

SUMMARIES

Janusz P., Kaliski M., Szurlej A.: **The role of underground gas storage in European Union gas market** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

One of the main intentions of the European Union is to create common and liberalized market of natural gas in Europe. Actions has been taken in this area for a few years, however achieved effects do not reach the aims that were assumed at the beginning. The quantity of natural gas consumption in the European Union during last years is characterized by a declining tendency (decreasing usage of natural gas in power sector, higher temperature during autumn and winter season also influences on limiting of natural gas demand), in 2012 the consumption was forming on the level of 444 billion m³, and for example in 2008 it amounted to 497 billion m³. The regulations concerning the natural gas market embrace all of the elements which have an impact on building consolidated and liberalized market, it means: transfer, distribution and LNG, storage. The authors of this article wants to draw one's attention to the particular role of underground gas storages and depict change of the tasks, which they have to fulfill on the liberalizing market of natural gas in Europe (ie. Price arbitration). The purpose of this article is to present the current situation on the market of storage services, which means available storage capacities, the level of their usage and plans regarding extension and constructing of new capacities.

Keywords: natural gas, underground gas storage

Jamrozik A., Gonet A., Fijał J., Terpiłowski K., Czekaj L.: **Analysis of waste mud stability** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Drilling fluids play a number of functions, e.g. they remove cuttings, lubricate the drill bits, maintain stability of the hole and prevent the inflow-outflow of fluids between well and the shales. For this reason, they are made of complex polymeric-mineral microcomposites of differentiated chemical and mineralogical-phase content with varying share of colloidal phase in dispersed solid phase in water, i.e. water-based muds (WBM) or oil environment, i.e oil-based muds (OBM). The major factor providing stability of the presented systems is the high participation of clayey minerals (smectite group), long-chain polymers and chemicals stabilizing dispersions.

The results of analyses of concentrated dispersions of waste muds from a few regions in Poland are presented in the paper. These are plastic-viscous dispersions of rheological parameters described most frequently by the Herschel-Bulkley model, the flow of which is connected with deformations of internal structures in the analyzed systems taking place in a function of temperature. There are also presented measurement results of light transmission and backscattering in the analyzed range of temperatures, i.e. 20 to 60°C with the use of Turbiscan Lab., Formulacion. The stability indicator is the turbiscan stability index (TSI).

Keywords: drilling waste, stability waste drilling mud

Białek M., Gross-Gołacka E., Kaliski M.: **Rationalization process in the refining sector of the European Union in the context of activities aimed at restoring the competitiveness of refineries** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Analysis of factors shaping the market environment the oil sector in the European Union leads to the conclusion that the main elements having an impact on the profitability of refinery operations include their complexity index, access to a particular slate of crude oil, supply infrastructure (land premium, supply side, etc.) as well as laws and regulations regarding this very industry (both EU and national legislation). It should be emphasized that on the one hand European refiners compete against each other on national markets (including the EU market), on the other hand, however, they are vulnerable to competitive activity of refineries from outside of the European Union. Recent years clearly outline the downturn in the oil refining sector of the EU, that is manifested by idling the refineries, changes in their base

model activity (conversion into the fuel and crude oil storage sites), or at best sector acquisitions by foreign companies (mainly from the Russian Federation). The progressive loss of capacity of oil refining on the Old Continent will cause significant changes in the energy security of fuel supplies, which simply, will have to be imported from abroad in the foreseeable future. In order to counteract the negative developments in the market, refineries affiliated with professional organizations (such as EUROPIA, Concawe) have taken an action in co-operation with the European Commission and the International Energy Agency aimed to develop the so-called pilot - horizontal control of refining sector efficiency (fitness check) involving the review of existing EU law. The purpose of this activity is to identify unnecessary burdens and unintended, negative impact of existing EU law on the sector. In line with the European Commission plans, the results of a fitness check are to be published in late 2014, yet the new non-legislative and legislative initiatives of the EU should take into account the context of the restoration of refinery competitiveness.

