SUMMARIES

Turkiewicz A., Brzeszcz J., Witek W., Kapusta P.: **Biocide testing for the application in the oil and gas industry** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

The paper discusses tests for effectiveness of three antibacterial substances for application in the national oil and gas industry. The substances were tested with reference to active cultures of microorganisms. These cultures were isolated, inter alia, from drilling fluids, produced waters and extraction sludge, and then multiplied and used in tests discussed in this publication. The tests demonstrated differences in particular tested substances in respect of effectiveness of their impact on aerobic and anaerobic bacteria and fungi. The results of the work will be used in industrial treatments in order to eliminate biogenic contamination, counteract biodegradation of drilling muds, and also for disinfection of reservoirs designed for storing water and other technological fluids.

Keywords: *biocide, microorganisms, triazine, peroxide, drilling fluid, biocidal activity*

Freidenberger C.G., Śliwa T.: **Residential price of natural gas in Argentina** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

This article was made to research about natural gas market in Argentina and its price for residential customers. Wellhead, transmission and distribution prices are developed in this paper. In addition taxes and special charges are shown. Commercial consumption is not included in residential consumption.
Argentina has changed its natural gas framework in 1992, after this year several regulations transformed the gas market. On the other hand the country lost its self-supply and imports are growing in the last years. In this context natural gas price for residential customers is small in comparison with international context.

Keywords: *natural gas market in Argentina, residential price of natural gas in Argentina, Argentine natural gas framework*

Włodek T., Łaciak M.: **Selected thermodynamic aspects of liquefied natural gas (LNG) pipeline flow during unloading process** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

Liquefied natural gas (LNG) is transported by ships to unloading points on the LNG terminals, where the LNG is transported by above-ground superinsulated pipelines to storage tanks. Storage tanks are located a few hundred meters to several kilometers away from the unloading point. The article shows the changes in the basic thermodynamic parameters of liquefied natural gas during the flow in the pipeline modeled for an exemplary unloading process for different variants using Peng-Robinson equation of state.

Keywords: *LNG, liquefied natural gas, unloading operations, thermodynamic processes, cryogenics, LNG terminal*

Kosowska K., Kosowski P.: **25 years of Gazprom on the gas market** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

Gas sector was one of the best growing industries of the Soviet Union in the last two decades of its existence. This was made possible thanks to the discovery and exploitation of natural gas fields in Western Siberia, as well as

the construction of transmission infrastructure – domestic and export pipelines. The history of the Russian gas industry is inextricably linked with the activity of Gazprom, the gas concern set up in 1989 in place of liquidated Ministry of Gas Industry. The article gives a summary of the 25-year history of Gazprom and its economic, social and political role. It discusses activities of the company on internal and external markets, issues of gas reserves, production and transmission, as well as the financial and political relationship with the authorities of the Russian Federation.

Keywords: *Gazprom, gas market, gas prices, Russia*

Ziaja J., Movchan V.: **Comparative analysis of technological efficiency of oil production intensification in carbonate collector. Advantages of the technology of radial drilling** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

The paper presents a comparative analysis of the results of radial drilling, drilling perforation, cumulative reperforation and acid treatment. The study was focused at carbonate deposits in Russia. For each technology average incremental oil rates were estimated at the same exploration targets. The analysis of technological effectiveness in the given geologic and physical conditions revealed that drilling perforation and radial drilling allow reaching higher incremental oil rates compared to acid treatment and cumulative perforation. This fact confirms effectiveness of drilling radial canals by enlarging infiltration area. For the sake of completion radial drilling and drilling perforation are performed in the same wells. To reveal limiting conditions of applying radial drilling and drilling perforation an effectiveness analysis is made depending on the thickness of the interlayers exposed.

To formulate criteria of radial exposing applicability an analysis of effects of different geological and physical formation parameters on geological and engineering operations effectiveness is done. The following parameters are considered: relation between the current formation pressure and initial formation pressure, formation permeability, skin factor, thickness of interlayers in overall perforation interval, thickness of interlayers exposed by radial canals.

