1. DRILL MUD DEPARTMENT

General information
Experience and geography of works
Infrastructure presence. Software

1.1 APPLICABLE MUDS

Drill mud SKIF
Drill mud SKIF+
Biopolymer inhibitive carbonate mud POLICARB BIO
Oil based mud EMULCARB
Mud for drilling fractured reservoirs SULFOBIT
Gel – emulsion mud MULTIBUR
Lime muds
Water based mud for drilling in high temperatures (up to 240°C)
Salt-saturated mud with thermal stability up to 130°C
Salt-saturated mud with thermal stability up to 150°C
Process fluids without solids with density 1.35-2.30 g/cm³
Temporary blocking compound “Burintekh Block Compound” (BBC)
Plugging mixture for lost circulation control
Process liquid for cleaning bottomhole formation zone
Core barrel insulating fluid IZOKOR

1.2 DRILL MUD REAGENTS

ANIPOL HV
ANIPOL LV
MULTISTAR
BIOPOL
SYNPOL HV
SYNPOL LV
BIO XX (organic inhibitor)
DPS (anti balling detergent)
BL SALT (lubricant)
BL (lubricant)
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STANDARD METHODS
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NONSTANDARD METHODS
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### 2.3 MUDS AND PROCESS LIQUIDS EXPOSURE TO BOTTOMHOLE FORMATION ZONE PROPERTIES RESEARCH

#### 2.3.1 CORE RESEARCH

- Preparation of necessary geometric shape core
- Samples extraction, water and oil saturation determination (Soxhlet and Zacs apparatus)
- Samples vacuum dehydration
- Core samples absolute permeability definition by air
- Core sample density, open porosity definition
- Reservoir residual-water saturation and wettability definition
- Formation producing characteristics research using research apparatus FDS-350
- Formation grain composition definition

#### 2.3.2 FORMATION FLUIDS RESEARCH

- Oil product density definition with densimeter
- Rheological properties definition
- Water content in oil product definition

### 2.4 WELL CEMENTING LABORATORY

- Overview
- Main lines of well cementing lab work
- Well cementing lab equipment
- Cement slurries and it components test methods
- Cement slurries main parameters measured under standard methods
- Filter value
- Definition of cement expansion capacity
- Definition of flushing fluids wettability
- Definition of set cement permeability
1. DRILL MUD DEPARTMENT
MUD DEPARTMENT

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Mud department was founded in 2005 on the basis of mud laboratory. Over the 10 years of mud department were created and implemented mud systems for drilling in different geological conditions as well as the line of own produced chemical agents for muds. In 2016 from mud department were separated laboratories and made new structure – muds and cement slurries development department which includes 3 laboratories: muds test lab, reagents development lab, and well cementing lab.
• Each object where services are rendered is equipped with modern mobiles with section inside for field lab which is in compliance with all requirements and regulations.

• Measuring all parameters and properties of fluids is made under the API standards on the OFITE equipment USA by qualified mud engineers.

• All personnel pass training for the knowledge of Russian Federation regulatory legal acts relative to HSE and have corresponding certificates. In addition all personnel pass defensive driving trainings, first treatment, etc.

• All personnel, according to internal regulations, annually pass specialized trainings. Every two years they pass professional development issuing diploma and certificates.

Mud parameters control is carried out in accordance with standards:
API R.P.13B-1 (water based mud control methods)
API R.P.13B-2 (oil based mud control methods)

Definition of filtration properties in standard conditions and high temperature and pressure;
Definition of rheological properties of mud;
Filtrate chemical properties definition (calcium, potassium and magnesium ions, chlorine ions, hardness analysis, alkalescency, etc);
Retort analysis, methylene blue analysis;
Colmatant concentration in system analysis;
Lubricating capacity definition, etc.
With the help of mud service support were drilled more than 1200 wells in different conditions, of different category of hardness and designs. More than 600 offshoots including more than 400 with horizontal end.

Was gained successful experience in different geological conditions on more than 100 fields of Western and Eastern Siberia, Tomsk and Orenburg regions.

Our partners:
- Surgutneftegaz
- NK Rossneft
- Gazpromneft
- Bashneft
- Tatneft
- Russneft
- Belorusneft-Siberia
- Katobneft
- VPT-Neftemash
- Samotlorneftepromkhim
- Krasnoleniskneftegaz
- NPRS-1
- Varieganskaya Oil Company
- Service Drilling Company
“BURINTEKH”, Ltd has own base of production-technical services and storage depots:

Central base in Ufa
Regional base in Nefteyugansk

Warehouses have enough area and provide the performance of all regulations and limitations presented for the storage equipment, materials and reagents.

For execution works in distributed and far away objects enterprise has sufficient amount of transport.

**Software**

SOFTWARE FOR DRILLING MUD ENGINEERS

“Hydraulic BIT” is designed for calculating and designing hydraulic drilling parameters to help mud manufacturing engineer.

The program for selection colmatant fractional composition “FD-Protection” – the program includes new methodology of selection colmatant fractional composition under Vickers criteria, including both Abrams theory and Kauffier (ideal package theory) and meaning more precise selection of factions for big, medium, small and intermediate pore size in layer.

“Landmark” – “WELLPLAN” is designed for designing mud properties and provides the correspondence of project information to modern scientific achievements in the field of drilling hydraulics.
1.1 APPLICABLE MUDS
«SKIF» IS SPECIALIZED FLUSHING FLUID WITH OPTIMAL PERFORMANCE PROPERTIES FOR DRILLING DEPLETED SANDSTONES, WATER-SENSITIVE ROCKS WHERE CHANCES OF DIFFERENTIAL STICKING ARE HIGH WHEN DRILLING HOLES WITH BIG DEVIATION.

Application
Drilling well with big horizontal displacement, long intervals of unstable and water-sensitive formations, tailing-in.

Features
• high quality of borehole cleaning
• usage of biodegradable components
• use of complex inhibiting
• minimum effect on reservoir properties of producing formations

Advantages
• high inhibiting ability
• low filter value
• easy mud parameters control
• good lubricating features

Main parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.06 – 2.10</td>
</tr>
<tr>
<td>Relative viscosity, s</td>
<td>35 – 55</td>
</tr>
<tr>
<td>Filtration rate, ml/30 min</td>
<td>6 – 9</td>
</tr>
<tr>
<td>Plastic viscosity, cP (mPa-s)</td>
<td>22</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>15 – 30</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>4 – 12/6 – 20</td>
</tr>
<tr>
<td>MBT, kg/m³</td>
<td>40</td>
</tr>
<tr>
<td>Solids content, %</td>
<td>8</td>
</tr>
<tr>
<td>Total hardness, mg/l</td>
<td>200</td>
</tr>
<tr>
<td>pH</td>
<td>8 – 9</td>
</tr>
</tbody>
</table>
«SKIF+» IS THE COMPLEX ENCAPSULATING FORMIATE SYSTEM PURPOSED FOR DRILLING DIRECTIONAL AND FLAT WELLS IN CONDITIONS OF UNSTABLE FORMATIONS AND SWELLING CLAY SLATES.

Application
Drilling wells in strongly swelling clay slates, tailing-in wells supposing development by means of hydraulic fracturing.

Features
- synergism of performance organic inhibitor and acrylic copolymer
- high thermal stability (up to 120°C)
- provision of wellbore stability
- high encapsulating and flocculating features
- minimum percentage of colloid solid phase in solution
- high electrical resistivity (~1 Om • M)

Advantages
- high inhibiting ability
- low filter value
- high lubricating features
- high drilling rate
- absence of balling

Main parameters
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.06 – 2.1</td>
</tr>
<tr>
<td>Relative viscosity, s</td>
<td>35 – 45</td>
</tr>
<tr>
<td>Filtration rate, ml/30 min</td>
<td>6 – 9</td>
</tr>
<tr>
<td>Plastic viscosity, cP</td>
<td>10 – 20</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>5 – 25</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>3-10/5-20</td>
</tr>
<tr>
<td>pH</td>
<td>8…9</td>
</tr>
<tr>
<td>MBT, kg/m³</td>
<td>40</td>
</tr>
<tr>
<td>Solids content, %</td>
<td>8</td>
</tr>
<tr>
<td>Total hardness, mg/l</td>
<td>200</td>
</tr>
</tbody>
</table>
«SKIF» AND «SKIF+» SYSTEMS PROVIDE QUALITATIVE WELL CLEANING FROM DRILLED OUT ROCKS AND STABILITY OF WELLBORE WALLS.

Non-linearity of rheological features is determined by the use of xanthum range as part of biopolymer. Thereat mud differs by its increased carrying ability in static condition and creates low resistances at increasing shearing rate.

Ability of systems to obtain features of pseudo plastic fluid provides good borehole cleaning and small values of plastic viscosity provide good mud cleaning from cuttings on the surface.

<table>
<thead>
<tr>
<th>Mud type / Core sample</th>
<th>Lfiltration, mm</th>
<th>Pbreak-off, psi/atm</th>
<th>βresidual, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>«SKIF» / kabs = 17 mD</td>
<td>248</td>
<td>204/14</td>
<td>85.9</td>
</tr>
<tr>
<td>«SKIF+» / kabs = 15.8 mD</td>
<td>242</td>
<td>258/17.8</td>
<td>71.2</td>
</tr>
</tbody>
</table>

Note:

Lfiltration - depth of killing fluid filtrate invasion to core sample;
Pbreak-off - pressure of initiation of oil stimulation treatment after mud effect;
βresidual - restoration of oil permeability after imitation secondary tailing-in in relation to layer permeability before mud effect.

«SKIF» system is successfully used on Western Siberian fields – there are drilled more than 150 wells in different geological conditions.

«SKIF+» system is successfully used on Western and East Siberian, Tatarstan, Bashkortostan, Orenburg and Samara regions.
BIOPOLYMER INHIBITING CARBONATE MUD «POLYCARB BIO»

«POLYCARB BIO» - is clay-free flushing fluid for primary tailing-in and drilling horizontal sections.

Application
Tailing-in with medium and high permeability with the purpose of preserving its physical and chemical characteristics.

Features and advantages
- ability of selection inhibitive additive
- wide range adjustable rheological features
- low filter value
- usage as calcium carbonate colmatant of calculated fractional composition
- convertible hydrophobic ability in relation to surface of layer pore channels
- minimum reduction of bottomhole formation zone permeability
- usage of environmentally safe reagents
- 100% destruction at acidizing

Main parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.06 – 1.40</td>
</tr>
<tr>
<td>Relative viscosity, s</td>
<td>45-65</td>
</tr>
<tr>
<td>Filtration rate, ml/30 min</td>
<td>6</td>
</tr>
<tr>
<td>HPHT, ml/30 min</td>
<td>12</td>
</tr>
<tr>
<td>Plastic viscosity, cP (mPa-s)</td>
<td>15</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>15-35</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>5-10/8-20</td>
</tr>
<tr>
<td>pH</td>
<td>8-9.5</td>
</tr>
<tr>
<td>MBT, kg/m³</td>
<td>30</td>
</tr>
<tr>
<td>Solids content, %</td>
<td>6</td>
</tr>
<tr>
<td>Total hardness, mg/l</td>
<td>200</td>
</tr>
<tr>
<td>Chloride Cl- content, mg/l</td>
<td>15000-30000</td>
</tr>
</tbody>
</table>

Influence of muds to reduction of bottomhole formation zone permeability to oil with different inhibitors

<table>
<thead>
<tr>
<th>Mud type / Core sample</th>
<th>Lfiltration, mm</th>
<th>Pbreak-off, psi/atm</th>
<th>βresidual, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>«POLYCARB BIO» (4% KCl) / kabs = 41.15 mD</td>
<td>205</td>
<td>91.2</td>
<td>85.9</td>
</tr>
<tr>
<td>«POLYCARB BIO» (3% NaCO₂H) / kabs = 41.18 mD</td>
<td>220</td>
<td>91.9</td>
<td>71.2</td>
</tr>
</tbody>
</table>

Note:
Lfiltration - depth of killing fluid filtrate invasion to core sample;
Pbreak-off - pressure of initiation of oil stimulation treatment after mud effect;
βresidual - restoration of oil permeability after imitation secondary tailing-in in relation to layer permeability before mud effect.

«POLYCARB BIO» system is successfully used on Western and East Siberian, Tatarstan, Bashkortostan, Orenburg and Samara regions.
OIL BASED MUD «EMULCARB»

«EMULCARB» - set of invert-emulsion drilling muds preserving in-place permeability.

Application
Systems are used for tailing-in, drilling out water-sensitive clays and water soluble (anhydrite, gypsum, salts) formations, for drilling wells with high inclination angle and horizontal bores.