Keywords: *crude oil price, refining sector, European Commission, competitiveness*

Stopa J., Wojnarowski P., Janiga D.: **Integrated model of hydraulic fracturing and hydrocarbon production** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

The dynamics of discovering conventional hydrocarbon reservoirs has significantly dropped down in the World over the last ten years. Resources deposited in reservoirs having poor properties, where the production with economically justified yield is possible after prior enhancement (hydraulic fracturing in particular), become more important. Accordingly, proper designing of development works and hydraulic fracturing are decisive.

Author's methodic and software for integrated modeling of hydraulic fracturing and production with the use of a 3D fracture model are presented in this paper. This can be used for evaluating the efficiency of the fracturing treatment and its optimization. The results of hydraulic fracturing modeling were implemented in the reservoir simulator with the software written in C++. The designed fracture can be introduced into a numerical grid of a reservoir simulator. This tool can be a choice for a quick variant simulation for the best scenario of reservoir development selection. The practical implementation of this program was presented on the example of a 'tight gas' reservoir.

Keywords: *hydraulic fracturing, reservoir simulation, efficiency estimation*

Liszka K., Łaciak M., Oliiynyk A.: **Analysis of new generation odorants applicability in the Polish natural gas distribution network** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Odorization is the process which has crucial impact on the safety of the distribution and usage of natural gas. A very small amounts of odorant are added into naturally odorless fuel. The odorant has distinctive and well odor. Traditionally, used for decades, odorants are based on sulfur compounds. More recently in some countries sulfur-free compound is used as odorant. This article is an attempt to determine the applicability of sulfur-free odorant in natural gas distribution network in Poland. This includes the possibility of implementing a new odorant for the usage in the aspect of existing legislation in the area of odorization. The existing infrastructure used in the process of natural gas odorization has been analyzed and range of necessary adaptation actions has been indicated. The issue of smell diversity in comparison sulfur-free with traditionally used odorants has also been discussed. At the end, the ecological aspects of new odorant usage on a larger scale and re being taken under consideration.

Keywords: *odorization, sulfur-free odorant, natural gas delivery, gas treatment*

Kondrat O.: **Improvement of high-viscosity oil production technology** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

According to the results of the laboratory and analytical studies and research-and-industrial operations, it is established the efficiency of complex use of thermal methods, hydrocarbon solvents and surfactants for the effect on high-viscosity oil and it is suggested the technology for high-viscosity oil wells stimulation.

Keywords: *well, high-viscosity oil, operation, stimulation, thermal effect, hydrocarbon solvent, surfactants, gas-lift, sucker rod pumping unit.*

Laciak M., Nagy S., Włodek T.: Combined heat and power systems in liquefied natural gas (LNG) regasification processes • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Adaptation of liquefied natural gas (LNG) to the quality requirements for natural gas transportation pipeline system is a high energy intensive process. The energy for this process can be obtained include from waste heat in the industry processes, steam power blocks or sea water in LNG unloading terminal. Another way of obtaining the heat is burning of gas or other fuels. A large temperature difference between the heat sources in each of these cases, and the low temperature of LNG can be used to control of the pumping engine operation, it can provide optimization and reduction of the costs. Liquefied natural gas (LNG) can be used as a source of cold to the increasing power of the cogeneration process. The article examines some practical cogeneration solutions (combined heat and called power - CHP), which can improve the efficiency of the process of regasification of LNG.

Keywords: LNG, liquefied natural gas, unloading operation, thermodynamic processes, cryogenics, LNG terminal, combined heat and power systems

Przybyłowicz J., Rychlicki S.: Enhanced oil recovery processes in sandstone reservoirs containing light oil in offshore fields • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Enhanced oil recovery methods can significantly increase recovery from offshore oil reservoirs provided that the appropriate method is selected. Enhanced oil recovery methods aim to recover the remaining original oil in place by applying additional energy sources and minimize flow resistance in the field. The application of these technologies results in enhancement, or replacement of natural or physical processes of displacement and modifies the composition and physical properties of formation fluids. The use of EOR technologies in offshore environment is limited compared to onshore fields. Constraints imposed by the offshore environment are associated with technical difficulties as well as economic risk. Before choosing the most appropriate EOR method for particular environmental conditions the restrictions associated with: large well spacing, disposal geological description as well as availability and cost of EOR agents, weight and space constraints or high capital cost requirements should be considered. Reservoir lithology is limiting the applicability of specific EOR methods. This paper presents a comprehensive review of EOR projects which are appropriate or possible for sandstone reservoirs containing light-oil in offshore field. The possibilities and limitations of selected methods are introduced.

