SUMMARIES

Bilstad T., Jensen B., Toft M.: **Environmental friendly drilling fluid management offshore Norway** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

Types and amount of fluids utilized when drilling a well determine to which extent the drilled cuttings are legally considered hazardous waste. The main categories of drilling fluids are oil based (OBM), water based (WBM) and synthetic based mud (SBM). The purpose of adding fluids to the drilling operations is to cool and lubricate the drill bit, to stabilize the well bore, to control subsurface pressure, to control formation pressure, to control well stability, to control corrosion, and to carry cuttings to the surface.
Historically, cuttings from drilling sub-surface wells have been depositeddirectly from the platform to the seabed. However, environmental laws and regulations for the Norwegian offshore sector prohibit such practice when the oil on cutting exceeds 1 % by weight. Re-injection of cuttings as a slurry into subsurface formations is still practiced. Due to migration, leaks, re-entering of slurry onto the seabed, and collapsing formations this disposal method is on a decline. Transport of oily cuttings to shore for final treatment is the preferred Norwegian practice. However, cutting treatment on platforms isalso continuouslyevaluated. For logistics and cost reasons, as well as health, safety and environmental (HSE) and working environment reasons, emphasis is put on offshore waste minimization, reuse and recycle.Ten onshore locations in Norway are currently receiving cuttings for further treatment and fluid recovery. The treated cuttings are for the most part disposed in landfills.

Keywords: *drilling, fluids, mud, cuttings, cleaning, TCC, reuse, disposal, regulations*

Bujok P., Fibinger J., Klempa M., Porzer M., Kalus D., Rado R.: **The problem of liquidation of the open eruption by drilling tools** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

Drilling process of deep borehole consists of different drilling operations. Each of them can cause numerous different drilling problems especially when a borehole is performed. While drilling the most dangerous problems can occur once the drilling fluids (oil, gas or water) spontaneously flow out from the drilled formations into the borehole and then to the surface.
It can also happen that the pressures in the borehole are not balanced and an influx of fluid into the borehole (a kick) will occur.
If no action is taken to stop a kick once it begins, then the fluids will be pushed out of the borehole and will be flowing uncontrollably to surface (blow-out).
Blow-out is prevented by closing off the well at the surface with special kind of valves (Blow-out Preventers – BOPs). When pressure control over the well is lost, swift action must be taken to avert the severe consequences. These consequences may include:

- endangering of human life,
- loss of rig and equipment,
- negative influence on the environment,
- additional costs of bringing the well under control again,
- loss of reservoir production.

In the case of kick or blow-out will occur in the practical use are different procedures and methods to control a borehole. These procedures and methods depend on the actual drilling operation scenario.
One of them can be a tripping operation when the drill string is pulled out or run back again. In this case the drill string is open either after a break-out or before making up the drill pipes and drill collars.
There is a variety of tools that can be used to prevent the formation of fluids rising up inside the drill pipes.
One of this tool is a safety valve (rod preventers - BOP) to prevent the blow-out of the drill string.
This manual safety valve should be kept on the rig floor at all times. It needs to be a full opening ball-type valve so there is no restriction to flow. This valve is installed onto the top of the drill string if a kick occurs during a trip.
However, this solution is quite inconvenient and difficult because involves special heavy tools, e.g. a crane.

This paper presents a new solution making use of special control equipment for the blowing open drill string. This equipment is based on a hydraulic press (named "Drill Pipe Rescue Press I") which has been developed by HBZS, MND S.A. Hodonin and VSB-Technical University of Ostrava, supported by Faculty of Drilling, Oil and Gas AGH-UST Krakow.

Keywords: *liquidation of the open eruption, drilling tools, drill string*

Nagy S., Polański K., Ślizowski J.: **The possibility of applying CAES technology in Polish conditions** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

In this paper were described the possibility of energy storage in salt caverns in Poland, using the technology CAES (Compressed Air Energy Storage), taking into account the natural conditions and parameters of existing power plants in the world. Focusing primarily on the storage part of such an installation, made initial selecting potential areas in the Poland enabling comprehensive execution of the installation - part of the ground (wind turbines, installation, gas turbine) and part of the underground (salt cavern).