Main parameters

<table>
<thead>
<tr>
<th>System</th>
<th>Hydrocarbon bases</th>
<th>Attitude hydrocarbon/water</th>
</tr>
</thead>
<tbody>
<tr>
<td>«EMULCARB D»</td>
<td>Diesel</td>
<td>60/40</td>
</tr>
<tr>
<td>«EMULCARB M»</td>
<td>Mineral or hydraulic oil</td>
<td>70-80/30-20</td>
</tr>
<tr>
<td>«EMULCARB ECO»</td>
<td>Complex ester</td>
<td>80/20</td>
</tr>
</tbody>
</table>

«EMULCARB D» features
- Because of low water-oil ratio requires less expenditures connected with preparation
- Has low solidification temperate (less than -30°C)
- Appropriate for drilling wells with low formation temperature
- Has low plastic viscosity and high yield point which provide good cutting transport and mud cleaning on the surface
- Provide effective drilling of directional wells by means of provision stability of wellbore and high lubricating features decreasing probability of drill pipe sticking
- Minimizes contamination of productive formation

«EMULCARB M» features
- Appropriate for drilling wells with high formation temperature
- High flash-point and low solidification temperature lighten work with hydrocarbon
- Provides effective directional wells drilling
- Allows maximally preserve reservoir properties and in future lighten formation fluid retrieval

«EMULCARB ECO» features
- Drilling mud system based on compound ethers for drilling in conditions of exclusive environmental requirements
- Takes to account environmental constituent at elimination of waste
- Can be used at drilling well with big horizontal displacement and horizontal wells, and also at tailing-in
- Has better lubricating features than oil based muds and excludes the ability of sticking
- Especially effective for works in wells with complicated profile and horizontal ending.
After drilling and system regeneration EMULCARB systems can be kept a long time or can be used as follows:

- Again on another wells
- As fluid for conservation of well
- As a packer fluid
- For processing and preparation water based muds as an effective lubricating and anticorrosion additive
- In well workover as a process fluid

**Advantages of EMULCARB systems**

- Well productivity preservation
- Reduction of torque and frictional force
- Increasing of ROP
- Provision of wellbore walls stability
- Ability of reutilization
- High thermal stability
- Possibility of drilling depleted reservoirs
- Sticking management
- Low corrosive activity

**Main parameters**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.06 – 1.40</td>
</tr>
<tr>
<td>Electrical stability at 50°C, V</td>
<td>&gt;300</td>
</tr>
<tr>
<td>HPHT Filtration (T=100°C, ΔP=35atm), ml/30 min</td>
<td>&lt;4</td>
</tr>
<tr>
<td>Plastic viscosity at 50°C, cP</td>
<td>20-40</td>
</tr>
<tr>
<td>Yield point at 50°C, lbs/100 ft²</td>
<td>10-20</td>
</tr>
<tr>
<td>Gel strength 10s/10min at 50°C, lbs/100 ft²</td>
<td>3-10/4-15</td>
</tr>
<tr>
<td>Excess lime content, kg/m³</td>
<td>&gt;8</td>
</tr>
<tr>
<td>Activity</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Influence of emulsion to reduction of bottomhole formation zone permeability to oil**

<table>
<thead>
<tr>
<th>Mud type / Core sample</th>
<th>Lfiltration, mm</th>
<th>Pbreat-off, psi/atm</th>
<th>βresidual, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMULCARB D (40°C) / kabs = 24.7 mD</td>
<td>53</td>
<td>-/-</td>
<td>99.8</td>
</tr>
<tr>
<td>EMULCARB M (40°C) / kabs = 65.1 mD</td>
<td>41</td>
<td>-/-</td>
<td>97</td>
</tr>
<tr>
<td>Emulsion (mixture of oil and diesel) (40°C) /kabs = 2500 mD</td>
<td>69</td>
<td>8/0.5</td>
<td>100</td>
</tr>
</tbody>
</table>

**Note:**

- Lfiltration - depth of killing fluid filtrate invasion to core sample;
- Pbreat-off - pressure of initiation of oil stimulation treatment after mud effect;
- βresidual - restoration of oil permeability after imitation secondary tailing-in in relation to layer permeability before mud effect.

**EMULCARB** successfully passed filed trials in Western Siberia.

Cuttings during drilling with PDC bits using «EMULCARB M» mud
«SULFOBIT» is the drilling mud which includes special bituminous based reagent processed by means of special technology. This reagent is the clay slates swelling inhibitor, it prevents caving formation in the unstable formations (argillites) intervals, considerably improves lubricating features and decreases filter value.

Application
«SULFOBIT» fluid system is good for drilling fractured reservoirs and in swelling clay slates. Inhibiting and stabilizing effect can be reached by means of occlusion micro fissures in clays. Besides, on walls is created rubber-like oil-permeable cake preventing filtrate invasion but not deteriorating residual permeability during stimulation.

Addition of special component increases thermal stability of reagents and allows using solution at temperatures up to 160°C.

Features and advantages
- Prevents and considerably decreases caving formation of unstable formations (argillites) by means of inhibiting effect
- has low cake friction coefficient
- Environmentally safe – does not contain environmentally hazardous reagents
- has high thermal stability
- Does not affect logging results
- Nearly does not deteriorate primary production characteristics

Main parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.06 – 1.35</td>
</tr>
<tr>
<td>Relative viscosity, s</td>
<td>45 – 65</td>
</tr>
<tr>
<td>Filter value, ml/30 min</td>
<td>6</td>
</tr>
<tr>
<td>HPHT, ml/30 min (T=100°C, ΔP=35atm),</td>
<td>12</td>
</tr>
<tr>
<td>Plastic viscosity, cP (mPa-s)</td>
<td>15</td>
</tr>
<tr>
<td>Yield point, lb/100ft²</td>
<td>5 – 35</td>
</tr>
<tr>
<td>Gel strength10s/10min, lb/100ft²</td>
<td>5 – 10 / 8 – 20</td>
</tr>
<tr>
<td>pH</td>
<td>8.0 – 9.5</td>
</tr>
<tr>
<td>MBT, kg/m³</td>
<td>30</td>
</tr>
<tr>
<td>Solids content, %</td>
<td>6</td>
</tr>
<tr>
<td>Total hardness, mg/l</td>
<td>200 – 2000</td>
</tr>
</tbody>
</table>

Influence of mud to reduction of bottomhole formation zone permeability to oil

<table>
<thead>
<tr>
<th>Mud type / Core sample</th>
<th>Lfiltration, mm</th>
<th>Pbreak-off, psi/atm</th>
<th>βresidual, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>«SULFOBIT» / kabs = 537 mD</td>
<td>389</td>
<td>19.2/1.3</td>
<td>93.9</td>
</tr>
<tr>
<td>«SULFOBIT» / kabs = 37.2 mD</td>
<td>201</td>
<td>128/8.8</td>
<td>97.6</td>
</tr>
</tbody>
</table>

Note:
Lfiltration - depth of killing fluid filtrate invasion to core sample;
Pbreak-off - pressure of initiation of oil stimulation treatment after mud effect;
βresidual - restoration of oil permeability after imitation secondary tailing-in in relation to layer permeability before mud effect.

«SULFOBIT» system is successfully used on Western and East Siberian, Tatarstan, Bashkortostan, Orenburg and Samara regions.
GEL-EMULSION DRILLING MUD «MULTIBUR»

«MULTIBUR» - gel-emulsion mud with increased inhibiting ability. By means of use ferrous salt there can be achieved density up to 1500 kg/m³. Because of absence of Mil-Bar the mud perfectly suits for tailing-in.

Application
For drilling different types of wells containing elongated intervals of active clays, unstable and avalanching clays and for tailing-in.

Features
• the use of inhibiting by bivalent positive ions allows provision of filtrate activity lower than fluids activity which saturate clay rocks, this leads to dehydration of bottomhole formation zone and excludes clay minerals swelling
• increased lubricating feature and wellbore walls stability is achieved by using 1st sort emulsion
• high quality of wellbore cleaning is provided by using specially selected non-ionic polymers, structure-forming agents and filtrate agents
• presence of specially selected fractional calcium carbonate leads to minimal filtrate invasion and solid phase and provide minimal effect to reservoir properties of productive formation

Advantages
• high inhibiting ability
• low filter value
• good lubricating features
• relatively low cost
• preservation of productive formation permeability
• wide range of densities without using Mil-Bar
• Secondary use is possible
• Prevents generation of colloidal clay phase and total mud volume
• Provided hih ROP – 35% more in comparison with conventional inhibiting biopolymer mud

It is possible to prepare on fresh, highly mineralized layer and sea water.
Main parameters (API)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.3 - 1.50</td>
</tr>
<tr>
<td>Relative viscosity, s</td>
<td>35-55</td>
</tr>
<tr>
<td>Filtration rate, ml/30 min</td>
<td>4-7</td>
</tr>
<tr>
<td>Plastic viscosity, cP (mPa-s)</td>
<td>40</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>20-50</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>15-20/9-10</td>
</tr>
<tr>
<td>pH</td>
<td>8-9</td>
</tr>
<tr>
<td>MBT, kg/m³</td>
<td>40</td>
</tr>
<tr>
<td>Solids content, %</td>
<td>15</td>
</tr>
</tbody>
</table>

Economy
By means of improved inhibiting, lubricating, capillary action on wellbore walls, «MULTIBUR» according its operational properties is equal to OBM, but exceeds it according to cost performance.

MUD IMPACT ON REVELATION OF PRODUCTING HORIZON
Developed mud leads to minimal contamination of productive layer flush with OBM.

<table>
<thead>
<tr>
<th>Mud type</th>
<th>Core sample kabs, mD</th>
<th>βresidual, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>«MULTIBUR»</td>
<td>831</td>
<td>93,9</td>
</tr>
<tr>
<td>OBM</td>
<td>2500</td>
<td>97,6</td>
</tr>
</tbody>
</table>

Note:
βresidual - restoration of oil permeability after imitation secondary tailing-in in relation to layer permeability before mud effect.

«MULTIBUR» system is successfully used on Western and East Siberian, Tatarstan, Bashkortostan, Orenburg and Samara regions. More than 150 wells were drilled in different geological conditions.

Using MULTIBUR system were drilled a dozen of horizontal wells with successful tripping-in of BHA for multistage hydraulic fracturing – this is the evidence that in Russia there is cost-effective technology of drilling wells in argillaceous layers with developing slate oil.
LIME MUDS

Lime muds are inhibiting calcareous systems containing lime and gypsum as suppliers of kalium ions, the action of which is based on conversion of natrium clay to calcium clay and prevention the transferring of drillied out formation to natrium, as a result of which hydration and swelling of clay-containing formations is reduced.

Application
Drilling in intervals of unstable clay-containing formations in conditions of carbon dioxide aggression and high temperatures.

Features
In consequence of low solubility of hydroxide and calcium sulfate lime and gypsum muds are self-adjusting systems. Content of calcium in it is almost permanent because lime and calcium sulphate are added to mud in plenty.

Advantages
- high inhibiting ability
- thermal stability up to 160°C
- permanent content of Ca2+ in mud filtrate
- low filter value
- ability of receiving muds with high density (up to 2.2 g/cm³)
- long-term stability to biological degradation
- High electrical resistance (≥0.5 ohm·m)
- Qualitative cleaning of hole from cuttings
- Increased solids-carrying capacity under static condition

Main parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.10-2.20</td>
</tr>
<tr>
<td>Relative viscosity, s</td>
<td>40-60</td>
</tr>
<tr>
<td>Filtration rate, ml/30 min</td>
<td>4-5</td>
</tr>
<tr>
<td>Plastic viscosity, sP</td>
<td>20-50</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>25-80</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>12-20/15-45</td>
</tr>
<tr>
<td>pH</td>
<td>9.0-9.5</td>
</tr>
<tr>
<td>MBT, kg/m³</td>
<td>35</td>
</tr>
<tr>
<td>Chloride content Ca2+, mg/l</td>
<td>200-3000</td>
</tr>
</tbody>
</table>

Developed mud passed successful trials in Stavropol Territory, Orenburg and Samara regions.
Fluid is based on sulphonated synthetic acrylic copolymers.

Application
Purposed for drilling in conditions of high bottomhole temperatures (up to 246°C) and high mineralization, polymineral and sulphureous aggression.

Features
At recipe making up of thermal and salt-resistant drilling mud are used four key reagents:
- Clay slates swelling inhibitor - in preference to inorganic salt.
- Acrylamide copolymers – filtration and rheology regulators.
- Sulphonated asphalt – filtration and rheology regulators.
- Bentonite - for creation filter cake and mud structure.
- Thermal resistant flocculant based on tannin – viscosity regulator.

Main parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>2,0 – 2,1</td>
</tr>
<tr>
<td>PV, cP (MPa·s)</td>
<td>40-45</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>25-35</td>
</tr>
<tr>
<td>Effective viscosity, cP (mPa·m)</td>
<td>55-60</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>4-6/6-8</td>
</tr>
<tr>
<td>n</td>
<td>0.68</td>
</tr>
<tr>
<td>k, cP</td>
<td>513,47</td>
</tr>
</tbody>
</table>
MUD ON THE BASIS OF POLYSACCHARIDES SATURATED WITH SODIUM CHLORIDE

Application
It is designed for drilling different wells in conditions of high mineralization and which contain long intervals of halite deposits.

Features
It contains the set of salts which prevent the increase of sodium chloride solubility with increase of temperature. Because of high inhibiting ability the mud can be used for drilling at once several intervals including productive formations which reduce exonomic expenses and allows avoiding technological process of changing one mud to another.

Advantages
• Low filter value
• Wide density range
• Secondary use is possible
• Prevents generation of colloidal clay phase and total mud volume
• Resistance to bivalent ions salts
• Provides the ability of qualitative tailing-in
• Possible to prepare on fresh, highly mineralized layer and sea water.

Main parameters
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.23–2.20</td>
</tr>
<tr>
<td>Filter value, ml/30min</td>
<td>4–7</td>
</tr>
<tr>
<td>Plastic viscosity, cP (mPa·s)</td>
<td>30–60</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>20–40</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>10–20/15–30</td>
</tr>
<tr>
<td>pH</td>
<td>8.0–9.0</td>
</tr>
</tbody>
</table>

DEVELOPED IN “BURINTEKH”, LTD SALT SATURATED POLYSACCHARIDES BASED MUD IS WIDELY USED ON THE FIELDS OF ORENBURG REGION FOR DRILLING HALITE DEPOSITS.
SALT-SATURATED MUD WITH THERMAL STABILITY UP TO 150°C

SODIUM CHLORIDE SATURATED MUD BASED ON SULPHONATED ACRYLIC COPOLYMERS WITH THERMAL STABILITY UP TO 150°C.

Application
It is designed for drilling different wells in conditions of high mineralization and which contain long intervals of halite deposits.

Features
It contains the set of salts which prevent the increase of sodium chloride solubility with increase of temperature. Because of high inhibiting ability the mud can be used for drilling at once several intervals including productive formations which reduce exonomic expenses and allows avoiding technological process of changing one mud to another.