Keywords: enhanced oil recovery, light-oil, offshore fields, sandstone reservoirs.

Kopey B.V., Bednarz S., Stefanyshyn O.I.: Prediction of pumping units reducers' resource • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Periodic monitoring of pumping units reducer vibration allow for a prediction of its full or residual resource to the next repair, which can be estimated on the basis of extrapolation methods and classification. Considering these two methods, we can say that the advantage extrapolation method has its accuracy and the possibility of adaptation to each specific gear, and the disadvantages include its complexity and the need to respect the conditions of constant change over time the vibration characteristics of the selected gear by law. In the application of classification method, which is simple, you need to process a certain amount of statistical data derived from the operation of machines, swing or perform experiments on a special stand that is relatively complex. In addition, the practice shows that the use of statistical techniques often makes accurate predictions due to the large gap modes of machines, swing and various properties of the pumped wells product, so the decision was made in solving this problem use the method of construction and extrapolation of time trend change of gear operating parameters. In Borislav CBPC the diagnostic examination of a number of reducers RN -2300 were conducted and the optimal level of vibration determined, whereby it can be concluded the qualitative repair of this type of gear. Some sensors during testing were installed on the gear housing near the output shaft. The average frequency of rotation of the input shaft gear was during vibroobservations was obtained respectively: $f_{vh} = 3.9$ Hz and $f_{vh} = 3.53$ Hz. Processing of the results was conducted by software MathCAD. Acceptable level of vibration that is recommended by standard GOST ISO 8579-2-2002 for gear RN -2300 is 8.3 mm / s, which can be used to determine its suitability for further exploitation. According to calculations conducted by an appropriate method the acceptable level of vibration above mentioned gear is 3.1 mm / s. These valid

values are in good agreement with the experimental values and have a lower level compared to the standard recommendations. According to conducted researches the curve of resource prediction for gear of pumping unit has been plotted. Thus, the expected service life of the gear RN -2300 of pumping unit will be approximately 36-38 thousand hours.

Keywords: *Pumping unit, reducer, vibration, monitoring, residual resource, sensor*

Stryczek S., Wiśniowski R., Gonet A., Złotkowski A.: The influence of time of rheological parameters of fresh cement slurries • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

The rheological properties of sealing slurries are very important at the stage of designing and realization of works related to the sealing and reinforcement of the ground rock mass with the use of drilling technologies. For providing high efficiency of the works related to the sealing of casing pipes in deep wells and the rock mass with borehole injection methods, the rheological parameters of sealing slurries should be selected depending on [1,2]:

- reservoir conditions of ground and rocks to be sealed,
- geometry of borehole and circulation system,
- interactions between the stream of injected slurry and the resulting flow resistance, especially in the sealed medium.

The results of laboratory experiments focusing on the influence of time on the rheological parameters of fresh sealing slurries based on API Class G HSR – Black Label drilling cement (Dyckerhoff) for various water to cement ratios are presented in the paper.

Keywords: *Class G Class G HSR drilling cement, rheology, rheological models, cement slurries*

Rzyczniak M., Rajchel G.: The analysis of technology of drilling with roller bits on the Carpathian foreland area in the years 1995–2011 • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

In the article, there has been described results of the statistical analysis lead towards two groups of roller bits, with bit teeth, with diameters 0,216 m and 0,4445 m produced by Drilling Equipment and Device Company “GLINIK”. Using these bits, there had been conducted a process of drilling holes on the Carpathian foreland area in the years 1995 – 2011.