Keywords: *drilling, radial drilling, intensification of oil production*

Sapińska-Śliwa A., Wiśniowski R., Korzec M., Gajdosz A., Śliwa T.: **Rotary – percussion drilling method – historical review and current possibilities of application** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

'Faster, deeper, cheaper' – it is not just a slogan, it is a motto of every oil company.The first application of rotary--percussion drilling method in drilling oil wells took place in early 60's of the XX century in the United States. Unfortunately, in Poland did not apply. First of all, the main advantage is the increased rate of penetration, in comparison with standard rotary drilling, and consequently – lower wellbore costs.

The purpose of present paper is to discuss the historical background of application of rotary-percussion drilling method, technological changes that have occurred over the years, and to show the potential of this drilling method, using modern technology, in comparison with standard rotary method.

Keywords: *rotary-percussion drilling method, drilling mud*

Kondrat O.: **Investigation of the interaction of reservoir sections with different permeability in depleted gas field** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

For many gas fields, including Ukraine, which are being developed in gas drive, there is a deviation of graphics rectilinear dependence of reduced average reservoir pressure from the theoretical straight line dependence. The reason for this may be the existence of imperfectly drained zones, zones with low-permeable reservoirs within

the limits of the field. They include peripheral areas and separate areas in the field. These zones are being gradually involved to the development, are characterized by high reservoir pressure and gas from them flows into the recovery zone with production wells. According to the results of conducted researches the mathematical model of interaction in the gas field reservoir areas with different degrees of permeability and drainage as a result of gas cross-flow between them was proposed. Applying a suggested mathematical model the impact of interaction of different permeable zones in the macroheterogeneity field on the shape of the dependence of reduced average reservoir pressure from cumulative gas production was estimated and the opportunity to identify the presence outbalance reserves in the field noninvolved into the development was found out. Layers with outbalance gas reserves can be considered as the perspective zones for development.

Keywords: *low-permeable reservoir, peripheral zones, development, macroheterogeneity field*

Volynskyy D.: **Study of the non-project operating modes of the gas pipeline transportation system** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

The paper refers to the investigation of various non-project operating modes that can occur during the operation of the gas pipeline transmission system. The only method of research is mathematical modeling since the study of accidents and emergency situations in real pipeline is unacceptable. Therefore, in order to carry out the set tasks, mathematical modeling and computer simulation of the gas pipeline system and processes that can cause accidents in its work were applied.
As an object of study area was taken a hypothetical gas pipeline transportation system with the possibility to research its unsteady processes arising from the sudden closing of valves, emergency gas leak, the appearance of illegal gas extraction, connecting or disconnecting of looping etc.
A mathematical model of the system is based on the classical equations of unsteady gas flow, continuity and energy together with the equation of state of a real gas, which form a closed system. Boundary value problem is selected according to the operating conditions.
The obtained results allow us to generalize the findings of a significant impact of location of a gas leak or its extraction for the period of its discovery and the rate of change of the gas flow mode in the pipeline.

Keywords: *the Rotliegend series, Drill Stem Tester (DST), Aeolian sandstones, natural gas accumulations, standard Halliburton drill stem tester, bottom hole pressure, rock permeability*

Falkowicz S., Cicha-Szot R., Dubiel S., Launt P., Nelson S., Wójcicki W., Rogaliński M.: **Microbial flooding increases recovery factor of depleted Pławowice oil field – from lab to the field** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

The paper relates to the application of microbial enhanced waterflooding to improve the recovery factor and extend the productive life of depleted oil fields in the Carpathians Foreland. This technology and the application method used are categorized as Microbial Enhanced Oil Recovery (MEOR). Results of laboratory tests simulating the microbial flooding process in the oil field are presented along with results from the first two years of microbial flooding at Pławowice oil field. In the first two years of field application this MEOR process has increased the production rate of two oil wells by 70% on average above the rate before treatment.

Keywords: *oil fields, Carpathian Foredeep, Carpathians, MEOR, recovery factor*

Şuţoiu F., Foidaş I., Avramescu M.: **Increasing the degree of certainty on depleted gas reservoir perforation, using geophysical saturation methods** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

New geophysical investigations, capable of highlight the most thin gas saturated layers, offers for depleted gas reservoirs a new chance.

Lately Romgaz, used most types of anterior mentioned investigations, in purpose of analyzing the petrophysical properties of thin sands.
Thereby, there had been identified within depleted gas reservoirs, many layers saturated with gas, which after perforation had been confirmed.
After, these were included in the effective thickness zone, constitute the foundation for gas resources and reserves reevaluation.
In this paper there will be presented some concrete examples regarding the usage of these high resolution logs, for a better definition of reservoir properties.