Advantages
• Low filter value
• Wide density range
• Prevent temperature thickening of mud
• Secondary use is possible
• Prevents generation of colloidal clay phase and total mud volume
• Resistance to bivalent ions salts
• Possibility of use in conditions of high bottomhole temperatures and pressures

Main parameters
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.23-2.20</td>
</tr>
<tr>
<td>Filter value, ml/30min</td>
<td>4-7</td>
</tr>
<tr>
<td>Plastic viscosity, cP (mPa·m)</td>
<td>30-60</td>
</tr>
<tr>
<td>Yield point, lbs/100 ft²</td>
<td>20-40</td>
</tr>
<tr>
<td>Gel strength 10s/10min, lbs/100 ft²</td>
<td>10-20/15-30</td>
</tr>
<tr>
<td>pH</td>
<td>8.0-9.0</td>
</tr>
</tbody>
</table>
PRIME OBJECTIVE OF SELECTION FLUID FOR KILLING AND WELL COMPLETION IS MINIMIZATION OF CONTAMINATION PRODUCTIVE FORMATION.

In most regions with low formation pressures are used kalium, natrium and calcium chloride brines which give the ability to prepare fluids with density from 1.02 to 1.36 g/cm³. In cases where required fluids with density higher than 1.36 g/cm³ wide range was found by calcium, natrium and zinc bromide salts, and recently also solutions based on sodium, kalium and cesium formats. Among standard operations which use clean brines are killing, fishing operations, perforation, flushing, drilling and washing up gravel-packed filter and also preparation of packer fluids. For performing necessary functions completion fluids must render backpressure to productive formation, transport solid particles, bring minimal contamination to productive formation, be stable on the surface and in bottomhole conditions, be environmentally benign or to be used at controllable effect to environment the use of such fluids must be economically feasible.

Main features of completion fluids based on salts are density, content of mechanical admixtures and solidification temperature. Intended density in required for controlling formation pressure. Transparency or content of mechanical admixtures is defined with the purpose of controlling contamination of productive formation and punched holes. Solidification temperature defines ability of use brines in different weather conditions.

<table>
<thead>
<tr>
<th>INORGANIC SALTS IN USE</th>
<th>Density, g/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
</tr>
<tr>
<td>HCOONa</td>
<td>1.1</td>
</tr>
<tr>
<td>CaCl2</td>
<td>1.08</td>
</tr>
<tr>
<td>NaBr</td>
<td>1.2</td>
</tr>
<tr>
<td>NaCl/NaBr</td>
<td>1.2</td>
</tr>
<tr>
<td>K2CO3</td>
<td>1.2</td>
</tr>
<tr>
<td>HCOOK</td>
<td>1.3</td>
</tr>
<tr>
<td>CaBr2</td>
<td>1.40</td>
</tr>
<tr>
<td>CaCl2/ CaBr2</td>
<td>1.4</td>
</tr>
<tr>
<td>CaBr2/ ZnBr2</td>
<td>1.68</td>
</tr>
<tr>
<td>CaCl2/CaBr2/ZnBr2</td>
<td>1.7</td>
</tr>
<tr>
<td>ZnBr2</td>
<td>2.30</td>
</tr>
<tr>
<td>HCOOC2</td>
<td>1.73</td>
</tr>
</tbody>
</table>
TEMPORARY BLOCKING COMPOSITION “BURINTEKH BLOCK COMPOSITION” (BBC)

COMPOSITION REPRESENTS CONCENTRATED SUSPENSION FOR PREPARATION PROCESS FLUID WHICH INCLUDES POLYMER THICKENERS AND FILTRATE AGENTS ENCLOSED IN SYNTHETIC INERT HYDROCARBON LIQUID, AND MIXTURE OF SURFACTANTS FOR INCREASING OIL PERMEABILITY OF WATERED ROCKS OF BOTTOMHOLE FORMATION ZONE.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th><strong>Appearance</strong></th>
<th>Uniform fluid from white to creamy color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density of product water solution with concentration</td>
<td>1.0-1.1</td>
</tr>
<tr>
<td>5.4% mass at 20ºC, g/cm³</td>
<td></td>
</tr>
<tr>
<td>Relative density of product water solution with concentration mass 5.4%, sec</td>
<td>100</td>
</tr>
</tbody>
</table>

Area of application

It is designed for temporary blocking productive formations during remedial cementing and workover operations.

Advantages

- Provides colmatation of reservoir by means of quick creation of thin, dense, impermeable cake for reducing productive formation contamination
- Filtrate has inhibiting action in relation to reservoir which does not damage permeability
- Easy-to-prepare if conventional mud mixing system is available
- Minimum affect to bottomhole formation zone and high rate of filtration properties recovery
- Makeup time reduction
- Easy removal of filter cake after job completion
- Complete compatibility with formation fluids and minerals.

Method of application

Working concentration is 54 kg/m³ from the volume of makeup water. The estimated amount of water is taken to a tank and the corresponding quantity of BBC is added, mix till complete polymers mixing. Add 40 kg/m³ potassium chloride and necessary quantity of calcium carbonate with selected fractional composition. Mix the mixture till the uniform state.

Toxicity and handling

It should be handled in accordance with industrial chemical agents general rules of transportation, storage and use. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

Packing and storage

Metal or plastic barrels. It is recommended to store in dry cool place. Reagent preserves its properties at freezing and subsequent defrosting.
PLUGGING MIXTURE IS POWDER-LIKE COMPOSITION OF EFFECTIVE POLYMER AND NONORGANIC COLMATANTS IN SYNERGIC MIXTURE WITH STITCHER AGENT DISTRIBUTED IN INERT LIQUID CARRIER.

Application
For lost circulation control by means of isolation formations with absorption intensity up to 40 m³/hour.

Features
- Supplied directly to lost circulation zones and after entering the permeable formation it within 10-20 minutes intensively absorbing water increases 5-10 times in size plugging up lost circulation zones.
- Creates firm, elastic, impermeable cake on the high permeability formation surface.

Advantages
- Material availability. All reagents are of home manufacture and used in drilling.
- Simplicity of use. This composition does not require special equipment for preparing and use.
- High effectiveness. Quick and effective isolating of formation with high permeability.

Lab tests on ceramic filters with permeability 5D, which flow characteristics are like formation characteristics with absorbing power up to до 40 m³/h showed that within 10 minutes from the beginning of test the is observed ultimate termination of filtration and on the surface of filter is created hard impenetrable cake.

Main components
- Polymer Colmatant gelling agent - Hard, noncrystalline white or partially transparent water-soluble powder. Molecular weight is up to 5 500 000. Used as gelling agent and encapsulant. Combined with reagent-stitcher makes hard elastic gel.
- Colmatant of non organic type - Foliate superfine aluminum silicate with high hydrophilic property. In hydration water penetrates in interlaminar space of reagent, hydrate its surface and exchangeable cations what causes swelling. In further watering makes stable viscous suspension with expressed thixotropic properties.
- Reagent-stitcher - Complex compounds of transition metal double salts III-VIII groups.
COMPOUND FOR BOTTOMHOLE FORMATION ZONE CHEMICAL CLEANING “BREAKER”

COMPOUND REPRESENTS THE MIXTURE OF SEVERAL COMPONENTS: COMPLEXONATES AND OXIDIZERS. THERE ARE POSSIBLE POWDER-LIKE ACID ADDITIVE, SURFACTANTS, MONOVALENT METAL CHLORIDES AND ORGANIC INHIBITORS. IT IS DESIGNED FOR REMOVING FILTER CAKES AND BFZ CHEMICAL CLEANING AFTER PRIMARY TAILING-IN.

Features and properties
- Uniform and complete cleaning of wellbore from filter cake along the whole openhole section
- Low corrosive activity – as distinct from conventional method of acidization
- Ecological safety and low reagent toxicity
- Adjustable filter cake removal rate
- Can be used in wide range of temperatures and pH values
- Powder-like reagents which are easy to use are mainly used in compound
- It allows destroying filter cake which includes both natural (starch, xanthan gum) and semisynthetic (PAC) polymers.

Engineering recommendations
Reagents are added in the following sequence and concentration:
1. Complexonates – 5-10% (50-100kg/m³)
2. Sodium hydroxide – 0-7% (0-70kg/m³) (depending on required pH)
3. Oxidizers – 1-2% (10-20 kg/m³)
4. Possible to add powder-like acids – 2-10% (20-100kg/m³)
5. Possible to add monovalent metal chlorides and organic inhibitors for provision necessary density and inhibiting action on clay
6. Possible to add mixtures of surfactants – 0,05-0,3% (0,2-3kg/m³)

Concentraions of reagents in the compound and the compound pH depend on required filter cake removal rate and mud used for primary tailing-in. Increase of reagents concentration and pH reduce below 7 boost filter cake removal rate.

Limitations
For preparation of compound do not use water with high content of calcium and magnesium salts (not more than 500mg/l Ca or Mg).
Does not destroy synthetic polymers (PHPA, NaPA).
In case of using surfactants before introducing to well it is mandatory to conduct pilot test for emulsion creation with oil or kerosene.

Packing and storage
Multilayer 25kg paper bags. By agreement with the xlient it is admissible to pack to consumer’s packing which does not deteriorate product.
CORE BARREL INSULATING FLUID «IZOKOR»

«IZOKOR» represents a solution of high-molecular compound in polyatomic alcohols.

Main properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Light liquid. Light inclusions as precipitation is admissible</td>
</tr>
<tr>
<td>Density at 20 °C, g/cm³</td>
<td>1,00</td>
</tr>
<tr>
<td>Plastic viscosity, cP</td>
<td>50</td>
</tr>
<tr>
<td>Filtration rate, ml/30min</td>
<td>5,0</td>
</tr>
</tbody>
</table>

Application

IZOKOR is purposed for recovery isolated core by means of protecting core from contaminating during its retrieving, processing core surface and transportation. During drilling ISOKOR encapsulates drilling-out core by means of viscous noninvasive protective film and protects core from mud filtrate invasion. The received sample of core material is more representative with respect to defining necessary characteristics (water saturation, water affinity, etc).

Advantages

• it has viscoelastic properties and has moving consistency of gel
• it has well lubricating ability and provides friction coefficient decrease in contact core – core receiver
• a total absence of hydrocarbons and water
• Does not exert influence on flushing fluid and circulation system units (pumps, vibroscreens, hydro clones)
• Does not penetrate core

Engineering recommendations

IZOKOR is loaded directly to core tube of barrel before core recovery. The loading of necessary fluid volume is made up to complete filling of core tube and calculated depending on volume and quantity of sections of core tube for core recovery. Directly in the process of core recovery the reagent, which is displaced by core, is mixed with mud and transported to the surface where it is removed by mud cleaning system.

Transportation and storage

Plastic canisters with screw lids with capacity 20-30 liters. By agreement with the xlient it is admissible to pack to consumer’s packing which does not deteriorate product.
1.2 REAGENTS FOR MUDS
ANIPOL LV

HIGH QUALITY MODIFICATION OF POLYANIONIC CELLULOSE (PAC) WITH LOW MOLECULAR WEIGHT.

Area of application
It is used for decreasing water loss with little to no increase of viscosity in any water based muds; often effectively dilutes salt muds. Promotes developing thin, compact, elastic and low permeability filter cake decreasing invaded zone.

Advantages
• Economic and effective – small additives are enough to decrease filter value
• Does not affect solution viscosity
• Resistant to calcium and magnesium salts aggression (up to 1000mg/l Ca2+)
• Stable to most solution contaminants
• Effective in wide pH range
• Stable to bacterial decomposition
• Compatible with all other reagents for mud treatment
• Nontoxic

Limitations
Effectiveness of reagent reduces at downhole temperatures over 149°C.

Method of application
Recommended concentration of reagent is 1 – 5 kg/m³ for most of solutions (for salt saturated and potassium solutions is recommended to increase concentration up to 8 – 12 kg/m³).
For achieving the best result reagent must be added through conventional funnel for muds slowly and uniformly with the speed approximately 1 sack per 20 minutes for avoiding unstirred flakes and possible loss of product on screens.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Free-flowing powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>Min 80%</td>
</tr>
<tr>
<td>Degree substitution</td>
<td>Min 1,0 – 1,2</td>
</tr>
</tbody>
</table>

Packing
Multilayer paper bags with plastic covering 22,7 kg each.
ANIPOL HV

HIGH QUALITY MODIFICATION OF POLYANIONIC CELLULOSE (PAC) WITH HIGH MOLECULAR WEIGHT.

Area of application
Polymer additive Purposed for stabilizing and controlling structural-mechanic properties and filtration characteristics of any drilling fluid systems on water basis with any salt load.

Advantages
- Can be used simultaneously as thickener and drill mud filtration agent
- Improves muds thermal stability
- Resistant to calcium and magnesium salts aggression (up to 1000mg/l Ca2+)
- Stable in the range of pH 6-14
- Provides muds the optimal structural and rheological properties and high cutting-carrying capacity
- Non toxic

Limitations
Effectiveness of reagent reduces at downhole temperatures over 149°C.

Method of application
Concentration of reagent depends on necessary filtration control and on mud salinity. Optimal concentrations are within 1,4 – 5,7 kg/m³.
Reagent is to be brought directly to mud agitator with the speed 1 sack per 20 minutes for avoiding unstirred flakes and possible loss of product on screens.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Free-flowing powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base material</td>
<td>Min 85%</td>
</tr>
<tr>
<td>Degree substitution</td>
<td>Min 1,0</td>
</tr>
</tbody>
</table>

Packing
Multilayer paper bags with plastic covering 22,7 kg each.
MULTISTAR

HIGH QUALITY MODIFIED STARCH FOR DRILLING.

Area of application
Filter agent of fresh, mineralized and highly mineralized process liquids containing bivalent metals Ca and Mg used for oil and gas wells drilling and workover operations.

Advantages
- Easily disperses in fresh water and salt solutions
- Not subject to exposure of dissolved salts up to saturation
- Hydrates and swells providing filtration control in all water based muds
- Reduces the risk of damaging producing formation
- Has minimal thickening capability
- Biodegradable

Limitations
Effectiveness of reagent reduces at downhole temperatures above 120°C. To prevent fermentation it is necessary to add biocide in standard concentration.

