SUMMARIES

Gonet A., Stryczek S., Fyda M., Stąporek G.: **A review of pile machines and their selection criteria** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

Many geoengineering investments can be realized thanks to the use of piles, which may play numerous functions. The piles were classified in the paper in view of assumed criteria and most frequent applications. These works can be performed with specialist pile equipment. In the description attention was paid to the most important technical parameters of pile machines produced by such companies as Bauer, Casagrande and Soilmec. The multi-criteria method with a synthetic measure of evaluation was used for selecting the most suitable pile machine. Among the assumed criteria were the pull up/down force, torque, maximum depth and diameter of the pile and the main winch. The analysis of the obtained weights and criteria revealed that the Bauer pile machine BG 50 had the highest CCS pull up/down and torque and was most appropriate for making long and large-diameter piles.

Keywords: *pile machines, geoengineering, drilling*

Fijał J., Gonet A., Jamrozik A.: **Characterization, properties and microstructure of spent drilling mud from the point of view of environmental protection** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

This investigations were carried out on different spent water-based muds, collected in drillings in various parts of Poland. The combined study methods included structural and phase investigations (X-ray diffractometry, infrared FTIR spectroscopy, scanning electron microscopy) and instrumental chemical determinations. The results characterize mineral and phase composition of the samples, their microstructure and chemical composition. The authors focused on the specific nature of polymer-clay complexes, which in drilling mud systems have the form of delaminated or exfoliated organic-clay polymer nanocomposites that control properties of such waste materials. Detailed recognition of properties chemistry, mineral and phase composition, microstructure of spent drilling muds have a fundamental meaning for studies on the management of these materials in the natural environmental.

Keywords: *drilling waste, drilling waste management, environmental protection*

Kulynych V.: **The influence of wettability on oil recovery** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

Understanding the mechanism by which oil is displaced from the porous medium requires knowledge about the role of wetting and capillary forces during EOR. Knowledge of the effect of wettability on oil production is also a key point for understanding the behavior of multiphase flows in the reservoir.
A literature review indicates that wettability is one of the main factors controlling and regulating the distribution of oil and water in the reservoir rock. Therefore, the resolution of problems associated with the calculation of oil resources, operation and analysis of core deposits, must take into account the wettability of rock. Therefore, the study of such phenomena as wettability is still valid today.
In the paper reservoir rock wettability and its types were described. Direct and indirect methods of determining the wettability were characterized, the graph of capillary pressure is used to characterize the wettability. In order to determine the effect of wettability on multiphase flow in porous media are discussed petrophysical parameters: capillary pressure, relative permeability and hydrocarbon saturation of the rock. Characterized wettability of each of the porous medium of carbonate and sandstone reservoirs.

Keywords: *wettability, contact angle, relative permeability, EOR, two-phase flow*

Kędzierski M., Wysocki S., Wiśniowski R., Uliasz M., Zima G.: **Drilling mud for shale gas drilling** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

The selection of the relevant components the drilling of 5mud can reduce the occurrence of negative physical-chemical phenomena observed between shales and drilling mud. The purpose of laboratory examination was to estimate the impact of different polymer inhibitors for hydration of clays and shales. A laboratory test were performed in order to estimate the concentration of polymer inhibitors in preventing the phenomena taking place in contact with the shale rocks – drilling mud. Also, research the influence a drilling fluids containing different kinds of hydration inhibitors on swelling and clays and shales dispersion.

Keywords: *drilling mud, shale gas drilling, hydration inhibitors*

Wysocki S., Wiśniowski R., Stopyra E., Romański M.: **Laboratory research on the influence of new BG-027 polymer addition on technological parameters of drilling mud dedicated to directional drilling in shale rocks** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

This paper shows the research results on the influence of new BG-027 polymer used in different concentrations onto technological properties of drilling mud for drilling in shale and clay rocks. Standard API test has been conducted as well as thermal resistance, resistance to mono- and divalent salts, LST were studied. The results show that polymer BG-027 addition gives the mud good technological parameters and is a good hydration inhibitor.

Keywords: *drilling, mud, hydration inhibitors, shale*

Janusz P., Liszka K., Łaciak M., Smulski R., Oliinyk A., Susak O.: **Applicability of equations for pressure losses in transmission gas pipelines** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

Transmission pipelines for gas have large a diameter and high pressure. Gas pump stations are built along the pipeline and their main task is to increase gas pressure to the technologically and economically justified level. Determining the exact value of pressure drop in the pipeline is the major problem in gas pipeline transport.
The drop of pressure is a result of external and internal friction. The pressure can be lowered in the gas pipeline but this depends on the geometric parameters of the latter, i.e. length, inner diameter, full-length profile, quantity and temperature of transmitted gas and its thermodynamic properties. The technical condition of the transmission pipeline and the character of gas flow in the pipeline have a great influence on the pressure variations.
A number of mathematical models focus on determining the drop of pressure in a pipeline section. The value of deviations of calculated values from the real data in each model strictly depends on the conditions in the pipeline.
The aim of this paper is an analysis of applicability ranges of various equations for pressure losses in transmission pipelines.