Keywords: *CAES, wind turbines, gas turbine, salt caverns, compressed air storage.*

Bednarz P., Stopa J.: **Enhanced Oil Recovery methods on offshore fields in the light of world literature** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

Enhanced Oil Recovery methods (EOR) are known since long time, but in recent years they have been used primarily in the U.S. mostly for research purposes. The increased interest in their use was in the 70's of the twentieth century, and associated with the increase in oil prices. Currently for several years there has been a return to the these methods, including offshore fields. Experience in the application of EOR methods in Poland is small, currently no exploitation is carried out using them.
The purpose of this article is to present the current trends and latest technologies in enhanced oil recovery methods in terms of the applicability by the Polish oil companies. Statistical data of current and planned EOR methods in the world with special emphasis on offshore reservoirs is presented. Current trends in technological development of EOR methods are given, both which are still in the phase of laboratory tests and the first tests on fields such as: carbon dioxide flooding, water alternating gas injection, low salinity water injection, carbonated water injection, conventional technologies of polymer gels and thermally activated polymers.

Keywords: *EOR, enhanced oil recovery, offshore fields*

Stec G., Rybicki C., Blacharski J.: **Evaluation of possibility applications of using membrane separators for purification of gas from unconventional deposits** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

In this paper the types of membranes used for purification of the gas streams were described, the principle of operation was discussed and the main areas of the industrial use of this type of separation equipment in the world were identified. The possibility of using membranes for natural gas purification in particular the unconventional gas (shale gas, natural gas with nitrogen) was analyzed. The authors presented the criteria for selecting the size of the membranes, the critical parameters of membrane system, the necessary installation and compilation of technology enabling the proper conduct of the separation process. Based on the experience of different companies rated the advantages and disadvantages of using membranes for gas treatment in Polish exploitation and transmission conditions both from the technological and the economic point of view. The paper ends with proposals for the possibility of application of the system of membranes for the purification of gas from unconventional sources.

Keywords: *membrane separators, purification of gas, unconventional deposits*

Tataru A., Ştefanescu D.-P., Simescu B.: **Liquid unloading optimization from gas wells which exploit depleted reservoirs** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

One of the most important aspects in natural gas exploitation, which must be constantly monitored, is the liquid impurities loading in gas wells, mostly in depleted reservoirs. The extension of this phenomenon is observed, as the natural gas reservoirs are depleted, thus substantially reduction of the reservoir pressure. The increasing quantity of liquid impurities is a major problem in gas depleted reservoirs exploitation, which could not be naturally removed in energetical depletion conditions. In this period, to avoid liquids acumulation and afterwards flooding, wells must produce with a minimum flow, named critical flow, under whose value is not possible the unloading of accumulated liquids.
Wells can produce without liquid accumulations if in the tubing is obtained a gas flow velocity, greater than the liquid drop free dowfall speed limit. The velocity and critical flow depend on bottom hole or surface dynamic pressure, flow section diameter, liquid and gas density, water superficial strength.
Liquid flow increase during gas depleted reservoir exploitation, but only a part of this quantity is naturally unloaded by gas stream, the other part tend to accumulate to the bottom hole. In this conditions, the dynamic bottom hole pressure will increase continuosly, causing continuous dropping and pronounced gas flow rate, until the well floods and stops producing.
Early recognition of signs that indicates well liquid loading and the most suitable lifting system selection can eliminate problems before the production drops and layers damage.

Keywords: *liquid unloading, optimization, depleted reservoirs, critical velocity, critical flow*

Tătaru A., Şuţoiu F., Bolázs S.: **Mature gas field rehabilitation concepts** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

Rehabilitation operations are applied to mature gas field, which although have a significant history production, owns a continuous energetical capacity which could be exploited in economicaly efficient conditions.
For rehabilitation are selected from all the mature fields those which could additionally offer to the currently obtained basis production, a supplementary production, generated through interventions in reservoirs, wells or surface infrastructure.
Although the opportunity of mature gas field rehabilitation is evident and unanimously accepted, the effective implementation of the concept represents a complex intervention. This fact is just due to natural gas reservoirs diversity, which involves developing particular models of rehabilitation, adapted to each reservoir capability.
Conceptually, mature gas field rehabilitation can be divided in three sequences: reservoir, well, surface facilities. Intervention in one section or another, or concomitent intervention in all three sequences, is dictated by technical and economical reasons.
Mature gas field rehabilitation must begin with main production problems identification that once recognized can be solved by remedial actions. Such corrective measures are commonly used in order to increase the productivity of gas wells and removing restrictions on reservoir - well - surface facilities route.

Keywords: *mature gas field, rehabilitation, concept, reservoir, well, surface facilities*

Foidaş I., Ştefănescu D.-P.: **Technical and economic analysis of the impact of compressors installed at well clusters** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

The current stage of mature gas fields exploitation is characterized by increasing the efforts for maintaining the wells in production, in order to maximize the gas recovery factor in conditions of economic profitability. In this respect, a permanent concern of the specialists in this domain is represented by the adjustment of the compression capacities with the dynamics of the energetic parameters of every well belonging to these fields. This assumes the compression units installing as close to the well head in order to decrease the dynamic pressure, allowing the gas rate increasing.
On the other hand, decreasing the dynamic pressure at the well head, results also in reducing the minimum gas rate necessary for removal the liquid accumulated at the wells bottom, avoiding thereby the risk of the wells flooding.