Method of application
Average concentration of starch must be from 5,7 to 17,1 kg/m³. When using in semimineralized muds to prevent fermentation it is necessary to add biocide in standard concentration.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Loose powder from white to feebly yellow or greyish color</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (1% water solution)</td>
<td>Neutral</td>
</tr>
<tr>
<td>Biological stability (test)</td>
<td>Minimum 3 days</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>672 kg/m³</td>
</tr>
</tbody>
</table>

Engineering recommendations
When using in mineralized muds the average concentration of starch must be from 5 to 30 kg/m³.

Packing
20 or 25 kg multilayer paper bags.
BIOPOL

POWDER-LIKE DISPERSING BIOPOLYMER OF XANTHAN TYPE.

Area of application
Thickening and structuring in fresh and sea water based muds, and brines.

Advantages
- Easily disperses in fresh water and in brines
- Minimal concentrations of reagent (0.2-0.3%) considerably improve thixotropic and rheological properties of muds with different salt load
- Provide perfect cuttings and weight materials retention in suspension without using clays
- Reduce the risk of damaging production formation
- Biodegradable

Limitations
Reagent effectiveness reduces at bottomhole temperatures above 130°C.

Method of application
Reagent is added in concentration 0.3 – 5.7 mg/m³ as necessary for receiving necessary viscosity and parameters for maintaining suspended conditions of other additives.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Fine powder from white to creamy color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>Not more than 13%</td>
</tr>
<tr>
<td>Seawater Brookfield viscosity at 1,5 rpm</td>
<td>Not less than 1 950 sP</td>
</tr>
<tr>
<td>Starch, guar admixtures</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Toxicity and handling
Nontoxic, refers to 4 class of hazard substances under GOST 12.1.007 (low hazardous).

Packing
25 kg multilayer bags.
SYNPOL HV

SYNTHETIC HYDROLYZED POLYACRYLAMIDE/POLYACRYLATE COPOLYMER WITH HIGH MOLECULAR WEIGHT HAVING HIGH ADSORPTION CAPABILITY TO CLAYISH SURFACE.

Area of application
It can be used in clay-free and low clay fresh and salt water based muds as well as potassium chloride salt-saturated muds as a thickening agent and clay encapsulant. Standard concentration rage in such solutions is 1.5-5 kg/m³.

While drilling big diameter wells it is often used for preparation viscous packs for return coarse slurry. To prepare viscous pack it id enough to pour 3-4 liters of concentrated (30%) polymer solution to drill pipes during round-trip operations or during connection.

Advantages
- Reduces bit balling
- Increases mud rheology properties
- Improves mud lubricating capacity when circulating at low pressure
- Provides stability of wellbore which contains unstable rocks
- Flocculates drilling cuttings
- When using in weighted muds it helps improving filter cake quality and reduce mud filtration
- Effective in small concentrations and when controlling viscosity and water loss
- Effective in muds with moderate and high pH value
- Does not require the use of bactericide

At first addition the intensive flocculation and thickening of mud can be observed, with increase of concentration and complete encapsulation of active solid phase the mud viscosity reduces to normal. To avoid excessive viscosity increase it is recommended to use reagent in muds containing at least 40 kg/m³ of bentonite.
Limitations
- Effectiveness of reagent reduces at bottomhole temperature above 150°C. Thermal stability limit is about 175°C.
- Reagent chemically reacts with polyvalent cations (calcium, magnesium, iron and chrome ions). At high concentrations of such ions (more than 300mg/l) total and partial precipitation of polymer is possible.
- Before drilling-out cement plugs and shoes it is recommended to treat mud with sodium bicarbonate and lignite, keep alkalinity and hardness at minimum level.
- When drilling wells with high content of H2S it is recommended to use reagents for binding H2S (zinc oxide or carbonate).
- Optimal level of pH is 8.5 – 10.5. High alkalinity of mud can lead to polymer hydrolysis with release of ammonia.
- Polymer is subject to mechanical destruction at high loads (downhole motors, nozzles, rotary pumps) which reduces viscosity but not reflected in inhibiting and encapsulating properties.
- Simultaneous addition of reagent, caustic, lime and organic diluting agents (ferro-chromelignosulfonate and lignites) should be avoided, in this case it is recommended to add SYNPOL after all others.

Method of application
Reagent should be added in concentration 0.3 – 1.4 kg/m³ through mud hopper. It can be added directly to circulation system through hopper or by means of preparation of concentrated polymer solution in separate tank for further dilution. The most effective way is to add polymer solution by thin jet to active tank during circulation.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Loose powder from white to creamy color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
<td>1,070 – 1100 kg/m³</td>
</tr>
<tr>
<td>Toxicity</td>
<td>Nontoxic</td>
</tr>
<tr>
<td>Degree of hydrolysis</td>
<td>Minimum 30%</td>
</tr>
<tr>
<td>Base material</td>
<td>Minimum 95%</td>
</tr>
</tbody>
</table>

Packing
25 kg multilayer paper bags.
SYNTHETIC SODIC POLYACRYLATE POLYMER WITH LOW MOLECULAR WITH HIGH ANIONIC CHARGE DENSITY

Area of application
Filtration reduction of fresh water based muds, muds with low solids content, weighted, clay free and low clay inhibiting systems. Most effective in fresh water systems.

Advantages
• Sodium polyacrylate molecules adsorbs in clay particles and bind them thus creating a net from polymer and clay on wellbore walls and effectively reducing mud filtration
• Stabilizes viscosity in undispersed systems
• Provides mud stability at high temperatures (minimum up to 200°C)
• Reduces concentration of gel and yield point with small influence on plastic viscosity
• Provides low fluid loss in muds which require big quantities of water for dissolution
• In low concentrations (up to 1,4 kg/m³) can exert flocculating effect on clay.

Limitations
• Reagent chemically reacts with polyvalent cations (calcium, magnesium, iron and chrome ions). At high concentrations of such ions (more than 300mg/l) total and partial precipitation of polymer is possible. It admits the presence of 500 mg/g of free calcium ions
• Before drilling-out cement plugs and shoes it is recommended to treat mud with sodium bicarbonate and lignite, keep alkalinity and hardness at minimum level.

Method of application
For filtration control it is recommended to keep concentration at 1,5 – 3 kg/m³. Higher concentration will induce viscosity increase.
For clay flocculation it is recommended to treat mud in lower concentrations about 0,3 kg/m³.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Loose powder of creamy color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
<td>1,070 – 1100 kg/m³</td>
</tr>
<tr>
<td>Toxicity</td>
<td>Nontoxic</td>
</tr>
<tr>
<td>Degree of hydrolysis</td>
<td>Minimum 30%</td>
</tr>
<tr>
<td>Base material</td>
<td>Minimum 95%</td>
</tr>
</tbody>
</table>

Packing
25 kg multilayer paper bags.
BIO XX (ORGANIC INHIBITOR)

EFFECTIVELY SUPPRESSES THE PROCESSES OF HYDRATION AND SWELLING OF CLAYS AND CLAYSTONES, PREVENTS FURTHER DISPERSION OF DRILLED-OUT CLAY SLUDGE AND HELPS DECREASE BALLING OF BHA PARTS AND BIT SLUDGING. BESIDES OF INHIBITING CLAYS AND CLAYSTONES THE REAGENT HELPS TO IMPROVE WELLBORE STABILITY, DECREASE THE PROBABILITY OF BALLING AND BIT SLUDGING, IMPROVE MUD CLEANING EQUIPMENT OPERATING EFFICIENCY.

Area and method of application
Reagent can be used in all types of water based drilling fluids. It does not require any additional equipment or special mud treating measures and can be added as directly to containers during preparation of mud, so through mixing hopper. Inhibits only non-dispersed clay particles therefore the mud must be processed with reagent before drilling clay rocks.
Recommended concentration of BIO XX in mud is – from 12 to 24 kg/m³. Optimal level of mud pH for providing maximal effectiveness is – 8-9. Practical concentration of reagent depends on type of clay rocks, well diameter, ROP and required inhibiting level.

Limitations
• If necessary to add bentonite to mud it should be preliminary hydrated in water
• During addition to mud with high content of fine active solids there can be seen short mud flocculating. Preliminary mud processing with liquefiers and deflocculants allows avoiding or removing such effect
• Thermal stability up to 150°C.

Toxicity and handling
It should be handled in accordance with general requirements of transportation, storage and use of industrial chemical agents. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Transparent or colorless fluid with amine flavor</td>
</tr>
<tr>
<td>Specific gravity, g/cm³</td>
<td>1.1 - 1.2</td>
</tr>
<tr>
<td>pH 1% solution</td>
<td>6.5 - 8.5</td>
</tr>
<tr>
<td>Solubility, %</td>
<td>100</td>
</tr>
<tr>
<td>Solidification point, not higher, °C</td>
<td>-18</td>
</tr>
<tr>
<td>Flash point, °C</td>
<td>99 (PMCC)</td>
</tr>
</tbody>
</table>

Packing and storage
BIO XX is supplied in plastic barrels of 215 liters. It is recommended to keep in dry cold place. Preserve its properties after freezing and subsequent defrosting.
**DPS (ANTI-BALLING DETERGENT)**

**DRILLING DETERGENT PDS REPRESENTS WATER MIXTURE OF SURFACE-ACTIVE MATERIALS AND PURPOSED FOR DECREASING SURFACE TENSION OF ALL WATER BASED DRILLING FLUIDS AND DECREASING TENDENCY TO CLAY PARTICLES BALLING.**

**Area and method of application**
- Effective in all types of water based muds of any mineralization
- Increase rate of penetration when using water based muds
- Reduce drilling tool friction on wellbore wall
- Improve filter cake, decrease filter value
- Prevent bit and BHA elements balling
- Prevent clay sludge dispersing
- Has an diluting effect upon clay mud

**Limitations**
Addition of reagent to mud directly during drilling when mud already gained enough quantity of solids (specific gravity >40 sec) will induce heavy thickening because of dispersing active clay component. To avoid this, the addition of reagent should be done only during preparation of fresh mud and renewal of volumes in recommended concentrations.

**Method of application**
- Optimal DPS concentration is 2 – 5 l/m³ depending on solids content in mud.
- In difficult conditions of drilling high-viscosity clays it is recommended to use concentrations up to 5 l/m³ for decreasing balling on bit and BHA; at higher concentration foam formation can be seen which will require the use of antifoaming additive.

**MAIN PHYSICAL PROPERTIES**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Nontransparent dark brown fluid with characteristic odor</td>
</tr>
<tr>
<td>Density at 20°C, g/cm³</td>
<td>1,00-1,10</td>
</tr>
<tr>
<td>pH at temperature 20°C</td>
<td>8,00-12,50</td>
</tr>
<tr>
<td>No-flow temperature, °C</td>
<td>Minus 12 (winter)</td>
</tr>
<tr>
<td>Water solubility</td>
<td>Mixing</td>
</tr>
</tbody>
</table>

**Packing and storage**
200 dm³ steel barrels with nominal weight 170kg. It preserves its properties when frozen and after subsequent defrosting.
BL SALT (LUBRICATING ADDITIVE)

REPRESENTS MIXTURE OF ADDITIVES AND FATTY ACID ETHERS IN HYDROCARBONS BASED ON PLANT AND MINERAL OILS.

Engineering recommendations
It is designed for processing salt and salt saturated muds with high content of monovalent or bivalent metal salts. Additive is recommended for water based muds in concentration 5 – 20 kg/m³.

Advantages
- Effectively reduces friction coefficient in highly mineralized muds
- Reduces the risk of differential sticking, reduces torques while rotating drill string
- Facilitates drilling tool movement, increases equipment lifetime
- Does not cause foaming
- Does not affect mud parameters
- Subject to quick bio destruction and non toxic

Limitations
- Not suitable for highly mineralized muds containing lime combining with pH>10
- At high concentration of solid phase the use of additive in concentration more than 2% can lead to slight rheology increase

Method of application
- For fresh and low mineralized muds the recommended concentration is 5 kg/m³. For muds with high content of sodium salts, potassium salts and calcium salts as well as salt saturated muds with high content of solid phase, calcium carbonate and barite the recommended concentration is 10-20 kg/m³.
- It is recommended to add lubricating additive to agitators or by means of mud hopper for effective dispersion of reagent and its uniform distribution throughout the mud volume.

Toxicity and handling
It should be handled in accordance with general requirements of transportation, storage and use of industrial chemical agents. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Oily fluid from light yellow to black color</td>
</tr>
<tr>
<td>Density at 20°C, g/cm³, not more</td>
<td>940</td>
</tr>
<tr>
<td>Kinematic viscosity at 40°C, mm²/s, not more</td>
<td>180,5</td>
</tr>
<tr>
<td>No-flow point, °C</td>
<td>-12</td>
</tr>
<tr>
<td>Lubricating capacity increase 0,3% of standard fresh bentonite solution, %</td>
<td>70</td>
</tr>
<tr>
<td>Lubricating capacity increase 1% of standard salt saturated NaCl solution, %</td>
<td>60</td>
</tr>
</tbody>
</table>

Package and storage
200 liters metal barrels. It is recommended to keep it in cold dry place. Preserves its properties when frozen and after subsequent defrosting.
LUBRICATION ADDITIVE FOR DRILLING FLUIDS BL REPRESENTS OLEAGINOUS FLUID OF BROWN COLOR CONSISTING OF MIXTURE SURFACE-ACTIVE MATERIALS AND ADDITIVES PRODUCED ON THE BASIS OF NATURAL MINERAL OIL.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Uniform oily fluid</td>
</tr>
<tr>
<td>Foaming activity, ml</td>
<td>10</td>
</tr>
<tr>
<td>Water index of 1% chemical product water solution</td>
<td>7 – 9</td>
</tr>
<tr>
<td>Lubricating capacity increase of 0.3% product in fresh mud</td>
<td>50</td>
</tr>
</tbody>
</table>

Application
It is designed for processing fresh and salt (up to 7%) muds during drilling vertical and directional sections of oil and gas wells. Additive is recommended for water based muds in concentration 3 – 20 kg/m³.

