

---

# EQUIPMENT AND TECHNOLOGIES FOR OIL AND GAS COMPLEX

October 2013

№ 5

published since 2001  
6 issues per year

---

## CONTENTS

### Machinery and equipment

- Bashmur K.A., Petrovsky E.A.* Dynamics of top drive system of a drilling rig .....4
- Arifulin R.Kh., Hodyrev A.I., Kashtanov I.M.* A valve: analysis of material-design manufacturing; projected power analysis; determination of optimization ways .....7
- Gabdrakhimov M.S., Fakhrieva K.R.* Dynamic loadings of borehole equipment and vibroprotection of electric centrifugal pumping unit (ECP) .....17
- Zakharov B.S.* Mechanical seals of piston and plunger pumps used for oil extraction .....22
- Rzaev A.G., Guluev G.A., Rasulov S.R.* Determination of power on a compressor shaft .....28
- Kozhevnikova L.N.* Problems of assessing economic efficiency of geological exploration equipment .....31

### Material and reagents

- Mullakaev M.S., Abramov B.O., Asylbaev D.F., Prachkin V.G.* Study of combined effect of ultrasound and chemical reagents on rheological properties of oil produced at borovsky oil field .....34
- Aliiev Z.A., Aliiev A.G., Kerimov J.A.* Study of casting temperature effect on plastic components shrinkage and precision .....37
- Amirov F.A., Agammedova S.A.* Determination of concentration of hydrodynamically active additive during pump and pipeline joint operation .....39
- Gurbanov A.N., Iskenderov E.Kh.* Choice of new composition of the inhibitor used for gas preparation for transportation .....41

### New methods and technologies

- Ryakhovsky A.V.* Well monitoring .....44
- Matveev Yu.V., Novikov S.G., Butuzov A.A., Mulgachev A.Yu., Berintsev A.V.* Stationary device for diagnosing and location of a leakage place of oil and oil products in a pipeline .....50
- Rzaev A.G., Rasulov S.R., Abasova I.A., Ragimova S.N.* Modelling of nanotechnological processes of petroleum emulsions formation and destruction .....54

### Memorial dates

- The 95th anniversary since the birthday of M.N. Fokin .....59
- Information on the articles .....62

---

## Information on the articles

### **DYNAMICS OF TOP DRIVE SYSTEM OF A DRILLING RIG (p. 4)**

**Kirill Alexandrovich Bashmur,  
Eduard Arkadievich Petrovsky**

"Siberian Federal University"  
Institute of Petroleum and Natural Gas Engineering  
82/6, Svobodny prosp., 660041, Krasnoyarsk, Krasnoyarsk territory, Russian Federation.  
Phone: 7 (391) 206-28-93.  
E-mail: bashmur@bk.ru

When operating top drive systems, there appeared some significant shortcoming, namely, large-amplitude oscillations of the top drive system – drilling rig – drill pipe string, inevitably leading to failure of the drive's mounts to the drilling rig, to accumulation of fatigue damage of the drill pipe string and to other harmful consequences that pay negative effect on the whole system reliability. Mechanical model of rotation head of drilling rig was used for carrying out some analytical study of operational dynamics of the top drive system, which served the basis for getting and analyzing solutions that characterize the nature of the system oscillations. The fact of essential effect of logarithmic damping decrement on the amplitude of forced oscillations of the top drive system is revealed. The most favorable technological modes helping to avoid appearance of the

system's operational resonant modes in conditions of a well are found out as well.

**Key words:** top drive system (TDS); drilling rig; drill-pipe string; oscillation; power top drive; drill tower.

### **A VALVE: ANALYSIS OF MATERIAL-DESIGN MANUFACTURING; PROJECTED POWER ANALYSIS; DETERMINATION OF OPTIMIZATION WAYS (p. 7)**

**Rafik Khasanovich Arifulin,  
Alexandr Ivanovich Hodyrev,  
Igor Mikhailovich Kashtanov**

I. Gubkin Russian State University of Oil and Gas  
65, Leninsky prosp., 119991, Moscow, Russian Federation.  
E-mail: rafik.arifulin@rambler.ru,  
E-mail: azerrus@yandex.ru

Valves with non-rising stems are nowadays widely used for wellhead equipping in oil and gas industry of the Russian Federation. The design of these valves differs by smaller weight and size dimensions and the effort required for their control. However, drive components should be placed in a borehole area, thus demanding them to have additional properties, such as corrosion resistance, wear-out resistance, etc.

Analysis of well-known methods of calculation and recommendations of technical literature on material-design manufac-

---

turing, carried out with the example of some specific sizes of valves, proved the fact of impossibility of their usage.

