

## SUMMARIES

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Kowalczyk D., Wach M., Plewik A., Wysocki S.: **Relationship between the rheological parameters and zeta potential of bentonites** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

The paper presents an estimation of bentonites quality using electrokinetic phenomena occurring in dispersed clay systems. The idea behind the work is to demonstrate the relationship between the rheological parameters of the tested materials, and their zeta potential and consequently determine the suitability of these criteria for preparing drilling fluids.

**Keywords:** *electrokinetic phenomena, Zeta potential, drilling fluids, bentonite*

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Wysocki S., Wiśniowski R., Gaczoł M., Nowak W.: **The influence of ionic hydration inhibitors on dual inhibitor system mud properties – clay rock swelling** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

Various organic and inorganic compounds can be used as the hydration inhibitors. The main purpose of this paper is the examination of five different ionic hydration inhibitors: KCl, K<sub>2</sub>CO<sub>3</sub>, HCOOK, NH<sub>4</sub>Cl, CaCl<sub>2</sub>. The paper contains survey findings of the influence of the abovementioned inhibitors different concentrations on technological parameters of drilling muds with dual inhibitor system and swelling of clays.

**Keywords:** *drilling fluids, ionic hydration inhibitors, clays and shales*

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Jamrozik A., Protasova E., Gonet A., Bilstad T., Żurek R.: **Characteristics of oil based muds and influence on the environment** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

Oil based muds (OBM) are highly important in well drilling. Water based muds (WBM) and synthetic based muds are not providing sufficient qualities in fulfilling all of the functions of OBM. OBMs ensure more efficient drilling but also disadvantages such as higher initial cost, more stringent pollution controls and reduced effectiveness of some logging tools.

Expenses for mud are reaching 10–15% of total well cost. However, high costs are still low compared to expenses for corrective measures in the case of using mud with poor properties, which could lead to drilling disruption as well as excessive time and cost.

OBM and cuttings are saturated with toxic compounds and if discharging to sea poses ecological threats. Perhaps the most hazardous oil component for aquatic organisms are low-boiling aromatics, which consist of benzenes and naphthalenes both soluble in water. Additionally, the higher-boiling aromatic fractions are of high environmental interest due to their persistence in sediments, leading to enzyme induction, cellular dysfunctions, genetic alterations, and chronic effects on organisms.

There is a difference in volume of generated waste between using water- and oil-based muds. WBM produces 7,000–13,000 bbl of waste per well. Depending on well depth and diameter 1,400–2,800 bbl are drill cuttings. OBM generates much less waste as the mud is usually recycled and only drill cuttings with volumes of 2,000–8,000 bbl per well need treatment prior discharge.

This paper discusses the hazardous effect of toxic compounds in OBM and evaluates the efficiency of different OBM treatment towards zero discharge.

**Keywords:** *oil based muds, drilling waste, toxicity*

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Davydenko A.N., Kamyshatsky A.F.: **Technology for preparing washing liquid** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

The advantages of the hydrodynamic super-cavitation technique used for the preparation of washing liquids in the course of drilling have been described. The results of theoretical research have been confirmed in practice and laid the foundation for creating a technique for preparing washing liquid.

**Keywords:** *well drilling, well, washing liquid, hydrodynamic super-cavitation, and cavitation disperser*

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**Zeljaś D.: How to localize an Underground Gas Storage (UGS) in a salt structure of the Fore-Sudetic Monocline in light of its geomechanical properties • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4**

The analysis of formal and legal regulations revealed that Underground Gas Storages are a favorable option in Polish conditions. The author presented a possible localization of an UGS in a salt structure of the Fore-Sudetic Monocline, indicating the advantages of the area and problems to be solved. Attention was paid to the UGS stability and complexity of this issue. The presented strength indices and rheological parameters of salt were based on laboratory experiments. In the future they can be used at the stage of designing and performing geomechanical analyses.

**Keywords:** *underground storage, natural gas storage caverns, saline rock mass stability, geomechanical properties of salt rock*

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**Rzyczniak M., Czekaj L., Cabala E., Rzyczniak A.: Properties of processed drilling wastes from the factory of ecological labors in Tarnogród • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4**

The following publication presents the results of laboratory testing of drilling wastes', so called filter cakes, physical and mechanical features, that are utilized in the Factory of Ecological Labors in Tarnogród. This kind of waste is obtained from filtration process lead on processed drilling fluids, in the cellular filter press.

As a result of lead tests, granulometric composition of tested ground, some basic and secondary physical features (water (moisture) content, bulk density, liquid limit, plastic limit, plastic index, liquidity index, consistency index), swelling sensibility (swelling curve, swelling coefficient, swelling index, swelling water content) and compressibility (consolidation curve, compressibility curve, edometric compressibility modules). There were defined filtration features (filtration coefficients, filtration curve) and shear strength of soil (shear strength curve, angle of shearing resistance, cohesion). Tests results were presented as charts and tables.