Advantages
- Effectively reduces friction coefficient of fresh and low-mineralized muds
- Reduces the risk of differential sticking, reduces torques while rotating drill string
- Facilitates drilling tool movement, increases equipment lifetime
- Does not cause foaming
- Easily disperses even in cold water, does not create problems with disposal, can be used in all drilling conditions, compatible with all chemical agents
- Resistant to hydrophobic coagulation

Limitations
- Not suitable for highly mineralized muds containing lime combining with pH>10
- At high concentration of solid phase the use of additive in concentration more than 2% can lead to slight rheology increase

Method of application
For fresh and low mineralized muds the recommended concentration is 3 kg/m³. Before entering formations with high clay rocks content (Alymskaya suite) it is recommended to increase concentration up to 15 - 20 kg/m³. Content of additive can be increased up to 30 kg/m³ in case of overpulls and stickings.
It is recommended to add lubricating additive to agitators or by means of mud hopper for effective dispersion of reagent and its uniform distribution throughout the mud volume.

Toxicity and handling
It should be handled in accordance with general requirements of transportation, storage and use of industrial chemical agents. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

Package and storage
200 liters metal barrels. It is recommended to keep it in cold dry place. Preserves its properties when frozen and after subsequent defrosting.
BL ECO (LUBRICATING ADDITIVE)

REPRESENTS MIXTURE OF ECOLOGICAL ADDITIVES AND PLANT ACID ETHERS IN HYDROCARBONS BASED ON PLANT OILS.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Oily fluid from light yellow to black color</td>
</tr>
<tr>
<td>Density at 20°C, g/cm³, not more</td>
<td>940</td>
</tr>
<tr>
<td>Kinematic viscosity at 40°C, mm²/s, not more</td>
<td>180,5</td>
</tr>
<tr>
<td>No-flow point, °C</td>
<td>-12</td>
</tr>
<tr>
<td>Lubricating capacity increase 0,3% of standard fresh bentonite solution, %</td>
<td>70</td>
</tr>
<tr>
<td>Lubricating capacity increase 1% of standard salt saturated NaCl solution, %</td>
<td>60</td>
</tr>
</tbody>
</table>

Application

It is designed for processing fresh and salt and salt saturated muds. Additive is recommended for water based muds in concentration 5 – 20 kg/m³.

Advantages

- Effectively reduces friction coefficient in muds of any mineralization
- Ecologically safe, subject to quick bio destruction
- Reduces the risk of differential sticking, reduces torques while rotating drill string
- Facilitates drilling tool movement, increases equipment lifetime
- Does not cause foaming
- Does not affect mud parameters
- Resistant to hydrophobic coagulation and high pH

Limitations

- Not suitable for highly mineralized muds containing lime combining with pH>10
- At high concentration of solid phase the use of additive in concentration more than 2% can lead to slight rheology increase

Method of application

For fresh and low mineralized muds the recommended concentration is 5 kg/m³. For muds with high content of sodium salts, potassium salts and calcium salts as well as salt saturated muds with high content if solid phase, calcium carbonate and barite the recommended concentration is 10-20 kg/m³.

It is recommended to add lubricating additive to agitators or by means of mud hopper for effective dispersion of reagent and its uniform distribution throughout the mud volume.

Toxicity and handling

It should be handled in accordance with general requirements of transportation, storage and use of industrial chemical agents. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

Package and storage

200 liters metal barrels. It is recommended to keep it in cold dry place. Preserves its properties when frozen and after subsequent defrosting.
FIBER (REAGENT FOR WELLBORE CLEANING)

THIS IS MODERN PRODUCT FOR INTENSIFICATION CUTTING TRANSPORT BY MUDS WITHOUT INCREASING LIQUID VISCOSITY. FIBER REPRESENTS POLYPROPYLENE SYNTHETIC FIBERS OF WHITE COLOR. FIBERS DO NOT CAUSE CORROSION, CHEMICALLY INERT AND THERMALLY STABLE.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Synthetic fibers of white color without odor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber length, mm</td>
<td>5 - 12</td>
</tr>
</tbody>
</table>

Application

Fiber is effective reagent for removal of sand, silt, gravel, clay-slate, metal deposits. As distinct from high-viscosity sludge removing polymers, the fiber can be used as often as it necessary without risk of increasing viscosity. Main functions and properties.

Advantages

- Fibers are added to different mud types for increasing of cutting transport
- Easily kept in suspension state and equalized in muds based on fresh and salt water allowing effectively remove cuttings during drilling
- Full absence of chemical influence on mud and bottomhole formation zone
- Do not increase viscosity of mud
- Facilitate removal of metal deposits which appear during milling
- Prevent accumulation of cuttings in annular space
- Can be used in any drilling interval
- Chemically compatible with all types of formation water, oils and synthetic based muds
- Thermally stable up to 148°C
- safe for the environment
- not affected to negative temperatures as against some polymers
- Fibers and cuttings can be easily separated by mud cleaning system

Method of application

It is recommended to use it for preparation cleaning packs purposed for cleaning bottomhole from cuttings. Cleaning pack with fibers by means of pumps supplied to circulation system. Fibers and cuttings transported from bottomhole are supplied to screen shaker or to sludge collector. The recommended concentration as part of cleaning pack is 2kg/m³. The volume of cleaning pack must cover 150m of annular space. Accordingly for drilling sidetracks the volume of cleaning pack is 3m³ and in drilling production well - 5m³.

Packing and storage

It is packed in 18 kg 30 packs of 600g or 20 packs of 900g or 10 kg sacks.
OPTIBUR (ANTI-ADHESIVE ADDITIVE)

IT IS REPRESENTS ENVIRONMENTALLY SAFE MIXTURE OF SURFACE-ACTIVE AGENTS AND COMPONENTS BASED ON PLANT OILS.

Main physical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Oily fluid from light-yellow to deep-brown color</td>
</tr>
<tr>
<td>Density at 20°C, g/cm³</td>
<td>0.860 … 0.920</td>
</tr>
<tr>
<td>Kinematic viscosity at 40°C, mm²/s, not more</td>
<td>30</td>
</tr>
<tr>
<td>Water mass, %</td>
<td>2</td>
</tr>
<tr>
<td>Lubricating capacity increase of 0.3% standard fresh bentonite mud, %</td>
<td>70</td>
</tr>
<tr>
<td>Pour point, not higher than, °C</td>
<td>-10</td>
</tr>
</tbody>
</table>

Application

It is purposed for increasing rate of penetration in plastic rocks, preventing balling, decreasing drilling string friction against wellbore walls, preventing sticking and overpulls during round-trip operations. The use of OPTIBUR is most effective in drilling with PDC bits.

Advantages

- Increase rate of penetration when using water based muds;
- Decrease drilling tool friction against wellbore walls;
- Increase quality of filter cake, decrease filter value;
- Prevent bit and BHA elements balling;
- Prevent clay sludge dispersing;
- Does not change drilling mud rheological parameters;
- Environmentally safe and biodegradable.

Restrictions

Concentration of 3% can lead to hydrophobic coalescence in solutions with high content of carbonates (more than 100kg/m³) and lime (pH more than 10).

Method of application

OPTIBUR is recommended for use during drilling wells in geological cross-sections with high content of argillaceous rocks. Use rate is 2-3% of flushing fluid volume. To increase the effectiveness the additive is added near sucking ports or directly to drill string during connection. In further drilling it is necessary to maintain intended concentration of additive in fluid.

Toxicity and handling

It is necessary to handle in accordance with general transportation, storage and industrial chemicals use requirements. It is recommended to use personal protective equipment (gloves and glasses) and observe personal hygiene rules.

Package and storage

200 liters steel barrels. Store in a cool dry place. It retains its properties after freezing and subsequent defrosting.
SULFOBIT (SULPHONATED ASPHALT)

REAGENT REPRESENTS PARTIALLY WATER SOLUBLE MULTIFUNCTIONAL REAGENT ON BITUMINOUS BASE.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Free-flowing powder from dark brown to black color</td>
</tr>
<tr>
<td>pH 1% of product solution</td>
<td>7 - 9</td>
</tr>
<tr>
<td>Humidity, %, not more</td>
<td>14,0</td>
</tr>
<tr>
<td>Residue, water soluble, %, not less</td>
<td>70,0</td>
</tr>
<tr>
<td>Residue, oil soluble, %, not less</td>
<td>25,0</td>
</tr>
<tr>
<td>Water loss (HPHT 220°F), ml/30 min, not more</td>
<td>25,0</td>
</tr>
</tbody>
</table>

Main functions and advantages
- Reduce risk of caving formation in unstable formation intervals (clay stones) by means of colmatation microcracks by fine oil-soluble part of reagent;
- Improve lubricating capacity of mud (reduce adhesiveness of filter cake);
- Reduce water return of mud, decrease dispersing ability (chopping) of cuttings during drilling;
- Is the emulgator during processing mud with hydrocarbon (oil)
- Can be used as a component of majority muds based on water independent on natural (PAC, CMC, starch, xanthum gum) or synthetic (PHPA) origin of mud components, and also effective during its use as a part of hydrocarbon based muds.

Application
Can be added at a well-chosen moment directly to mud preparation system through hopper or directly to container with preparing mud. This reagent does not affect working capacity of most polymers used in drilling practice. Preferably to add reagent at startup of mud preparation in concentration provided by program. Recommended concentration from 3 to 17 kg/m³ depending on purpose.

Limitations
- When reagent enters to mud it paints it to dark color
- When adding reagent to mud containing enough quantity of solid phase, whether it be bentonite or worked sludge, there happens mud rheology downfall and small mud thinning. Sulfonated asphalt interacts only with solid phase and does not exert influence on polymers. It is recommended to add reagent at initial preparation of mud with subsequent permanent dosing of reagent in concentration provided by program.
- Before adding additive to mud it is compulsory to make pilot test.
- Reagent can cause some foam production therefore it is necessary to have antifoaming additive.
RTP
(ROCK HARDNESS REDUCER)

REPRESENTS THE MIXTURE OF SURFACTANS.

Main physical properties

<table>
<thead>
<tr>
<th></th>
<th>Viscous fluid from light-yellow to light-gray color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td></td>
</tr>
<tr>
<td>Density at 20°C, g/cm³</td>
<td>1.0–1.10</td>
</tr>
<tr>
<td>pH at 20°C</td>
<td>6–7</td>
</tr>
<tr>
<td>Foaming capacity of 0.1% product</td>
<td>absent</td>
</tr>
<tr>
<td>Solidification point, not higher, °C</td>
<td>-10</td>
</tr>
</tbody>
</table>

Area of application

The additive for drilling muds RTP is purposed for using in water based drilling muds for reducing rock hardness by means of decreasing interfacial tension at the «liquid — formation» boundary. Additive RTP intensifies detergent power of water by decreasing its surface tension. Providing wedging effect in the zone of bit performance the reagent RTP simultaneously facilitates the dispersing process of sludge present in drilling mud.

Restrictions

Compatible with majority of drilling muds. Can be used in all types of drilling muds including salt-saturated systems.

Toxicity and handling

Surface-active materials, which are part of reagent, are biodegradable. It should be handled in accordance with general requirements of transportation, storage and use of industrial chemical agents. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

Package and storage

RTP is supplied in 30 liters plastic canisters or in 200 liters barrels. It is recommended to keep in dry cold place. Preserve its properties after freezing and subsequent thawing.
COMPLEX REAGENT FOR FLUID BATH INSTALLATION FOR RELEASING DIFFERENTIAL STICKING. IT REPRESENTS THE MIXTURE OF ADDITIVES AND FATTY ACIDS DERIVATIVES IN HYDROCARBON CARRYING AGENT.

**MAIN PHYSICAL PROPERTIES**

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Oily fluid from light brown to black color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinematic viscosity at 40°C, mm²/s</td>
<td>25-43</td>
</tr>
<tr>
<td>Acid index, KOH/g</td>
<td>30-50</td>
</tr>
<tr>
<td>No-flow point, °C</td>
<td>-14</td>
</tr>
</tbody>
</table>

**Application**

BAS is recommended to be used in all cases where the string is to be released from differential sticking. For bath preparation it is possible to use as diesel, so oil or mineral oil.

**Advantages**

- Allows avoiding time consumptions for selection receipts and bath preparation because for bath creation it is needed any hydrocarbon solvent and BAS only.
- Dehydrates and destroys clay filter cake creating channels for liquid siphoning and pressure counterbalancing.
- Moistens and greases drill string for decreasing frictional force and torque facilitating reciprocating of drill string and its releasing.
- Effectiveness of anti-sticking operations directly depends on time between sticking appearance and bath installation
- It is referred to hardly combustible products (flashpoint is higher than 200°C)

**Engineering recommendations**

- Clean and wash feed lines and container for tempering working mixture.
- Fill mineral oil or diesel then add BAS through mud hopper based on 25 lt (2,5%) of reagent for 1 m³ of hydrocarbon solvent
- Mix within 30 minutes by means of rotary pumps

**Bath installation**

- Calculate the volume of annular space from sticking zone to bit
- Increase calculated volume by 25% for periodical contact zone refreshing
- Calculate bath flush time to sticking zone
- Pump down the bath and switch off the pumps
- Make periodic string reciprocation and rotation
- Each 30 minutes switch on pumps and pump down 0,1-0,2 m³ of fluid to refresh contact zone.