Operational conditions (loading) of drive components and necessity of conducting studies to determine dependence of components strength of undercarriage threaded pair on friction coefficient in the thread, on sliding path and specific contact load are found out by means of application of calculation analysis.

**Key words:** analysis; material-design manufacturing; gate valve; ways of optimization; wellhead equipment; calculation of power required for a valve; method of calculation.

#### **DYNAMIC LOADINGS OF BOREHOLE EQUIPMENT AND VIBROPROTECTION OF ELECTRIC CENTRIFUGAL PUMPING UNIT (ECP) (p. 17)**

**Mavlitzyan Sagityanovich Gabdrakhimov,  
Kristina Rinatovna Fakhrieva**

Ufa State Petroleum Technical University, an affiliate in Otyabrskiy-city  
54a, Devonskaya str., 452600, Oktyabrskiy-city, Republic of Bashkortostan, Russian Federation.  
E-mail: FahrievaKR@bashneft.ru

The article analyzes operation of electric centrifugal pumping units (ECP).

Some factors affecting operation of electric centrifugal pumping units are presented, dynamism of operation of electric centrifugal pump is considered.

Bench and field testing is carried out to measure vibration of installations the electric centrifugal pumping unit. Graphs of dependences of longitudinal oscillations on wellhead pressure are built.

The design of a vibration absorber of stretching, squeezing and torsional vibrations is proposed to decrease loads on electric centrifugal pumping units. The main elements are described; the scheme of the vibration absorber is considered.

**Key words:** electric centrifugal pump; wellhead pressure; failures of electric centrifugal pump; two-channel analyzer of vibration signals; vibration of electric centrifugal pumping unit; pump output; bench for testing electric centrifugal pumping units; vibration absorber of stretching, squeezing and torsional vibrations.

#### **MECHANICAL SEALS OF PISTON AND PLUNGER PUMPS USED FOR OIL EXTRACTION (p. 22)**

**Boris Semenovich Zakharov**

"Ecogermet-M, Ltd."  
125, Leninsky prosp., 117513, Moscow, Russian Federation.  
E-mail: ecogermet@mail.ru

Seals of movable joints of hydraulic machines are the basic element operating capability of which guarantees operational reliability of pumps and compressors in general. "Ecogermet-M, Ltd." developed and implemented a number of mechanical seals in the industry thanks to which there appeared possibility to sufficiently increase interval between failures of sucker-rod and field pumps. All designs of mechanical seals were tested for operational capability in the most complicated operational conditions.

**Key words:** piston and plunger pipes; mechanical seals; prefabricated pistons; combined seals; combined double seals; sucker-rod pumps for low-debit wells.

#### **DETERMINATION OF POWER ON A COMPRESSOR SHAFT (p. 28)**

**Abbas Geydar Rzaev,  
Gambar Agaverdi Guluev**

Institute of Cybernetics of the National Academy of Sciences of Azerbaijan Republic  
9, B. Vakhbazade str., AZ 1141, Baku, Republic of Azerbaijan.  
Phone: 8(1099450) 395-40-08.  
E-mail: abbas\_r@mail.ru;

**Sakit Rauf Rasulov**

Azerbaijan State Oil Academy  
20, Azadlyg prosp., AZ 1010, Baku, Republic of Azerbaijan.  
Phone: 8(1099450) 212-08-35.  
E-mail: rasulovsakit@gmail.com

The article presents the developed mathematical model allowing adequate calculation of power consumed on a centrifugal compressor shaft with account of all basic design parameters and hydro-thermal-dynamic characteristics of gas flow. Some specific example proving adaptability of the developed mathematical model to a manufacture is given.

**Key words:** centrifugal compressor; velocities' triangles; angular momentum; wheel; power on a compressor shaft.

#### **PROBLEMS OF ASSESSING ECONOMIC EFFICIENCY OF GEOLOGICAL EXPLORATION EQUIPMENT (p. 31)**

**Lyudmila Nikolaevna Kozhevnikova**

M. Kalashnikov Izhevsk State Technical University  
7, Studencheskaya str., 426069, Izhevsk, Udmurt Republic, Russian Federation.  
E-mail: lyudakozhevnikova1011@rambler.ru

The article considers problems relating to the lack of generally accepted system of economic efficiency evaluation of geological exploration equipment as well as the necessity of developing the required methodology. The problem is relevant for each stage of geological exploration process, for example, choice of drilling equipment when it is necessary to take into account possibility of information content increase as well as costs decrease of geological exploration operations. The problems of geological survey state in the Udmurt Republic, where the majority of hydrocarbon stocks are hardly-recoverable ones, are revealed. Definition of the term "efficiency criterion" is given, attention is focused on possibility of a computational technique development by means of the above-said criterion. Development of efficiency criterion model is analyzed, in other words, the previously mentioned methodology of effectiveness evaluation of geological and exploration equipment. Key steps of the methodology development that will allow efficiency evaluation of geological-exploration drilling equipment are considered.

