.

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HYDRODEOXYGENATION OF LIGNIN-DERIVED BIO-OIL MODEL COMPOUNDS OVER UNSUPPORTED CATALYTIC SYSTEMS

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Introduction. The technologies for the transformation of biomass into fuels and value-added chemicals are being extensively investigated by researchers worldwide. One of the obvious ways to proceed is hydrodeoxygenation (HDO), which substantially decreases the content of oxygenates in biomass-derived oil, making it possible to further refining. Among the many oxygen removal techniques, a catalytic processes is believed to be most efficient. Guaiacol (2-methoxyphenol) is one of the main products of the fast-pyrolysis of lignin containing substrates, the molecular structure makes it possible to use it as representative model compound of bio-oil for investigation of HDO-reactions.

Aim. The experimental work was focused on the study of the catalytic behavior of unsupported catalytic systems Ru -nano- TiO_2 in the hydrotreatment of guaiacol.

Materials and methods. Catalysts were obtained by thermal decomposition of the precursors in situ. The reactions were carried out in a steel autoclave at 50 atm. H_2 and the temperature range 250-300 °C, as raw material the 10 wt% guaiacol solution in hexedecane and 10 wt% methanol in guaiacol with or withot adding of the water were used.

Results. Various methoxyphenols were the main products of reactions at the temperatures below 260 °C, with the increase of the temperature to 300, it was possible to obtain high yields of phenol and cyclohexane. 49% yield of cyclohexane at 99% conversion of guaiacol was achieved by using 5% Ru/nano-TiO2 in conversion of 10 wt% guaiacol in hexedecane.

Conclusions. Today the most promising materials are bifunctional, they contain disparate active sites that catalyze complementary reaction steps. Combinations of noble metals including Ru, Rh, Pd, and Pt and acid sites have a synergistic effect for HDO revealed in a more efficient activation of hydrogen, reduced deactivation by water and selectivity of oxygen removing.

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MODIFYING ADDITIVE OF BASED ON PETROCHEMICAL WASTE FOR TO PRODUCE ROAD BITUMEN OF MEETS THE REQUIREMENTS OF GOST 33133-2014

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Mentor: Serafima Pokrovskaya, PhD

Key words. Road bitumen, combination additive, petrochemical waste.

Introduction. With the growth of annual automobile park and pavement surface load the demand for the road bitumen of high quality production has increased. In Russia and Belarus there is new road bitumen standard GOST 33133-2014, which provide requirements and characteristics that are, in contradistinction to BS EN 12591-2009, significantly stricter. That is why oil refineries have to carry out technical upgrading and modernization of the manufacture. It is well-known fact that as opposed to light crude oils, bitumen production doesn't have the income and such reequipment is going to be unprofitable. This problem can be solved by the usage of the effective inexpensive modifying additive.

Aim. The aim of this research was to make the road bitumen compound additive, which could give an opportunity to regulate and improve indexes of goodness up to requirements of modern standards, in particular GOST33133.

Materials and methods. The selection and investigation of basic properties of original raw materials such as the road bitumen, low molecular weight polyethylene (LMPE), heavier cut of pyrolysis gas oil (PGO) was made. Modifying additives based on LMPE and PGO were prepared by the compounding and heat treatment.

Results. By adding 1% mass of compound additive to the road bitumen 70/100, the new bitumen modification differ by the increase of softening temperatures on a ring and a sphere by 2,5% and heat resistance consequently. The rise of the penetration and tensile properties by 30 % and 5% respectively, leads to the bitumen hardness decrease. The bitumen tensile properties increase gives an opportunity to forecast the rise of properties like elasticity and agglutination (cohesion). The penetration index obeys GOST 33133-2014. The dispersed structure of the modified bitumen is very close to type «sol-gel», which is the road bitumen optimal quality. As a consequence of the brittle temperature decrease by 4–6 °C, the road surface will not change the structure in the bleak climate or subfreezing weather. The usage of 1% mass of modifying additive gives the plasticity to the bitumen structure and increase of the plastic range.

Conclusion. The combined influence of modifying additives on the road bitumen structure leads to the improvement of characteristics like hardness, heat resistance, ductility, flexibility, cracking resistance, adhesion to mineral materials that, in the end, gives an opportunity to forecast the high quality bitumen production. Offered additive can be used to improve principal indexes of goodness of the road bitumen of meets the requirements of GOST 33133.

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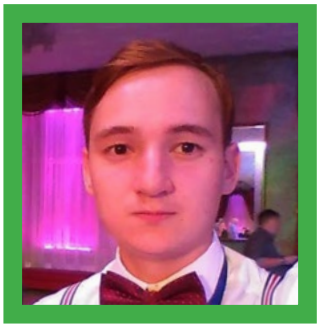

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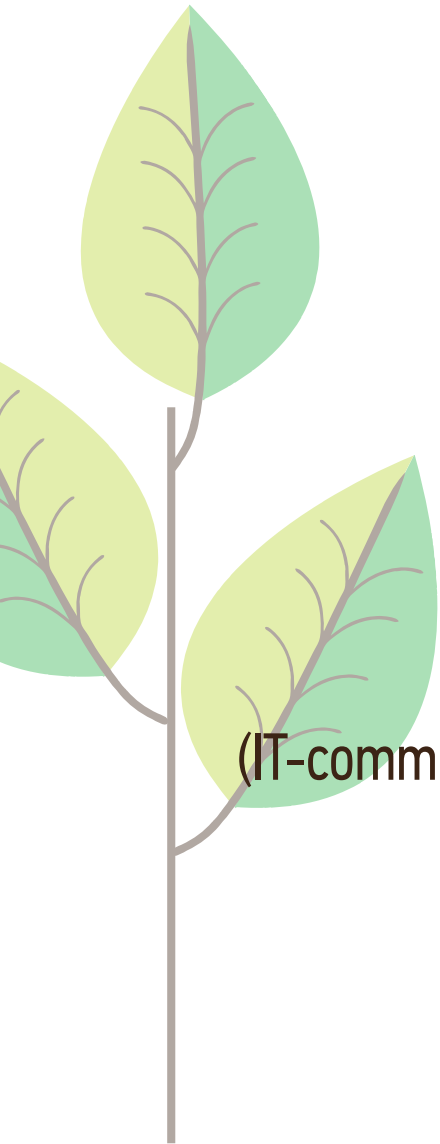

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