Keywords: *natural gas, transmission system, gas transport*

Włodek T.: **Phase equilibria for liquefield natural gas (LNG) as a multicomponent mixture** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

Liquefied natural gas (LNG) has an increasingly important role in the global natural gas market. Global demand for natural gas will grow over the coming years. LNG is transported by ships to unloading points on the storage terminals. During the LNG unloading and storage processes some part of LNG evaporates into gas phase and causes changes in the composition of stored LNG. The main component of LNG is methane, the remaining components are primarily ethane, propane, butane and nitrogen. Depending on the participation of these components the basic thermodynamic parameters of LNG can significantly change. LNG is also product sensitive to changes of temperature. In order to better prediction of changes of individual parameters of stored LNG caused by changes of temperature and LNG composition vapor-liquid equilibrium (VLE) calculations are performed for cryogenic conditions using equations of state.

Keywords: *LNG, liquefied natural gas, thermodynamic processes, cryogenics, VLE calculations, phase equilibria*

Wiśniowski R., Toczek P.: **The methods of pressures prediction based on geophysical data** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

Prediction of reservoir pressure and so its values at an early stage of wellbore designing significantly increases the profitability of exploration and production wells design. The prediction of rock mass pressures can be performed in a number of ways. The prediction methods have been reviewed since the 1950s. The methods of empirical forecasting of pressures proposed by Eaton B.A. as well as Hottman and Johnson were described in the paper. The paper also refers to the prediction of rock mass pressures on the basis of seismic well log results obtained from works performed on the same geologic unit. A relation between basic parameters of rocks along the wellbore profile is shown. The Eaton method was used for empirical determining pressure for a planned well based on seismic data form the existing well.

Keywords: *Eaton coefficient, prediction of pressure, prediction method, geophysical measurements*

Jamrozik A., Ziaja J., Gonet A., Fijał J.: **Selected aspects of drilling waste management in Poland** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

One of the main problems related to environmental protection in the search for hydrocarbon deposits are drilling waste. In these article the authors presented their research results on the toxicity of drilling muds and suggested the possibility of their utilization. Research material represents drilling waste collected during prospecting for both conventional and unconventional deposits of oil and gas in the Polish Lowlands, Pomerania, the Carpathians and the Carpathian Foredeep.

Keywords: *drilling waste, spent water-based drilling muds, drilling waste management*

Rybicki Cz., Dubiel S., Blicharski J.: **Analysis of selected problems encountered while testing natural gas-condensate fields in the Western Carpathians** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

The potential change of natural gas composition in the near-wellbore zone creates a big problem with the selection of appropriate initial value of counterpressure exerted by the displacement fluid on reservoir during the test, and also with the interpretation of the reservoir and production tests results. The analysis of the industrial data reveals that the effect of condensate production in the near-wellbore zone could take place while using too high counterpressure during DST tests, as a consequence of using a relatively high column of water displacement fluid in the DST column, i.e. about 2500 m. This thesis can be confirmed after further detailed theoretical analysis of the occurring thermodynamic conditions. The paper addresses technological and interpretation problems encountered during drill stem tests (DST) of gas-bearing Devonian strata, on the example of the Stryszawa field in the Western Carpathians. Special attention was paid to the possible changes of gas composition during flow tests and the cases of gas condensation of heavier fractions during build-up tests. Attempts were made at explaining sudden drops of pressure at the build-up stage along with the thermodynamic conditions responsible for this effect. The authors explained the necessity of using an appropriate Ful-Flo sampler in the DST set for collecting gas samples at any time of the test, and devices for continuous measurement of temperature. The use of new types of drill stem testers and appropriate interpretation methods, which would account for a detailed analysis of technological and reservoir conditions allows for more efficient oil prospecting and deciding about enhancement methods in hydrocarbon production. The analysis of thermodynamic conditions on the bottom of the wellbore allows for selecting proper counterpressure values in view of the condensation of heavier gas fractions in the near wellbore rocks. The analysis of conditions in which heavier gas fractions undergo condensation is approximate and general because the gas samples were collected at the outlet of the DST string (in surface conditions), without a Ful-Flo sampler and without temperature measurements.

Keywords: *oil prospecting, Western Carpathians, gas-bearing Devonian strata, natural gas-condensate field in Stryszawa, testing technology, thermodynamic conditions of gas condensation*

Stopa J., Czarnota R., Wojnarowski P., Janiga D.: **Oil production technology for unconventional reservoirs** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

Interest in the subject related to the oil production from unconventional hydrocarbons has increased in recent years. Operation of such reservoirs requires the use of the state-of-the-art technology. Definitely, drilling horizontal and multilateral wells in conjunction with hydraulic fracturing and acidizing meet that requirement. This paper discusses the most important from the author's view issues, including artificial lift systems, connected with oil production from unconventional reservoirs around the world and its applicability for Polish hydrocarbons reservoir.