**Key words:** geological exploration equipment; cost effectiveness; efficiency criterion.

#### **STUDY OF COMBINED EFFECT OF ULTRASOUND AND CHEMICAL REAGENTS ON RHEOLOGICAL PROPERTIES OF OIL PRODUCED AT BOROVSKY OIL FIELD (p. 34)**

**Marat Salavatovich Mullakaev**  
**Vladimir Olegovich Abramov**  
**Damir Fuatovich Asylbaev**

N. Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences  
31, Leninsky prosp., GSP-1, 119991, Moscow, Russian Federation.  
Phone/fax: 8(495) 955-48-38.  
E-mail: mullakaev@mail.ru;

**Viktor Gennadievich Prachkin**

Ufa State Petroleum Technical University  
22B, Gubkin str., 453250, Salavat-city, Russian Federation.  
Phone: 8-901-517-23-46.

The effect of ultrasound and chemical agents on oil rheological properties of Borovsky field is studied. The experimental studies resulted in revealing possibility of changing of oil rheological characteristics under the influence of ultrasound and chemical reagents and tracing of clear synergism in their action. Significant reduction of oil viscosity and pour point is reached in case of the combined effect of ultrasound and oil reagent R-12.

**Key words:** oil; ultrasound; chemical reagents; dynamic viscosity; intensity and time of ultrasound treatment; the pour point.

#### **STUDY OF CASTING TEMPERATURE EFFECT ON PLASTIC COMPONENTS SHRINKAGE AND PRECISION (p. 37)**

**Zazur Aziz Aliev,**  
**Aziz Gusein Aliev**

JSC "AzINmash", an affiliate  
4, Araz str., Az 1029, Baku, Republic of Azerbaijan.  
Phone: 8(1099412) 567-69-49; fax: 567-08-08.  
E-mail: azinmash@mail.ru;

**Jahid Ali Kerimov**

Azerbaijan State Oil Academy  
20, Azadlyg prosp., Az 1010, Baku, Republic of Azerbaijan.  
Phone: 8(1099412) 567-69-49; fax: 567-08-08.

The article studies problems, relating to casting temperature effect on shrinkage and precision of plastic components. Some curves of dependence of shrinkage on casting temperature for samples and components manufactured from high density polyethylene as well as dependence of dimensions variation of components precision on casting temperature are built.

**Key words:** casting temperature; shrinkage; variation of dimensions; precision; curves of dependence.

#### **DETERMINATION OF CONCENTRATION OF HYDRODYNAMICALLY ACTIVE ADDITIVE DURING PUMP AND PIPELINE JOINT OPERATION (p. 39)**

**Fikret Alibaba Amirov,**  
**Sevda Alipasha Agammedova**

Azerbaijan State Oil Academy

20, Azadlyg prosp., Az 1010, Baku, Republic of Azerbaijan.  
E-mail: Agammadova.adna@rambler.ru

Some formula of volumetric concentration determination of hydro-dynamically active admixture is developed on the basis of the balance of pump and pipeline heads. Equation of the hydraulic drops balance can be solved by means of application of modern software (MathCAD Maple, Mathematic) as well as by graphical active methods.

**Key words:** hydro-dynamically active additives; kinematic viscosity; density; head; pipeline; hydraulic characteristics; pressure.

#### **CHOICE OF NEW COMPOSITION OF THE INHIBITOR USED FOR GAS PREPARATION FOR TRANSPORTATION (p. 41)**

**A.N. Gurbanov,**  
**E. Kh. Iskenderov**

"NIPIneftegaz" of State Oil Company of Azerbaijan Republic  
88A, Zardabi prosp., AZ 1012, Baku, Republic of Azerbaijan.  
Phone: 8(1099412) 431-58-85.  
E-mail: gabdulaga@mail.ru

The article is devoted to the problem of developing of inhibitor new composition required for prevention of hydrate generation at the fields while preparing gas for transportation. The inhibitor new composition of complex action allows simultaneous prevention of hydrates generation, corrosion and salt sedimentation in the system of gas field preparation for transportation, reduction of methyl alcohol specific consumption, extension of the base of nano-composition and chemical reagents usage in oil and gas industry as well as increase of the region's ecological cleanness.

Analysis of experimental studies results witnessed the fact that while mixing the components, forming the new inhibitor composition, there appears synergistic effect, thanks to which high degree of natural gas purification and dehydration from moisture and acidic components is reached when using the newly-developed composition of the inhibitor.