Characteristic of the filtered processed drilling fluid waste/filter cakes was based on the achieved results.

**Keywords:** *cohesive ground, drilling waste, drilling waste features/characteristics*

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**Wartak J., Chruszcz-Lipska K., Knapik E., Rychlicki S.: Soil contamination by petroleum substances in the vicinity of oil production wells • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4**

The paper presents the study of various indicators of soil contamination by petroleum substances from the area of active exploitation of oil deposits in the south of Poland. Nineteen studied soil samples were taken directly around the production wells (0–1 m) or their vicinity (1–7 m) at a depth of 0.1 to 0.3 m. Collected samples were tested for the presence of benzene, toluene and xylene (BTX), and polycyclic aromatic hydrocarbons (PAHs) such as phenanthrene, anthracene, fluoranthene, fluorene, pyrene, benzo(a)anthracene, chrysene, benzo(a)pyrene, dibenz(a,h)anthracene and benzo(g,h,i)perylene. An analysis of the content of these chemical compounds in the soil samples was performed by gas chromatography.

The observed results were interpreted to determine the hazard for the natural environment and human health. The evaluation of soil samples was based on the new Regulation of the Ministry of Environment of 1 September 2016 regarding the assessment of contamination of the surface of the earth (Journal of Laws 2016 Nr 0, item 1395) as well as guidelines presented by the Institute of Soil Science and Plant Cultivation (ISSPC).

**Keywords:** *oil exploitation, soil contamination, petroleum substances, BTX, PAHs, environmental protection, Poland*

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**Smulski R., Sacha J.: The dependency on the temperature of efficiency of the regeneration process in glycols • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4**

The water content of glycol is important from the perspective of the dehumidification quality of natural gas, as the greater is it's content, the more adversely it will affect further absorption of glycol during the dehumidification

process. In order to restore its original properties, sorption glycol undergoes regeneration that is the process which consists of thermal evaporation of water contained therein. The separation of these components is made possible by the evaporation of water at a lower temperature, compared to glycols.

In the industrial practice of dehumidifying natural gas using the absorption method, four kinds of glycol can be used. Their characteristics are presented in the report, discussing the current methods of regeneration, as well as presenting results from the laboratory tests which consisted of water content measurements taken after evaporation of water from the glycol solutions. These results were summarized and compared.

To determine the content of water, the Karl Fischer titration method was used.

**Keywords:** *gas dehydration, EG, DEG, TEG, TREG, glycol regeneration*

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**Łukańko Ł., Macuda J.: The influence of prospecting unconventional hydrocarbon reservoirs on acoustic climate • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4**

In Poland the perspective shale gas formations concentrate in the area of the Baltic Basin, Podlasie Depression and Lublin Basin. Their depth varies from slightly above 2,000 to 4,500 m, depending on the location. Accordingly, novel rigs of high hoisting capacity and installed power capacity of master motors have to be used for opening natural gas deposits with the use of directional wells. The operation of such systems creates an acoustic hazard for the environment, especially in the close vicinity to the rig.

The results of noise analyses of a prospecting well for hydrocarbons from unconventional sources in the north of Poland performed with the use of a rig MASS 6000E are presented in this paper. The noise analyses concentrated on the rig area among the direct noise sources and the neighborhood to show the influence of drilling operations on the acoustic environment. The obtained results revealed that the noise emission in the rig area can be limited by optimizing the localization and placement of particular objects and systems within the rig site. This also applies to the placement of the noise barriers on the border of the rig to limit the noise emission towards objects requiring protection.

**Keywords:** *drilling wells, drilling operations, exploration drilling, rig, shale gas, noise, noise emitted by rig, measurement of noise*

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**Kosowska K., Kosowski P.: The geopolitics of Gazprom's pipelines • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4**

The natural gas market over the years has been strongly dependent on pipeline transport and based on it a gas market was created and functioned. For this reason, unlikely to the oil market, the global gas market was not created and did not function, but only national, regional and continental markets separated from the others functioned. The consequence of this situation is the fact that the key importers of Russian gas abroad are the CIS and European countries. The Kremlin hiding behind Gazprom has consistently pursued a policy of diversification of export transmission system, designed to eliminate "problematic" transit countries such as Ukraine. That aim can be accomplished by completed and planned pipelines' diversification projects.

**Keywords:** *Gazprom, pipelines, geopolitics, gas market, Russia*

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**Łukańko Ł., Macuda J.: Methodics of assessing environmental noise emission while performing hydraulic fracturing operations in shale formations • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4**

Hydraulic fracturing operations performed at the stage of gas prospecting in shale formations are aimed at opening out gas residing in rock micropores. Large quantities of fracturing fluid, with physicochemical composition adjusted to their properties, are injected to the selected interval of a horizontal well. Finally, sand (proppant) is injected along with the fracturing fluid to support the newly formed fracture.