According to the analysis of a dispersion of measure points it was assigned linear regression equations and lead significance tests for values of the correlation factors and linear regression factors, drilling technology parameters dependency (weight on bit, rotational speed, product of normalized weight on bit and rotational speed, drilling mud capacity flow rate) and bit performances (rebore, drilling time, average rate of penetration), since the year in which analyzed bits were used. The results of the researches has been showed in the form of charts of dispersion of measure points with lines and regression equations and lines of confidence intervals. The results of significance tests for correlation factors and linear regression factors has been inserted in tables. The purpose of lead analyses were acquiring information about changes of drilling technology parameters in a long period of time and about their influence on bit performances' values.

Keywords: *bits' exploitation, drilling technology parameters, bit performance*

Wysocki S.: Laboratory research on modified bentonite PT-85 for HDD mud development • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

HDD (Horizontal Directional Drilling) is classified as trenchless technology. Specific character of HDD causes specific parameters of drilling mud. Searching for innovated solutions is important to fulfill increasing technological requirements. The paper presents results of lab research on modified bentonite PT-85. Research of reological parameters, mono- and multivalent ions contamination resistance and lubricity was conducted. Rheological models for tested mud were presented also. Results show possibility for industrial application of PT-85 bentonite.

Key words: *HDD, bentonite, drilling mud*

Wysocki S., Bielewicz D., Wysocka M., Lewicki D., Wilaszek J.: **Weighting of new starch-polymer salted mud with PT-23 polymer** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Rheological properties of mud should assure high rate of penetration and supply maximal hydraulic power to the hole bottom. From this point of view drilling mud should have as little density and viscosity as possible and also minimal solid phase fraction. By the reason of the hole depth and geological conditions in the region it often occurs that maintenance of low density is impossible and drilling mud have to be treated with weighting materials. The process may cause change of mud rheological parameters and cause decrease of penetration rate. In case of weighted mud there is also a problem consisting in sedimentation of weighting material.

During these project realization there was developed recipe of new mud for well completion with new PT-23 polymer. The next step was testing of possibilities of weighting the mud with different weighting materials: barite with grain size lower than 75 μm , barite with grain size lower than 25 μm , commercial barite, hematite, bridging agent M-25. Barite with grain size lower than 75 μm and barite with grain size lower than 25 μm were conditioned in water, then wet separated into fractions.

Keywords: drilling muds, weighting materials, starch mud

Laura A.: **Analysis of fracturing fluid system, effect of rock mechanical properties on fluid selection** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 1

Hydraulic fracturing treatments of shale gas reservoirs is pumping process in which millions of gallons of fracturing fluids mixed with proppant materials and thickening agents are pumped into the target shale formation.

Fluids are used to create the fractures in the formation and to carry a propping agent which is deposited in the induced fractures to keep them from closing up. Type and percentage of chemical additives that used in a typical fracture treatment varies depending on the conditions of well being fractured. A series of chemical additives are selected to impart a predictable set of properties of the fluid, including viscosity, friction, formation-compatibility, and fluid-loss control. Each component in fracturing fluids serves a specific, engineered purpose and geological structure of rock. The properties of fracturing fluid are very important in the creation and propagation of the fracture. For successful stimulation fracturing fluid must to have certain chemical and physical properties.

Study of the properties fracturing fluids has a huge role in the processes of shale gas extraction. In scientific literature indicates that hydraulic fracturing fluid performance became a prevalent research topic in the late 1980s and the 1990s. The majority of literature pertaining to fracturing fluids related to their operational efficiency and classification. Some of the existing literature offer information regarding the basic chemical components present in most of these fluids.

This paper will discuss types of fracturing fluids and it components that may be used for hydraulic fracturing. Comprehensive history of the evolution of hydraulic fracturing fluids in the oil and gas industry plays a significant part in research. This work summarizes requests for fracturing fluids. In addition, this paper shows effect of rock mechanical properties on fracturing fluid selection.

Keywords: fracturing fluids, rock mechanical properties, shale gas reservoirs