The pilot project of installing the portable compressors at the level of some gas groups operated by Romgaz, was a real success, the future perspectives regarding the production enhancing and revenue growth, based on this technology, being certainly.

Keywords: *dynamic pressures, suction pressures, group compressor, cash-flow*

Jędrzejczyk A., Rychlicki S., Stopa J.: **The characteristics of perspective areas of non-conventional oil accumulations in Poland** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

In Poland, the focus so far has been on unconventional gas deposits, but equally interesting are unconventional oil deposits. As a result of intensive research in the past few years, it was found that we have significant deposits of oil shale, which may be rich in both gas and oil. Undoubtedly, after a period of research and analysis on the prospects of the presence of shale gas in these structural units would come the turn of the shale oil. In the article on the basis of industrial materials have been characterized:

- shale formations in the basin of the Baltic - Podlasie - Lublin (potential of the Silurian and Ordovician),
- Prągowiec ravine (southeast of Kielce) - Graptolitic Shales (Silurian)
- menilite shales in the Carpathians external-especially of south of Rzeszow in municipalities Błażowa, Boguchwala, Wojaszówka.
- discovered heavy oil deposit Lubaczów

Keywords: *Poland, shale oil, unconventional deposits*

Knapik E., Stopa J.: **Laboratory experiments for crude oil removal from water surface using hydrophobic nano-silica as sorbent** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

Nanomaterials have a great potential for the possible oil spill cleanup due to their unique wettability characteristics and large surface area. This work reports investigations on oil sorption behavior of a commercially available hydrophobic nano-silica when tested with a light paraffinic crude oil and a heavy aromatic crude oil. Sorption experiments were carried out in batch sorption system under static and dynamic conditions. Influence of mass of sorbent, sorption time, temperature and pH value of water on sorption capacity were tested and compared to find an optimal operational conditions for adsorption process. Nanopowder exhibited high selectivity for absorbing oil from water; a removal efficiency found by gravimetric method was high as 96% to 99%. The sorption capacity increases with the increase of sorption time and mass of sorbent. Nano-silica powder was found to be effective sorbent material as compared to widely used synthetic fibers.

Keywords: *oil sorbent, hydrophobicity, nano-silica, batch adsorption.*

Dubiel S., Rybicki Cz., Zubrzycki A., Maruta M.: **Interpretation of DST test results for the identification of HC accumulation limits or boundaries in the area of the Carpathians and Carpathian Foredeep (South Poland)** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

The result and interpretation of reservoir tests (DST) are presented in the paper. They were performed in 20 intervals of 17 production wells in years 1995–1997. These wells are located in the Central Carpathians (flysch sand beds) and mainly in the external and internal Carpathian Foredeep (the autochthonous and allochthonous Miocene thin bedded sandstones) and their substratum (mainly carbonates). The basics of the theoretical diagnoses for determining the main types of drainage zones or limits of hydrocarbon accumulations are presented in the form of a short description of the Kappa Company's programmatic procedure (Saphir 202B system). Some diagnostic diagrams for the main reservoir border models are described using the log–log method. Examples of their geological interpretation are also provided.

Keywords: *petroleum explorations, Carpathians, Carpathian Foredeep, Carpathian Foredeep basement, reservoir rocks, DST, diagnostic diagrams of the log–log method, HC accumulation limits and/or drainage zones.*

Szabó D., Pinka J., Stoličný E.: **Stimulation of unconventional hydrocarbon reservoirs•** AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

In the "new age" oil and gas industry came more and more into focus term of unconventional hydrocarbons. Gained experience and success in the United States tight gas sand reservoirs Piceance, Anadarko, Greater Green, Lobo fields confirmed the hidden potential of unconventional hydrocarbon resources. In some production and development areas called coal bed seam, shale gas and tight sand reservoirs without intensifying operations isn´t possible to produce commercial gas volumes. Used practises and gained large experiences in the crude oil fields are commonly used in the shale and tight gas fields across the United States. Application of these technologies of stimulation methods like fracturing in Europe is at the very beginning. Pioneer investors are waiting in all Europe for the well testing results from the first dozen fractured shale gas and tight sand reservoirs. Test results could have significant influence on the future planned massive drilling campaign of exploration of the unconventional hydrocarbon resources.