The results of a computer simulation of noise emission generated by high pressure pumps during hydraulic fracturing operations, and the results of noise measurements during such work in the north of Poland are presented in the paper. The analysis of the obtained results revealed that the noise standards for day hours in the residential area localized ca. 320 m from the well pad was not exceeded for the hydraulic fracturing operations. The noise level in the night hours was considerably higher, therefore a respective sound berm should be construed.

**Keywords:** *hydraulic fracturing, sound level prediction, simulation, reference point, prospecting, well pad, shale gas, noise, noise measurement*

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Kremieniewski M., Rzepka M., Stryczek S., Wiśniowski R., Kotwica Ł., Złotkowski A.: **Technological parameters of innovative cement slurries used for sealing wellbores in shale formations** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

In the years 2014–2016 two scientific units, i.e. Faculty of Drilling, Oil and Gas, AGH UST and Oil and Gas Institute – National Research Institute cooperated on the realization of a project called Optidrilltec. A group of innovative recipes of slurries to be used for sealing wellbores in shale formations were worked out. Both fresh and hardened cement slurries should meet restrictive technological requirements, therefore this issue was in the focus of the conducted research. Laboratory experiments were performed on high-class research and control/measurement equipment, thanks to which innovative recipes of cement slurries for sealing casing in shale gas formations could be worked out. These recipes comply with standards and can be successfully used as read-made applications for sealing casing installed in shale formations.

**Keywords:** *cement slurry, well cementing, sealing casing, shale formations*

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Wysocki S., Gaczoł M., Wysocka M.: **New mud for UnderBalanced Drilling** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

This paper describes a research finding of drilling mud designed for UnderBalanced Drilling. The UnderDril mud formula is based on a low number of compatible components, therefore it enables uncomplicated adjustment of its technological parameters to specific conditions and contributes to the reduction of its application costs. Moreover, the UnderDril mud is composed of biodegradable ingredients, that results in a beneficial effect on the possibility of its utilization and simultaneously makes it hazardous free for the environment.

The conducted research showed that the abovementioned mud can find an industrial application.

**Keywords:** *drilling fluids, underbalanced drilling*

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Zhuk H.V., Pyatnichko O.I., Krushnevich V.T., Fedorenko D.S., Klymenko V.V.: **Methane hydrate technologies in Ukraine: research and prospects** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

Abstract Methane production from natural gas hydrates will enable the reduction of a great part of natural gas import deliveries and to give up them completely in the future. Gas hydrate technologies compared with existing ones, also gives the possibility to transport gas, divide gas and liquid mixtures, concentrate water solutions, utilize and store CO<sub>2</sub>, etc. with greater efficiency. However, methane production technologies have not developed industrially and their study was performed with the help of experimental units and in separate gas hydrates deposits in the mode of tests and elaborations.

The prospects of the hydrate technologies development in the Ukraine were determined: transportation of natural gas in the form of hydrates, long-term storage of natural gas in hydrate state, natural gas production from its hydrate deposits. Positive international experience in terms of the development of hydrate technology is studied. In order to study formation and dissociation hydrates of carbon dioxide and natural gas components, Gas Institute have made hydrate stand facility. The express method of determining thermodynamic and kinetic parameters of hydrate transformation was tested. Natural gas hydrates as well as carbon dioxide hydrates were produced with the help of the express method. It was determined that the composition of original natural gas and gas of hydrates decomposition is of great difference – it means that “selective” hydrates formation of natural gas formation is performed.

A set of experiments was also performed to study the process of methane replacement with the help of carbon dioxide. According to the gaseous phase analysis, 14% increase of methane content was fixed. This fact proves its replacement in hydrates with the help of carbon dioxide.

**Keywords:** *methane hydrate, transport of natural gas, methane production, alternative fuel sources, carbon dioxide capture and storage, hydrate test stand, Ukraine*

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Macuda J., Wysocki S., Gaczoł M.: **New mud for hydrogeological drilling** • AGH Drilling, Oil, Gas 2016 • Vol. 33 • No. 4

A major source of valued water are groundwater deposits. Therefore, constantly growing water demand requires greater focus on the subject of hydrogeological drilling. The primary requirements for groundwater drilling are: protection of important aquifers as well as formations being drilled and further easy removal of the mud residues during well development. Both aspects are connected to mud ingredients and additives selection. This necessitates an improvement of drilling fluid formula for most effective borehole drilling and successive exploitation. This article concentrates on the drilling fluid for hydrogeological drilling. In order to validate the practical utility of developed mud, laboratory research was conducted. An analyses of the outcomes expose the mud improving drilling process and fulfilling above mentioned requirements

**Keywords:** *drilling fluids, biodegradable mud, hydrogeological drilling*

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