**Package and storage**

BAS is stored and transported in 200 liters plastic barrels. Keep away from contact with oxidizer, open fire, ignition sources. Keep and use in ventilated places.
BURINTEKH DEFOAMER (BD)

DEFOAMER. IT REPRESENTS WATER EMULSION BASED ON ORGANIC-SILICON POLYMERS WITH ADDITION OF NON-IONIC SURFACTANTS.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Viscous fluid from creamy to light yellow color</td>
</tr>
<tr>
<td>Exponent of hydrogen ion activity (pH)</td>
<td>6.0-7.0</td>
</tr>
<tr>
<td>Defoaming performance indicator 0.05% product, %</td>
<td>50</td>
</tr>
<tr>
<td>No-flow temperature, ºC</td>
<td>-10</td>
</tr>
</tbody>
</table>

Application

It designed for using in water based drilling muds and slurries for reducing foaming and as defoaming additive to chemical agents.

Advantages

- Effectively prevents foaming of polymer and lignosulphonate muds, reduces air content in mud.
- Reduces foaming of lubricating additives (FK-2000, etc.)
- Compatible with all reagents used for muds chemical treatment

Engineering recommendations

Defoaming properties are most effectively appear when added 0.05 – 0.5 l/m³ of mud. High level of degassing is maintained during long period of time. Defoamer is added to mud together with reagents – foamers or directly to circulating mud.

Toxicity and handling

Reagent has moderate irritation effect to eye mucosa. According to GOST 12.1.007 reagent refers to 4th class of low hazardous substances. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

Package and storage

200 liters metal barrels or plastic canisters. It is recommended to store in dry cool place. Reagent preserves its properties at freezing and subsequent defrosting.
CI-130 (CORROSION INHIBITOR)

REPRESENTS THE MIXTURE OF METAL COMPLEX AND SURFACTANTS

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Transparent fluent colorless or yellowish fluid with faint odor</td>
</tr>
<tr>
<td>Density, g/cm³</td>
<td>1,10</td>
</tr>
<tr>
<td>Base material</td>
<td>Minimum 40%</td>
</tr>
<tr>
<td>pH</td>
<td>6,5-8,0</td>
</tr>
<tr>
<td>Chilling point, °C</td>
<td>-12</td>
</tr>
</tbody>
</table>

Application
Protection of drilling tools metal from corrosion in media with low and high content of potassium, sodium, calcium and magnesium salts.

Advantages
- At moderate concentrations (0,4 – 0,5%) inhibitor has high effectiveness – it allows reducing corrosion velocity up to 0,03 mm/year in highly mineralized mud and up to 0,1 mm/year in low mineralized mud at temperatures up to 130°C.
- High stability to clay accumulation
- Optimal pH level of mud for provision maximum effectiveness of reagent is 8-9
- Inhibiting activity reduces at temperatures above to 130°C
- If necessary to treat mud with bentonite and in case of clay accumulation more than 10-15% it is necessary to increase concentration of CI-130 in mud (more than 0,5%)

Engineering recommendations
Recommended concentration in mud is from 4 to 5 kg/m³. Practical concentration depends on type of clay rocks, bentonite content in mud and well temperature. Inhibitor does not require any additional equipment or special mud treating measures and can be added as directly to tanks during mud preparation so through mud hopper.

Packing and storage
215 liters plastic barrels. It is recommended to store in dry cool place. Inhibitor preserves its properties when frozen and after subsequent defrosting.
PRESENTS PRESSURIZED GRANULATED HUSK, LOOSE MATERIAL FROM YELLOW TO BROWN COLOR. EFFECTIVE COLMATANT FOR FLUSHING FLUIDS LOSS CIRCULATION CONTROL DURING OIL AND GAS WELLS CONSTRUCTION.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Loose material from yellow to brown color</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAIN COMPOSITION:</td>
<td></td>
</tr>
<tr>
<td>grains diameter, mm</td>
<td>4,0-12,0</td>
</tr>
<tr>
<td>grains length, mm</td>
<td>50,0</td>
</tr>
<tr>
<td>screens residue mass content 0,5 mm, %</td>
<td>35,0</td>
</tr>
<tr>
<td>Moisture content, %</td>
<td>15</td>
</tr>
<tr>
<td>Chemical stability</td>
<td>Inert</td>
</tr>
</tbody>
</table>

Application
It designed for flushing fluids loss circulation control during oil and gas wells construction.

Advantages
- Nontoxic, refers to 4th hazard class under GOST 12.1.007 (low hazardous)
- Noncorrosive, chemically inert, thermally stable material
- Possibility of use in any interval of well drilling
- Chemically compatible with all types of muds.

Engineering recommendations
For preventing loss of circulation by permeable sandstones up to 5 m³/h it is recommended to treat in concentration 30-50 kg/m³. In case of more severe losses it is necessary to use 60-100 kg/m³.

Packing and storage
Cloth sacks under GOST 30090. By agreement with the consumer it can be packed to cloth sacks with film liners under GOST 19360, to special soft containers of “big-bag” type with plastic liner and net weight not more than 500kg, or it can be loaded out without packing (in bulk), it is possible to pack it to similar consumer packing which does not deteriorate the product quality.
DRY LUBRICANT

ADDITIVE REPRESENTS NONCRYSTALLINE INORGANIC POLYMER IN THE SHAPE OF SOLID MICROBALLOONS OF THE GIVEN DIAMETER; IT DESIGNED FOR REDUCING MUDS FRICTION COEFFICIENT.

Application
It operates according to ball bearing not subject to destroying under excessive pressures. Dry lubricant reduces torsion torque and the probability of drill string overpulls, improves lubricating capability in directional wells, and facilitates casing running. Dry lubricant in the shape of microballoons can be used together with other lubricating materials.

Advantages
• High compressive strength.
• High chemical resistance (to acids, alkalies, liquid lubricants), chemically inert.
• Chemically compatible with all types of muds.

Method of application
Recommended concentration of reagent is 1 – 5 kg/m³ for most of solutions (for salt saturated and potassium solutions is recommended to increase concentration up to 8 – 12 kg/m³).
For achieving the best result reagent must be added through conventional funnel for muds slowly and uniformly with the speed approximately 1 sack per 20 minutes for avoiding unstirred flakes and possible loss of product on screens.

Limitations
Before use it is necessary to estimate MWD capacity.

Toxicity and handling
Nontoxic. It should be handled in accordance with industrial chemical agents general rules of transportation, storage and use. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Semi-transparent or white grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter, mm</td>
<td>0,5</td>
</tr>
<tr>
<td>Melting point, °C</td>
<td>over 400 °C</td>
</tr>
</tbody>
</table>

Packing and storage
25kg sacks. Keep in dry ventilated places avoiding heating and moisture ingress.
ADDITIVE “POLYEMULAN C”

REPRESENTS THE MIXTURE OF NATURAL RAW MATERIAL BASED SURFACE-ACTIVE COMPOUNDS

Application
It is designed for additional stabilization of invert-emulsion muds, and for cuttings hydrophobization.

Advantages
• It improves rheological and filtration factors of emulsion.

Method of application
Recommended concentration of reagent is 1 – 5 kg/m³ for most of solutions (for salt saturated and potassium solutions is recommended to increase concentration up to 8 – 12 kg/m³).
For achieving the best result reagent must be added through conventional funnel for muds slowly and uniformly with the speed approximately 1 sack per 20 minutes for avoiding unstirred flakes and possible loss of product on screens.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Liquid from dark brown to black color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilling point, ºC</td>
<td>minus 10</td>
</tr>
<tr>
<td>Acid index, mg KOH\g</td>
<td>minimum 60</td>
</tr>
</tbody>
</table>

Toxicity and handling
Reagent causes moderate irritation of skin and eye mucosa. It should be handled in accordance with industrial chemical agents general rules of transportation, storage and use. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

Packing and storage
200 liters metal barrels. It is recommended to store in dry cool place. Reagent preserves its properties at freezing and subsequent defrosting.
ADDITIVE “POLYEMULAN E”

REAGENT REPRESENTS THE MIXTURE OF RATTY ACIDS DERIVATIVES IN MIXED HYDROCARBON SOLVENTS WITH SPECIAL EMULSIFIERS; IT EASILY CREATES STABLE EMULSIONS WITH HYDROCARBON COMPOUNDS AND WATER.

Application
Reagent is the primary emulsifier and stabilizer for system “EMULCARB” which is used when drilling.

Advantages
It also has protective properties from field equipment corrosion which is affected by corrosion environment and formation waters.

Method of application
It is recommended to use as a part of system “EMULCARB”. Working concentration of the primary emulsifier is 20 – 40 kg/m³ (depending on values indicated in flushing program). It is recommended to preliminary dissolve primary emulsifier in hydrocarbons during mixing.

MAIN PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Liquid from dark brown to black color</td>
</tr>
<tr>
<td>Chilling point, °C</td>
<td>minus 15</td>
</tr>
<tr>
<td>Acid index, mg KOH\g</td>
<td>maximum 60</td>
</tr>
</tbody>
</table>

Toxicity and handling
Reagent causes moderate irritation of skin and eye mucosa. It should be handled in accordance with industrial chemical agents general rules of transportation, storage and use. It is recommended to use personal protective equipment (glasses, gloves) and observe personal hygiene rules.

Packing and storage
200 liters metal barrels. It is recommended to store in dry cool place. Reagent preserves its properties at freezing and subsequent defrosting.
1.3 CEMENT SLURRIES
EXPANDING BACKFILL MATERIALS FOR CEMENTING PRODUCTIVE INTERVALS

BIT-CEM-RTM

During well cementing the considerable part of cement slurry filtrate can penetrate the layer which can cause the reduction of reservoir properties of productive layer as a result of insoluble precipitates fallout, creation of high viscous mixtures, clay components swelling, etc. Our lab developed special expanding backfill material with decreased water loss purposed for cementing productive intervals. Expanding of cement stone during solidification reduces the probability of appearing cross flows and water and gas shows. As a result of expanding of slurry-stone during its solidification the cement stone is created in closed well conditions with more dense structure and less permeability which increase its stability to corrosion under the influence of aggressive liquids and gases. During cement stone expanding during WOC also is created contact stress between cement sheath, wellbore walls and string which increase the hermiticity of well cementing.

Besides the expanding additive BIT-Cem-RTM contain specially selected reagents which reduce water loss of slurry, stabilizers which reduce cement slurry water loss, and thickening regulators, and strength generation regulators which are selected for specific well conditions.

Technical characteristics

<table>
<thead>
<tr>
<th>VALUES</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.9-1.95</td>
</tr>
<tr>
<td>Thickening time till 30Bc consistence, min at 75°C*</td>
<td>140-200</td>
</tr>
<tr>
<td>Spreadability, mm</td>
<td>&gt;220</td>
</tr>
<tr>
<td>Filter value 30 min, ml</td>
<td>150-200</td>
</tr>
<tr>
<td>Liner expansion coefficient, %</td>
<td>Not less than 1,5</td>
</tr>
<tr>
<td>Water gain, ml per 2 hours</td>
<td>0-1</td>
</tr>
<tr>
<td>Deflection/compression strength after 24 hours at 75°C, MPa</td>
<td>5-6/17-20</td>
</tr>
<tr>
<td>Deflection/compression strength after 72 hours at 75°C, MPa</td>
<td>6-8/35-40</td>
</tr>
<tr>
<td>Deflection/compression strength after 168 hours at 75°C, MPa</td>
<td>8-9/35-40</td>
</tr>
<tr>
<td>Temperature range of use, °C</td>
<td>20-90</td>
</tr>
<tr>
<td>Permeability, mD</td>
<td>0,01-0,08</td>
</tr>
</tbody>
</table>

*Thickening time can be adjusted depending on temperature conditions.

Storage

Guaranteed storage life is 6 months in dry warehouses (relative air humidity not more than 60%). Manufacturer guarantees the correspondence to parameters subject to package integrity and observance of storage and transportation conditions.
BIT-CEM-RTM-GT

Backfill material BIT-Cem-RTM-GT is developed specially for cementing gas wells. By means of special additives the slurry creates almost impermeable (0,002 – 0,01mD) corrosion resistant cement stone. Cement stone expansion during solidification reduces the probability of gas shows.

The use of expansive additives also allows increasing contact stress between cement sheath, wellbore walls and string which increase the hermiticity of well cementing and avoiding gas flow in borehole annulus.

Technical characteristics

<table>
<thead>
<tr>
<th>VALUES</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1,9-1,95</td>
</tr>
<tr>
<td>Thickening time till 30Bc consistence, min at 75°C*</td>
<td>140-200</td>
</tr>
<tr>
<td>Spreadability, mm</td>
<td>&gt;220</td>
</tr>
<tr>
<td>Filter value 30 min, ml</td>
<td>150-200</td>
</tr>
<tr>
<td>Liner expansion coefficient, %</td>
<td>Not less than 1,5</td>
</tr>
<tr>
<td>Water gain, ml per 2 hours</td>
<td>0-1</td>
</tr>
<tr>
<td>Deflection/compression strength after 24 hours at 75°C, MPa</td>
<td>5-6/17-20</td>
</tr>
<tr>
<td>Deflection/compression strength after 72 hours at 75°C, MPa</td>
<td>6-8/35-40</td>
</tr>
<tr>
<td>Deflection/compression strength after 168 hours at 75°C, MPa</td>
<td>8-9/35-40</td>
</tr>
<tr>
<td>Temperature range of use, °C</td>
<td>20-90</td>
</tr>
<tr>
<td>Permeability, mD</td>
<td>0,002-0,01</td>
</tr>
</tbody>
</table>

*Thickening time can be adjusted depending on temperature conditions.

Storage

Guaranteed storage life is 6 months in dry warehouses (relative air humidity not more than 60%). Manufacturer guarantees the correspondence to parameters subject to package integrity and observance of storage and transportation conditions.
BIT-CEM-L3/BIT-CEM-L4

With the purpose of process simplification and expenses decrease for well cementing it is up-to-date to use lightened backfill materials for well cementing per one stage without cement stage collar. We developed sedimentation stable compounds distinguished by corrosion resistance and high strength of cement stone contact with wellbore wall. We produce backfill materials on the basis of high quality Portland cement with addition of ash and micro silica which allows receiving non-shrinking stone and increasing formation isolation quality.