Keywords: *unconventional oil reservoirs, method of exploitation, hydraulic fracturing*

Topolski T., Gonet A., Stryczek S.: **Analysis of inaccuracy of determining a directional borehole axis** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

The development of directional drilling made designers work out numerous measurement devices for spatial location of the borehole axis. The borehole trajectory can be determined on the basis of very accurate calculation methods. The authors present a brief characteristic of devices for measuring dogleg angle and azimuths as well as methods for calculating the spatial placement of borehole axis, i.e.:
– average angle method,
– tangential method, modified to balanced tangential method,
– radius of curvature method (RCM),
– minimum curvature method.

Calculations and graphical representations of deviations obtained with these four methods were performed for three selected trajectories of borehole axes (2D), increase/decrease of dogleg angle and 3D, increase/decrease of dogleg angle and azimuth with the use of COMPASS software (part of Halliburton Landmark package).

Keywords: *directional drilling, trajectory borehole*

Wysocki S., Stec M., Artym R.: **New mud for drilling in clay and shale rocks with cationic KAN-001 polymer** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

This paper presents laboratory researches on KAN-001 cationic polymer application dedicated for drilling fluids used in drilling through sensitive shale formation and also the formulation of a new mud system for drilling in clayish rocks. Laboratory researches showed the great utility of KAN-001 polymer, synthesized in AGH-UST, for its application in special drilling fluids for shale and clay rocks.
A new mud system – Mud-17 – with an addition of KAN-001 polymer, is distinguished by good technological parameters. It is resistant against univalent and divalent salts contamination. Therefore, a new mud system can be salted up to the saturation. Mud-17 is also resistant against high temperature, so it can be used in deep wells.

Keywords: *drilling mud, polymers, shale drilling*

Filanowski P., Rybicki Cz.: **Role of biomethane in the improvement of energy safety in Poland** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

The renewable energy gains over the recent years on the meaning, also in consideration of increasing prices the energy and some signs of changes of climate caused by the man. Thereby in many countries the large press lies down on the use of renewable sources of energy such as water, the sun, the wind and the biomass covering every now and again the best part of the power requirement. One of method of the production of the energy from the biomass is the production of the biogas in specially to this end constructed devices so called biogas plants. To create of conditions to the development of this field are necessary specific performances supporting and propagating on the domestic grade and regional. In Germany the enforcement of amended law about the renewable energy contributed to true bumu in the sector of the energy production from the biogas. In Germany in 1999 functioned 850 agricultural biogas plants, in 2003 – 1700 and in 2005 – 2800. In Poland until the year 2005 according to data given by the Office of the Regulation of the Energetics worked 64 power plants supported on the biogas. One ought however to remember

that this number includes except agricultural biogas plants first of all installations of the refuse dump gas and the biogas on the refinery of sewage.
Poland is a rich country in the stony coal field in the face of this the dependency of the country from the import of this raw material is least. In turn of the gas consumption of terrestrial in Poland increases and the perspective of the dependency himself from the import of this raw material until the year 2030 indicates the more and more greater need for the purchase of this raw material besides limits of our country.
On the basis the information contained in the report European Putting green Gas Grid from the year 2014 results that the biomethane production in countries of western Europe gains the more and more greater popularity. This results from this that the import of natural gas to Europe is realized almost as a whole from the east direction. In European Union are many countries which import 100% their demand on natural gas to {in the face of} this aspect the reduction of the dependency themselves these countries from the import of gas in the figure {form} of the production of biomethane becomes a key-matter.
For the purpose of the improvement of the development of agricultural biogas plants in Poland arose the government-document going out opposite to postulates about the necessity of the establishment of the system promoting and supporting the production of the agricultural biogas. A foundation „of Directions of the development agricultural biogas plants in Poland in years 2010–2020" is the creation of optimum-conditions to the development of installations producing the agricultural biogas so until the year 2020 to lead to the construction of averagely one biogas plant in every commune using the biomass of the agricultural origin, on the assumption possessions through the commune of applicable provisions to the execution of such undertaking

Keywords: *biomethane, biogas plant, biogas, biomass, electricity, energy consumption, energy market*

Kotwica Ł., Wons W., Malata G., Murzyn P., Jamrozik A., Gonet A.: **Utilisation of drilling waste muds from drilling waste dump** • AGH Drilling, Oil, Gas 2015 • Vol. 32 • No. 3

Dynamically developing drilling industry is connected with some environmental impact. Considerable amounts of contaminated drilling waste is produced, regardless the applied prevention measures. The generated drilling waste is diversified both chemically and physico-mechanical. These properties make utilization or managing of drilling waste difficult. In article presented results laboratory research stabilization of drilling waste mud from Polish commercial drilling waste dump. Samples were taken from an old lot which is not currently under operation and was provided to be subjected to reclamation.
Investigated waste drilling mud stored in waste dump contains high amounts of unbound ions, which can be leached out of the sample. It cause the method of utilization to fulfill two goals: first it should allow to solidify the material in order to obtain material easy to transport and process and second the method should allow to decrease the amount of ions which can be leached out of the final material.

Keywords: *drilling waste, drilling waste management, stabilization drilling waste*