Keywords: *depleted gas reservoir, geophysical investigation, effective thickness zone, high resolution logs*

Laura A.: **Geomechanical properties of shale rock from Baltic Basin in Poland area** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

The successful development of shale gas requires a fundamental understanding of shales and that can be challenging because these rocks vary significantly.
For recoverable shale gas resources assessment a broad range of geological, geochemical, geophysical and geomechanical data is required. Information about the variable lithologies, mineralogies, and kerogen content is vital to locate favorable intervals for gas production. Knowledge of the in-situ stresses and porosity of these intervals is essential for developing hydraulic fracturing strategies to recover the gas in place.
Geomechanical properties of shales are important in terms of determination of the likelihood of fractures initiating and propagating in shale materials. Geomechanical properties of rock include: Poisson's Ratio, Total Minimum Horizontal Stress, Bulk, Young and Shear Modulus. These properties play significant role in developing shale assets. Having access to geomechanical data can assist engineers and geoscientists during geomechanical modeling, hydraulic fracture treatment design and in some cases during reservoir modeling in shale gas fields.
This paper is intended to give characterization of geomechanical properties of shale rock. It then refers to a case study of Baltic Basin of shale gas in Poland, for discussing it geological condition and rock properties.

Keywords: *shale gas, geomechanical properties, mineralogy, Poisson's Ratio, Young Modulus*

Pinka J., Kucirková L.: **The importance of the formation and fracture pressures for the selection of the depths for casing setting in Slovakia** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

Different oil companies place shallow casing strings at different depths. Apparently there is no general method or procedure that gives the optimal location. This article is an attempt to define this optimum casing seat location. The potential benefits will improve safety and economy of the operation. The two major factors determine the depth of the casing shoe, that is, the fracture pressure and the pore pressure. A third factor is the lithology, because it is desirable to place the casing shoe in a competent shale section. The methods of predicting fracture gradients for deeper wells already exist. In this article, a method of predicting fracture gradients for shallow well has been derived. This method is combined with kick tolerance criteria to obtain a casing depth selection method. Also, the variation in fracture pressures at any depth has been investigated.

Keywords: *casing strings, fracture pressure, pore pressure, fracture gradients*

Nowakowski A., Paszylk P.: **Metal Magnetic Memory method used for analyzing high--pressure gas pipelines** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

Keeping the linear part of transmission infrastructure in proper technical condition, ensure an appropriate level of safety require performing a number of exploitation activities. The use of Metal Magnetic Memory (MPM)

method, mainly Non-contact Magnetometric Diagnostics (NMD) is a very interesting solution for gas pipelines testing. The method is used primarily for unpiggable gas pipelines. In the gas industry can be seen a growing interest of use such methods, due to its effectiveness and applicability of NMD tests without the need for excavations and is an alternative to predictive methods. The article present the examples of using the Metal Magnetic Memory method for the high pressure gas pipelines testing with examples of detected defects.

Keywords: *gas pipelines testing, Metal Magnetic Memory method*

Macuda J.: **Efficiency of drilling large diameter wells with cutter bits on the Szczerców opencast** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

Drilling of large diameter wells to be used for dewatering of lignite deposits is inefficient due to the presence of large packages of loose Quaternary and Tertiary strata. Moreover, considerable dewatering of the rock mass favors serious complications and drilling break-downs connected with the sliding of wellbore walls. Accordingly, new technical and technological solutions, which enable faster drilling, are searched for. In this way the time of operation of drilling mud on the near-wellbore zone can be shortened and the safety of drilling works increased. For the sake of obtaining higher rates of drilling in large diameter dewatering wellbores a new cutter bit 0.96 m of diameter was designed. Drillability tests in industrial conditions followed. These tests were performed in separated, loose and low-compaction, macroscopically homogeneous rocks of similar drillability. The tests were performed on selected sections 0.3 to 1.0 m long, and each of the sections was drilled at constant rotational velocity and weight on bit.
Prior to these tests there were established limitations regarding weight on bit and rotational velocity of the bit, in reference to the technical characteristic of the rig, strength of the string and the cutter bit.
Two different regression models were considered to find a dependence of mechanical drilling rate on weight on bit and rotational velocity of the bit for selected macroscopically homogeneous strata. The most favorable results were obtained for a power model representing impact of axial stress and rotational velocity of the bit on the drilling rate. They have been confirmed by calculated regression coefficients and statistical parameters.
Industrial tests were performed to assess the efficiency of drilling large diameter dewatering wells with a cutter bit of 0.96 m diameter on the basis of the presented model of average drilling rate. The results for the average drilling rate turned out to be much higher than the ones obtained so far.