**Technical characteristics**

<table>
<thead>
<tr>
<th>VALUES</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BIT-Cem-L3</td>
</tr>
<tr>
<td>Density, g/cm³</td>
<td>1.30-1.35</td>
</tr>
<tr>
<td>Thickening time till 30Bc consistence, min at 24°C</td>
<td>100-300</td>
</tr>
<tr>
<td>Spreadability, mm</td>
<td>&gt;220</td>
</tr>
<tr>
<td>Filter value 30 min, ml</td>
<td>300</td>
</tr>
<tr>
<td>Water gain, ml per 2 hours</td>
<td>0-1</td>
</tr>
<tr>
<td>Deflection/compression strength (after 48 hours) at 24°C, MPa</td>
<td>0.7-1/1.5</td>
</tr>
<tr>
<td>MPA (after 48 hours) at 60°C, MPa</td>
<td>1-2/5-6</td>
</tr>
<tr>
<td>Deflection/compression strength (after 96 hours) at 24°C, MPa</td>
<td>0.7-1/1.5</td>
</tr>
<tr>
<td>MPA (after 72 hours) at 60°C, MPa</td>
<td>2-2.5/8-9</td>
</tr>
<tr>
<td>Deflection/compression strength (after 168 hours) at 24°C, MPa</td>
<td>1-2/1.5-3</td>
</tr>
<tr>
<td>at 60°C, MPa</td>
<td>2-2.5/8-10</td>
</tr>
<tr>
<td>Temperature range of use, °C</td>
<td></td>
</tr>
</tbody>
</table>

**Storage**

Guaranteed storage life is 6 months in dry warehouses (relative air humidity not more than 60%). Manufacturer guarantees the correspondence to parameters subject to package integrity and observance of storage and transportation conditions.
SPECIAL MATERIALS FOR WELL CEMENTING

BIT-CEM-LOCK

This slurry is designed for lost circulation control of different intensiveness. Permeating the lost-circulation formation BIT-Cem-Lock by means of effective combination of fillers creates impermeable plug in passages chokepoints (3-10mm) which prevent the total loss of slurry to lost-circulation zone. After this it consolidates to low permeable cement stone.

Technical characteristics

<table>
<thead>
<tr>
<th>VALUES</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1,5-1,9</td>
</tr>
<tr>
<td>Thickening time till 30Bc consistence, min at 24°C*</td>
<td>100-300</td>
</tr>
<tr>
<td>Spreadability, mm</td>
<td>&gt;220</td>
</tr>
<tr>
<td>Filter value 30 min through disk (fractures 3*3mm) ∆P=0,7 MPa, ml</td>
<td>80-100</td>
</tr>
<tr>
<td>Filter value 30 min through disk (fractures 3*3mm) ∆P=7 MPa, ml</td>
<td>150-200</td>
</tr>
<tr>
<td>Max overbalance ∆Pmax, MPa</td>
<td>More than 15</td>
</tr>
<tr>
<td>Water gain, ml per 2 hours</td>
<td>0-1</td>
</tr>
<tr>
<td>Deflection/compression strength (after 48 hours) at 24°C, MPa</td>
<td>1-3/2-4</td>
</tr>
<tr>
<td>Deflection/compression strength after (96 hours) at 24°C, MPa</td>
<td>2-4/4-6</td>
</tr>
<tr>
<td>Deflection/compression strength after (168 hours) at 24°C, MPa</td>
<td>2-4/4-6</td>
</tr>
<tr>
<td>Temperature range of use, °C</td>
<td>20-80</td>
</tr>
</tbody>
</table>

*Bc – Beardon units of consistency

Storage

Guaranteed storage life is 6 months in dry warehouses (relative air humidity not more than 60%). Manufacturer guarantees the correspondence to parameters subject to package integrity and observance of storage and transportation conditions.
IMPACT-RESISTANT REINFORCED BACKFILL MATERIAL FOR WELLS WITH SUBSEQUENT FRACTURING

BIT-CEM-ARM

The experience of well cementing shows that cement sheath is subject to heavy dynamic loads during completion, hydraulic fracturing, and high pressure differential and also subject to effect of formation waters. Simple cement cannot, to the right degree, provide the integrity and sealing of cementing especially during fracturing. "BURINTEKH", Ltd lab developed special impact-resistant reinforced backfill materials. Such material has good fluidity and high sedimentation stability which allows the most closely fill annular space. The main feature is that cement stone of such slurry has much higher impact resistance than simple cement and additional reinforcing prevents crack propagation along the sheath.

Technical characteristics

<table>
<thead>
<tr>
<th>VALUES</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1,9-1,95</td>
</tr>
<tr>
<td>Thickening time till 30Bc consistence, min at 75°C*</td>
<td>140-200</td>
</tr>
<tr>
<td>Spreadability, mm</td>
<td>&gt;220</td>
</tr>
<tr>
<td>Filter value 30 min, ml</td>
<td>150-200</td>
</tr>
<tr>
<td>Water gain, ml per 2 hours</td>
<td>0-1</td>
</tr>
<tr>
<td>Deflection/compression strength after 24 hours at 75°C, MPa</td>
<td>5-6/17-20</td>
</tr>
<tr>
<td>Deflection/compression strength after 72 hours at 75°C, MPa</td>
<td>6-8/35-40</td>
</tr>
<tr>
<td>Deflection/compression strength after 168 hours at 75°C, MPa</td>
<td>8-9/35-40</td>
</tr>
<tr>
<td>Temperature range of use, °C</td>
<td>20-90</td>
</tr>
<tr>
<td>Permeability, mD</td>
<td>0,01-0,08</td>
</tr>
</tbody>
</table>

*Thickening time can be adjusted depending on temperature conditions.

Storage

Guaranteed storage life is 6 months in dry warehouses (relative air humidity not more than 60%). Manufacturer guarantees the correspondence to parameters subject to package integrity and observance of storage and transportation conditions.
ACID-SOLUBLE BACKFILL MATERIAL

BIT-RESOLUBLE-CEM

Acid-soluble backfill material BIT-Resoluble-Cem can be used for lost circulation control, cement sheath sealing recovery and for consolidation of loose rocks. It represents fine mineral powder (particles size 3-10 mkm) mixed with water. Received slurry has high fluidity which gives the ability of pumping it through the bit and BHA. Solidification of slurry happens under the well temperature. The received cement stone immediately gains strength which considerably reduces WOC time (after 2-3 hours depending on temperature cement stone gains 60-90% of ultimate strength).

Technical characteristics

<table>
<thead>
<tr>
<th>VALUES</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.5-1.9</td>
</tr>
<tr>
<td>Spreadability, mm</td>
<td>&gt;240</td>
</tr>
<tr>
<td>Water gain, ml per 2 hours</td>
<td>0-1</td>
</tr>
<tr>
<td>Deflection/compression strength after 48 hours at 24°C, MPa</td>
<td>1.5-2/2-4</td>
</tr>
<tr>
<td>Deflection/compression strength after 96 hours at 24°C, MPa</td>
<td>2-4/4-6</td>
</tr>
<tr>
<td>Deflection/compression strength after 168 hours at 24°C, MPa</td>
<td>2-4/4-6</td>
</tr>
<tr>
<td>Temperature range of use**, °C</td>
<td>20-70</td>
</tr>
</tbody>
</table>

** Composition of backfill material is selected on the basis of well temperature
One of the main ways of achieving reliable separation of intervals is the preparation of well to cement slurry. To this effect the displacement fluids are used primary objective of which is the complete displacement of mud from annular space and treating casing surface and wellbore walls for better linking with cement. Selection of displacement fluid depends on many factors: intention of pumping, well temperature, and well condition before cementing, formation pressure, flushing fluids treatment type, and the condition of well cementing technology in the specific region. The next stage of displacement fluid selection is excluding negative consequences during its use such as caving, rock slide, and corrosion attack. All these occurrences can happen mainly if displacement fluid was left in annular space after cementing. We developed own method for estimation washing properties of displacement fluids which allows us, as soon as possible, qualitatively select fluid composition for specific well conditions. Currently we have ready compositions for water or oil based muds.
### 2. MUDS AND CEMENT SLURRIES DEVELOPMENT DEPARTMENT

**Muds and cement slurries development department**

- **Well casing laboratory**
- **Reagents development laboratory**
- **Mud testing laboratory**
- **Drill muds development and fieldwork branch**
- **Drill mud reagents testing branch**
- **Regional mud laboratories (Buzuluk, Neteyugansk)**

**“BURINTEKH”, Ltd MUDS AND CEMENT SLURRIES DEVELOPMENT DEPARTMENT**

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAD OF MUDS AND CEMENT SLURRIES DEVELOPMENT DEPARTMENT</td>
<td>Marat Dilmiev</td>
<td>(347) 292-26-46</td>
<td><a href="mailto:mdilmiev@burinteh.com">mdilmiev@burinteh.com</a></td>
</tr>
<tr>
<td>DRILLING REAGENTS DEVELOPMENT LABORATORY CHIEF</td>
<td>Sergey Lozhkin</td>
<td>(347) 291-25-43</td>
<td><a href="mailto:lozhkin@burinteh.com">lozhkin@burinteh.com</a></td>
</tr>
<tr>
<td>DRILLING MUDS TESTING LABORATORY CHIEF</td>
<td>Aleksey Mileiko</td>
<td>(347) 291-25-43</td>
<td><a href="mailto:mileiko@burinteh.com">mileiko@burinteh.com</a></td>
</tr>
<tr>
<td>WELL CEMENTING LABORATORY CHIEF</td>
<td>Ramil Ishbaev</td>
<td>(347) 246-08-74</td>
<td><a href="mailto:ishbaevrr@burinteh.com">ishbaevrr@burinteh.com</a></td>
</tr>
</tbody>
</table>
«BURINTEKH», Ltd drilling muds laboratory represents the scientific and research base with full cycle of researches on making and implementation of new perspective developments in the sphere of drilling fluids. Specialists formulate water-based solutions: biopolymer without solids with high density, aerated drilling fluids with decreased density, process liquids without solids; and oil-based solutions: invert-emulsion drilling mud for different ecological requirements. Laboratory provides searching, selection, and if needed, synthesizing of new reagents, used as components of drilling fluids. Also laboratory allows operatively solve and correct problems, arising during engineering maintenance of fluids.

**MAIN LINES OF WORK**

- Development of dedicated systems of drilling fluids on water and oil base for drilling with «BURINTEKH», Ltd PDC bits optimized for its effective work. Development of drilling fluids with increased greasy and hydrophobic properties, which increase ROP, suppose encapsulation, effective inhibiting and returns.
- Incoming analysis and selection of reagent samples, produced in Russia and foreign-made. Quality control of reagents, used during the drilling mud maintenance service.
- Optimization and selection of reagents for developed drilling mud systems.
- Creation of synthetic polymer drilling mud systems for control of its rheology and filtration in conditions of high temperature and salt aggression (monovalent and bivalent salts) copolymer of acrylamide and its non-ionic derivates, sulfo derivate acrylamide.
- Search of new effective stoppers of shale hydration on the basis of non organic and organic compounds - glycols, polyamines, quaternary ammonium compounds, and polyamine-polyether.
- Synthesizing and lab tests of new effective lubricants to drilling fluids on water base.
- Chemical treatment of bottomhole formation zone - chemical agents, breakers for soft and effective removal of cake of different composition.
- Systems for liquidation of difficult lost circulation.
- Defoaming agents for drilling fluids on water base.
- Drilling mud surfactant, drilling accelerators and oil-wetting agents of reservoir surface.

2.2 DRILL MUDS AND COMPONENTS TEST METHODS
2.2.1 WATER AND OIL BASED MUDS

BASIC PARAMETERS OF MUDS MEASURED UNDER THE STANDARD METHODS

BEAM SCALES OFITE API 13B

Beam scales under pressure API 13B. It increases accuracy by means of air removal from mud.

RELATIVE VISCOSITY.

Viscometer VP-5 under Engineering Documentation 39-00137001-772.

Marsh funnel API 13B.

Relative viscosity measuring with Marsh funnel.
2.2.1 WATER AND OIL BASED MUDS

RHEOLOGICAL PARAMETERS
Viscometer 8-speed OFITE 800 API 13B
Allows measuring mud parameters at normal and elevated temperature.

From values are calculated:
Plastic viscosity (sP)
Yield point (pound/foot²)
Non-linearity index, consistence index
Effective viscosity (sP)
Gel strength (pound/foot²)

FILTER VALUE
Table filter press API 13B-1
Designed for measuring static filtration at room temperature and pressure drop 0,7MPa

WATER, HYDROCARBON AND SOLIDS CONTENT
Retort OFITE API 13B
Increased up to 50 ml mud sample allows more precisely define water, hydrocarbon and solids content.
2.2.1 Water and oil based muds

SAND CONTENT
Kit for defining sand content OFITE API 13B-1
Easy and quick method of defining up to 10% sand content in mud.

PH VALUE
PH-meter API 13B-1 or test strips.

MUD FILTRATE CHEMICAL ANALYSIS
Determination of chloride, alkalescency, lime, total hardness content by calcium under API 13B, API 13I. Chemical analysis is carried out by titrimetric analysis and by means of measuring instrument SevenMulti combined with pH-meter which is designed for quick and precise definition of ions of Ca2+, Na+, Cl-, K+ concentration.

ELECTRICAL STABILITY
Defined for oil based muds by means of:
Emulsion stability tester TEE-01C under Engineering Documentation 39-00137001-772;
Emulsion stability tester OFITE API 13B-2.
HIGH PRESSURE, HIGH TEMPERATURE FLUID LOSS (HPHT)
For well bottomhole simulation the filter press HPHT API 13B is used. It allows running trials of fluid loss properties in conditions of high temperature and high pressure. Trials temperature can reach 175°C and cell pressure over 500 psi. As a substitute for filter paper ceramic disks with different pore sizes can be used allowing running filtration study with the same porosity value as drilled formation.