High quality and the best indicators of synergistic properties of the developed inhibitors open a new direction of their wide usage in oil and gas industry.

**Key words:** hydrate; inhibitor; gas; composition; fraction.

#### **WELL MONITORING (Technology of inter-string pressure prevention in wells. Control of sealing of wellhead seals of drill casing strings) (p. 44)**

**Alexander Viktorovich Ryakhovsky**

CJSC "Vankorneft"  
20, 78<sup>th</sup> Dobrovolcheskaya brigada str., 660077, Krasnoyarsk, Sovetsky district, Krasnoyarsky region, Russian Federation.  
Phone: 8-927-567-66-82, 9-905-363-20-21.  
E-mail: aryakha@yandex.ru

The technology is relevant to working wells of different purposes and design with ultra-low injective capacity between strings equaling to  $< 0,0083 \text{ m}^3/(\text{hour}\cdot\text{MPa})$  or less than  $2 \text{ m}^3$  per day at 10 MPa. The technology is implemented immediately

---

after a well completion and works during the whole operational time of the well till its elimination.

Occurrence of inter-string pressure (ISP) on wellhead equipment points to presence of fluids interflow channels in the space between strings, threaded connections of drill-pipe strings or in wellhead equipment, what is surely considered unacceptable in the wells of any purpose. Industrial Safety provisions (PB 08-624-03) refer these wells to technically defective and that fact requires taking steps to eliminate inter-string pressure, and in case of impossibility of fulfilling the operation – to wells killing.

A well is a complicated technical structure and development of new technologies to be applied for their construction make them more and more expensive facilities. The world practice of wells operation lacks effective monitoring system of tightness state of casing strings, their threaded connections, wellhead seals of casing strings as well as technology of constant maintenance of integrity of well equipment and inter-string area. The article discusses the idea and considers some method allowing implementation of the above-said control by means of constant maintaining and monitoring integrity of well equipment and inter-string area, thus essentially increasing wells operational lifetime, reducing labor and material costs to be spent on their repair, monitoring ecological safety of a well. Implementation of the method will ensure low-cost control as compared with the cost of a well.

**Key words:** landing head; inter-string pressure; inter-string space; wellhead casing-strings seals; sealing plasticizer.

#### **STATIONARY DEVICE FOR DIAGNOSING AND LOCATION OF A LEAKAGE PLACE OF OIL AND OIL PRODUCTS IN A PIPELINE (p. 50)**

The RF patent of utility model

**Yury Alexeevich Matveev,  
Sergey Gennadievich Novikov,  
Alexey Alexandrovich Butuzov,  
Andrey Yurievich Mulgachev,  
Alexey Valentinovich Berintsev**

Federal State Budget Educational Establishment of Higher Professional Education "Ulyanovsk State University"  
42, Leo Tolstoy str., 432017, Ulyanovsk, Russian Federation.  
Phone: 8 (8422) 27-24-62.

E-mail: bgd020762@mail.ru

The device allows diagnosing and identifying petroleum products leakage places in a pipeline. The useful model includes two conductors with insulators, communication lines, ohmmeters and a personal computer. In case of any leakage resistance between conductors changes and that fact is fixed by an ohmmeter and PC.

**Key words:** petroleum product; pipeline; conductor; resistance; ohmmeter; personal computer; leakage.

#### **MODELLING OF NANOTECHNOLOGICAL PROCESSES OF PETROLEUM EMULSIONS FORMATION AND DESTRUCTION (p. 54)**

**Abbas Geydar Rzayev**

Institute of Cybernetics of the National Academy of Sciences of Azerbaijan Republic  
9, B. Vakhazade str., Az 1141, Baku, Republic of Azerbaijan.  
Phone: 8(1099450) 395-40-08.  
E-mail: abbas\_r@mail.ru;

**Sakit Rauf Rasulov,  
Inara Afrail Abasova,  
Seylan Nariman Rahimova**

Azerbaijan State Oil Academy  
20, Azadlyg prosp., Az 1010, Baku, Republic of Azerbaijan.  
Phone: 8(1099450) 212-08-35.  
E-mail: rasulovsakit@gmail.com

The article proves the fact that processes of oil preparation refer to nanotechnologies, as these processes are realized on a nano-sized level, lying in charge interaction of mono- and polyvalent ions existing in inter-acting media of oil and formation water. Some mathematical model of processes of oil thermochemical de-watering is proposed with account of specific peculiarities (nano-phenomena) of petroleum emulsion formation and destruction.

**Key words:** nanotechnology; double electrical charge; adsorption; poly-dispersion; petroleum emulsion; inter-phase straining; moistening.