Keywords: *drilling of wells, cutter bit, dewatering of rock mass, lignite*

Wiśniowski R., Uliasz M., Zima G., Wysocki S., Gaczoł M.: **Drilling fluids for drilling in shale and clay rocks** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

Clay shale rocks large intervals drilling generates a serious issues caused by hydration, swelling and dispersion of clay rock. Those reactions might lead to break-downs and complications in drilling as the consequences of borehole wall stability loss that have source in cave effect (occurrence of caverns and cavings) and borehole diameter sharp decreasing. Therefore, the outcomes of the research that have been undertaken are muds formulas adjusted for drilling various clay rock intervals.

Keywords: *drilling fluids, shale gas*

Stryczek S., Wiśniowski R., Kotwica Ł., Złotkowski A., Rzepka M., Kremieniewski M., Skrzypaszek K.: **Analysis of technological parameters of cementing slurries for horizontal casing works in Pomeranian Basin** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

Paper presents results of investigation on the properties of cement slurries used in casing works in horizontal wells. Six slurries were investigated. Each slurry was optimized to fulfill the demands of a particular well drilled

in Pomeranian Basin in northern Poland. Slurries were designed the way to obtain flow diameter in the range 240–270 mm and exhibiting no sedimentation. Special emphasis was put on the stability of the slurries, due to high requirements for stability of slurries used in casing works in horizontal wells. Slurries were cured in conditions characteristic for particular wells (pressure in the range between 35 and 49 MPa, temperature in the range between 80 and 90^{o}C). For hardened slurries mechanical properties were determined. Phase composition of hardened slurries was determined with XRD and thermal analysis. In addition microstructural observations were done in order to determine the influence of temperature on microstructure of hardened cement matrix.

Keywords: *cement slurries, horizontal casing works*

Fąfara Z., Ilkiv I., Przybyłowicz J.: **The analysis of the soil gases on the chosen example of oil mine** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 2

In the autumn of 2014 were performed the geochemical research of the soil gases composition in the area of selected oil mine in southern Poland. For a total were carried out of 75 individual analysis at 55 measuring points. The average depth of the measuring point was about 84.4 cm. The grid selection of the measurement points was made ad hoc, taking into account arrangement the existing mine installation and the location of the abandon wells. Finally, geochemical studies were performed in the vicinity of 6 exploitation wells (1 liquidated, one flowing well and 4 pumped periodically), on the route of transmission pipelines and in the area of group centers. The free choice of the measurement point location was limited by buildings and agricultural crops. In the area of the analyzed deposit were drilled more than 100 wells, most of which were liquidated and usually did not stay after them no trace on the surface.

Based on the results of the geochemical research of the soil gases composition there was determined the spatial distribution of the methane concentration in the soil in the nodes of a regular grid by geostatistical methods using kriging. On this bases there were developed the maps of the methane concentration. Generally, on the oil deposit site there were detected two areas with the increased methane concentration in the ground. The distribution of the methane concentration in soil on the first one shows the installation leak in the vicinity of several wells. In the second much smaller area it may suspect that the pipeline transporting crude oil to the group centre is leaky. In the research area are vast cultivated fields of high oxygenation and small wet ground. There are no permanently wetlands areas. This means that in soil occur at most aerobic rot and decay processes, resulting in the production of carbon dioxide but not methane. There is no reason to assume that occur also the natural anaerobic putrefaction processes. Therefore, the detected abnormally high methane concentration in the ground is not of biological origin. To confirm formulated hypothesis should also be do the chromatographic research of C14 carbon isotope content in the taken methane samples from the soil to determine his age and confront it with the age of methane produced from the deposit. In general, the results analysis of the geochemical research of the soil gases composition leads to the conclusion that the rock mass is hermetic from the geological point of view, but there are occasional leaks in the production system of several wells and transmission pipeline, that can remove.

Keywords: *geochemical testing, soil gases, oil mine, geostatistics methods*