Keywords: *Tight gas sand, shale gas, coal bed seam unconventional, intensification, fracturing, propant, mesh, Darcy´s law*

Duşe D.-M., Duse C. S., Nemeş C.: **The vision of students regarding tomorrow's world in European engineering education** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

Starting from Michael Rendell and his team's "Managing tomorrow's people", this paper sets out to build a possible future of leadership in the European engineering education by taking the students' view on tomorrow's world into consideration. We can ask ourselves if European technical universities, and engineering education in particular, could exist in a Blue, Green and Orange World. How would they look like and how efficient would "corporate" universities be, assuming that the Blue World would prevail in the next 10 years. What should their development strategies be and what labor markets would absorb their graduates? What if universities would be in the Green or Orange World? What leaders should they have then? Starting from these questions we try to construct possible scenarios for a European reality.

Keywords: *leadership, engineering, education, technical universities, future*

Blicharski J., Rybicki C., Stec G.: **Analytical prediction model of UGS performance** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

The purpose of underground gas storage in porous media is to allow compensation for peak shaving in gas consumption. Especially during the winter months, the stored gas must then be supplied at full capacity for short periods. Currently storage capacities of existing UGS facilities in Poland are not fully sufficient for proper regulation of gas demand. The more they do not overcome long term limitation in gas supply from import. There is therefore a need for increasing capacity of existing UGS or development of new ones. This paper presents an analytical model based on equations of material balance combined with well inflow and tubing performance equations for modeling gas storage operations. Presented model was used to maximize the capacity and efficiency of natural gas storage developed in partially depleted gas fields located in the region of south-eastern Poland for a given reservoir/well configuration. On the basis of this model variant scenario of gas storage operation with the use of vertical and horizontal wells were demonstrated.

Keywords: *underground gas storage, gas withdrawal, working and base gas capacity, vertical and horizontal well deliverability*

Włodek T., Kuczyński S., Hendel J.: **Technical and economic issues of offshore pipeline carbon dioxide transportation** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

The technical and economic conditions of carbon dioxide offshore pipeline transportation are presented in this paper. The basic conditions in which carbon dioxide will be transported, as well as the thermodynamic conditions, physicochemical properties and technical parameters, relevant to CO_2 pipeline transport, are addressed in this article. The basic costs of pipeline carbon dioxide transport are also considered.

The carbon dioxide flow was simulated for a few pipeline diameter sizes to determine the operating pressure of the pipeline for various maximum mass flow rate values. Different conditions of CO_2 flow including impact of ambient conditions were analyzed. There is also included an analysis of technological systems and installation concepts for carbon dioxide preparation for efficient pipeline transportation.

Keywords ENG: *carbon dioxide, CO_2, pipeline, CO_2 transport, pipeline transportation, offshore pipeline.*

Liszka K., Łaciak M., Oliinyk A.: **Study of the effect of geometrical parameters of the LNG storage tanks on the process of evaporation of liquefied natural gas** • AGH Drilling, Oil, Gas 2014 • Vol. 31 • No. 2

Storage of liquefied natural gas (LNG) is one of the most important processes taking place during liquefaction which is also significant for the regasification and receiving terminals operation. The task of the tanks lies not only in the safe storage of gas, but also in preventing its evaporation related, among others, to the heat transfer through the walls and roof of the tank.
Even a small quantity of heat flowing to the LNG increases its internal energy, consequently leading to the evaporation of a certain quantity of LNG. Phase transitions of even small amounts of liquid may cause changes in the composition of both LNG and its density, which may contribute to the formation of stratification of liquefied gas.
The geometric parameters of the storage tanks have a very large impact on the amount of heat penetrating the tank: with the increase of its size the surface area of heat transfer increases, too.
The dependence of heat penetrating the tank, its geometric dimensions and the effect of temperature on the stability of the stored LNG are discussed in this paper .

Keywords: *liquefied natural gas, LNG, gas storage, storage tanks, vaporization*

Stefanescu D. P., Iturbe Y., Falk I.: **Optimizing recovery factor in multilayers mature gas field, based on decline curve analysis methodology** • AGH Drilling, Oil, Gas 2014 • Vol 31 • No. 2

Generally, the mature fields have a good portion of the remaining reserves still trapped due to inefficient drainage, pressure decline, increase in water cut, sand production and aging of the existing system. This paper addresses a methodology applied on the historical production behavior to identify techniques and initiatives to optimize the recovery factor based on redevelopment plans in a mature field. For Laslau Mare field in particular, there have been identified and implemented opportunities such as: infill drilling, work over optimization, dynamic underbalance perforation (DUP), acidizing, kick off with N2, propellant stimulation, snubbing, soaping, sand management, Wavefront Technology stimulation and wellhead and/or group compressor installation.

Keywords: *mature gas fields, the Laslau Mare field, recovery factor*