CUTTINGS DISPERSION, ASSESSMENT OF CUTTINGS INTEGRITY
Test evaluates tendency of mud to disperse cuttings in dynamic conditions at given temperature with further measurement of its hardness by means of moment creation.

HIGH PRESSURE, HIGH TEMPERATURE RHEOLOGY (HPHT)
For studying muds rheology on the bottomhole the viscometer OFITE HPHT is used. This fully automatic system perfectly defines rheological properties of fluids at temperature up to 260°C and pressure up to 30000 psi (207 MPa). Software allows setting parameters and saves the received results and it is the part of multifunctional system for scientific researches.
LOW SHARE RATE RHEOLOGY
Viscometer Brookfield LVD-II+PRO is designed for defining plastic viscosity at low share rate. This is the most universal viscometer with continuous reading and displaying viscosity, temperature share rate and torque on the digital display with ability of automatic data acquisition.

Measurement range: from 15 to 6000000 sP.
Speed range: from 0.01 to 200 revolutions/minute

NEGATIVE TEMPERATURE RHEOLOGY
Research lab has the ability to investigate rheological parameters of mud (for example oil based muds) at negative temperatures. By means of circulation bath with cooling and heating modes CARON it is possible to maintain mud temperature from minus 15 to plus 90ºC. Mud parameters are changing for example by means of viscometer OFITE 900 connected to computer. Software moulds device into automated system simultaneously being data-collecting system considerably reducing researcher operating time and decreasing mistake probability.
Clay-slates longitudinal swelling tester OFI helps to define inhibiting ability of muds in dynamic mode at different temperatures. This test analyses fluid and clay behavior in short time (3-5 min) and long time (several days). Within a given period the clay sample height change is automatically measured with micrometer relative to initial value. The less height is changed the higher the inhibiting ability of environment is.

For balling test into ageing cell with mud under investigation is placed iron rod and particles of swelling sludge. Cell is closed and rotated in roller furnace OFI-5 at a certain temperature the necessary period. The more percent of sludge stuck to rod the higher mud tendency to balling.
LUBRICATING ABILITY AND ULTIMATE PRESSURE TEST

RESEARCH LAB INVESTIGATES LUBRICATING ABILITY OF MUDS BY SEVERAL METHODS.
Clay cake static coefficient of friction is defined by means of device KTK-2. On the lifting table the mud clay cake is placed on which the polished cylinder is put. The table is lifted at the angle to horizontal surface and the angle at which the table moved off. The bigger breakaway angle the higher coefficient of friction.

Lubricating ability and ultimate pressure tests under Engineering Documentation 39-00137001-772 are carried out on ultimate pressure and lubricating ability tester OFITE. This is high quality device used for measuring muds lubricating ability, receiving data for defining type and quantity of lubricating additives, wear rate of mechanical parts. It is possible to simulate rotary speed and pressure of string given to wellbore wall.

Lubricating ability test gives an insight into effectiveness of different lubricating additives to muds. The liquid which is between two moving steel surfaces is put under the pressure from 5000 to 10000 psi (34.5 to 69 MPa). Steel block and wheel are rotating with the speed 60 rev/min.

Ultimate pressure test gives an insight into the strength of tested mud film. The test is made by means of application of measured stress by means of torque arm to bearing outer race which is sensitive to torsion torque. Usually this is made at high rate of shear – 1000 rev/min, with liquid pressure within the limits from 5000 to 10000 psi (34.5 to 69 MPa) between two moving steel surfaces.
MUDS HIGH TEMPERATURE AGING

For accelerating the achievement of equilibrium level of hydration of clays and/or polymers in mud, or for holding mud in conditions close to well one, is used mud aging at high temperature under API 13I. Drill mud is filled to steel aging cell where if necessary the pressure is delivered up to 2000 psi (13,8 MPa). Cell is hermetically closed and put to roller furnace OFI-5 where is rotated at the set temperature the definite time.

RISK OF STICKING DEFINITION

Device for sticking test under the pressure drop provides the measurement of typical of flushing fluids “drill string sticking coefficient” and allows defining the effectiveness of mode of processing various muds. The indicated coefficient considers friction or “balling” of clay cake at which consolidation or pipe sticking in well will occur. Standard test is made at pressure 477 psi (3,3 MPa) with steel disks with flat face and spherical frontal surface which simulate pipe in casing or drill collar in open hole with radius 31,75 cm.

ADHESION DETERMINATION

Influence of various additives to muds on adhesion force of compressed argillaceous material with metal surface in mud environment can be estimated by specially designed by lab experimental unit “adhesiometer”. By means of digital dynamometer is defined the breakaway force of metal from clay sample or sample break force.
For performing filtration tests without solids sinking on filter medium under API 13I the plugging material permeability tester is used. As filter medium can be used filter paper, ceramic disks or metalceramic filters. During the test the volume of filtrate is measured and there id built the dependence of filtrate (ml) against time square root (√minutes). By values of collected filtrate volume made a conclusion about the ability of mud to permeate to porous medium and create filter cake in formation conditions. The working pressure can reach 2000 psi (13,8 MPa), temperature is 260°C.

Intrusion of water from emulsive mud to formation and interaction of shale rocks with water promotes the decreasing of wellbore stability. Water losses from oil based muds can be reduced by means of solving salt in water phase and as a consequence decreasing water activity.

For defining activity (chemical potential or reaction possibility with the participation of water) there is used hygrometer. It measures relative humidity in closed space above the emulsified solution. The range of relative humidity definition is 20÷100%, temperature -0÷+50°C; also device defines dew point temperature and index of equilibrium relative humidity of investigated material.

For defining concentration of sulfides (H2S, S2, HS-) and carbonates (CO2, (CO2)2-, (HCO3)-) in mud The Garret apparatus is used. Mud filtrate passing through the sequence of vials and pipes acidizes transforming all sulfides to H2S or all carbonates to CO2. Gas separates from fluid and with the flow of inert gas passes through indicator pipe Drager which darkens proportionally to concentration of defined gas.
Specific resistivity of mud, filtrate, clay suspension and semisolid materials is measured by digital resistivity meter OFITE. Range of measurements: 0,01 – 400 Om*m2/m.

The content of chalk of marble aggregate in mud is defined by titrimetric and apparatus methods. In the first case calcium carbonate in mud is solved by acid and by titration is defined the calcium content. In the second case the calcimeter is used. It represents hermetically closed cylinder with manometer. The mud sample with certain quantity of acid is placed to cylinder. Based on the quantity of gas evolved as a result of reaction the quantity of calcium carbonate is defined.

The influence of reagent on clay water absorption from mud is determined by increase in weight of clay samples at direct contact with mud. Specific adsorption isotherm of water by clay allows conclude about influence of tested reagent on fluid inhibiting ability.
SPECIFIC RESEARCHES

OPTIMIZATION OF COLMATION ABILITY OF MUD

CALCULATION OF OPTIMAL COLMATANT FRACTIONAL COMPOSITION FOR PRODUCTIVE FORMATION MINIMAL CONTAMINATION

- In 2010 test lab specialists developed program for selection optimal colmatant fractional composition “FD-Protection”.

- In the optimal colmatant fractional composition selection program is realized the ability of use real calcium carbonate particles-size distribution determined on laser analyzer HORIBA which provides more accurate selection of optimal concentration values.

- Using known formation characteristics (permeability, porosity) “FD-Protection” program makes ideal colmatation mixture computation (with optimal correlation of fractional colmatant) for blocking pores by creating low-permeability filter cake on wellbore wall.

- At the present time the program is registered in Federal Intellectual Property, Patent and Trademark Service, was obtained certificate of state registration of program for ECM.
SPECIFIC RESEARCHES

FLUID LOSS TEST AND COLMATANT ABILITY OF FLUSHING FLUIDS ON PERMEABLE CERAMIC DISKS

Permeability plugging tester PPT under ANSI/API 13I/ISO 10416 allows defining filter value of flushing fluid on ceramic disk of different permeability at temperature and pressure close to formation conditions and estimate colmatant effectiveness.

Operational characteristics:
Temperature up to 500ºF (260ºC)
Pressure up to 2000 psi (≈140 atm)
Filtration medium – ceramic disk / filter paper.

During the test mud filtrate volume is measured and the dependence of filtrate volume (ml) against time square root (min1/2) is built.

Using the values of filtrate in ml per 7,5 (Vф7,5) and 30 (Vф30) minutes are calculated the following rates of filtration values in accordance with method:

1. Total filtrate volume.
2. Instant filtrate volume.
3. Static filter velocity.
4. Filtrate ingress depth.
5. Filter cake permeability.

Instant filtrate volume allows estimating the volume of mud coming to formation before creation of filter cake at the porous medium surface.

Using the certain filter values is made the conclusion about the ability of mud to permeate to porous medium and create filter cake in formation conditions.
2.2.3 DRILL MUD REAGENTS QUALITY CONTROL IN ACCORDANCE WITH STANDARD METHODS

BARITE, HEMATITE

The following parameters are measured for mud weighting material under API 13A:

Real specific gravity – is measured by means of Le Chatelier flask;

Content of particles more than 75 micron and less than 6 micron – by means of sizing method or Horiba analyzer;

Content of soluble alkaline-earth elements – by titrimetry.

BENTONITE

Bentonite is natural clay containing clay mineral smectite. It also can contain such minerals as quartz, mica, feldspar and tiff.

According to API 13A the following suspension parameters are rated:

- Viscometer scale readings at 600 rev/min;
- Plastic viscosity to yield point ratio;
- Filtrate volume;
- Residue with diameter more than 75 micron;
- Cation-exchange volume.

Rheological parameters measurement with 8-speed viscometer OFITE 800.
UNTREATED BENTONITE
Untreated bentonite for drilling is the dried and crushed clay but not chemically treated mainly consisting from smectite. Also it can contain such minerals as quartz, mica, feldspar and tiff.

According to API 13A the following parameters are rated:
- Plastic viscosity to yield point ratio;
- Plastic viscosity of dispersed suspension;
- Dispersed suspension filtrate volume;
- Cation-exchange volume.

Preparation of dispersed bentonite suspension

OCMA GRADE BENTONITE
OCMA grade bentonite is montmorillonite clay which naturally does not fit the bill of requirements to bentonite. This bentonite can be treated by sodium carbonate, polymers or other chemicals for improving suspension properties.

According to API 13A the following parameters are rated:
- Viscometer scale readings at 600 rev/min;
- Plastic viscosity to yield point ratio;
- Filtrate volume;
- Residue with diameter more than 75 micron;
- Cation-exchange volume.

High speed mixer Hamilton Beach is used for muds preparation

ATTAPULGITE AND SEPIOLITE
Sepiolite and attapulgite clay for drilling are natural clay minerals. They can contain admixtures of quartz, feldspar and tiff.

According to API 13A the following parameters are rated:
- Viscometer scale readings at 600 rev/min for suspension in 40% solution of NaCl;
- Residue with diameter more than 75 micron;
- Wetness.

Programmable desiccator SNOL
CARBOXYMETHYL CELLULOSE OF LOW VISCOSITY TECHNICAL GRADE (CMC LVT)

CMC LVT is alkali salt of carboxymethyl cellulose. The product represents free running or granulated powder, usually, not cleaned from reaction by-product.

According to API 13A the following parameters are rated:
- Presence of starch and its derivatives;
- Viscometer readings at 600 rev/min;
- Filter value.
Additionally the weight ratio of base material is determined under GOST 16932-93.

1. Starch presence determination:
   a) iodine test solution in water;
   b) carboxymethyl cellulose solution – starch is absent;
   c) carboxymethyl cellulose solution – starch is present.

CARBOXYMETHYL CELLULOSE OF HIGH VISCOSITY TECHNICAL GRADE (CMC HVT)

CMC LVT is alkali salt of carboxymethyl cellulose. The product represents free running or granulated powder, usually, not cleaned from reaction by-product.

According to API 13A the following parameters are rated:
- Presence of starch and its derivatives;
- Viscometer readings at 600 rev/min:
  - In distilled water;
  - In salt solution 40 g/l;
  - In saturated salt solution;
- Filter value.
Additionally the weight ratio of base material is determined under GOST 16932-93.

Liquid thermostat is used for determining kinematic viscosity
STARCH
Starch for drilling is made from several types of natural starch. Starch must hydrate in cold water and can be treated in such way that to be used as a filtrate agent in water based muds.

According to API 13A the following parameters are rated:
- Viscometer readings at 600 rev/min and filter value:
  - In salt solution 40 g/l;
  - In saturated salt solution;
- Residue more than 2000 micron.

Filter value measuring

OIL BASED REAGENTS
FOR HYDROCARBONS AND REAGENTS BASED ON IT IS MADE THE RANGE OF STANDARD ANALYSIS TO DETERMINE ITS GENERAL PROPERTIES.

Water weight ratio under GOST 3477-65 is made by device AKOB-10.
Determination of density under GOST 3900 is made by densimeter.
Determination of flow temperature and solidification temperature under GOST 20297-91 is made by device LZN-75M.
Acidity and acid number determination under GOST R 50497-52 is made by titration.
Determination of aromatic hydrocarbons and aniline point under GOST 12329-77 – by device for determination aniline point AT-PHP.
HIGH VIScosity PolyAnionic Cellulose (HV PC) and Low VIScosity PolyAnionic Cellulose (LV PC)

HV PC and LV PC are water-soluble polymers obtained only from cellulose by chemical reaction with carboxymethyl (anionic) groups which do not contain other polysaccharides such as starch, guar and other natural polymers and its derivatives. Notwithstanding that HV PC and LV PC are widely used in drilling for different purposes the tests under API 13I are focused on viscosity and filtration characteristics. For tests the sea water model is used.

THE FOLLOWING PARAMETERS ARE DEFINED:
- Wetness;
- Filter value;
- Effective viscosity;
- Chlorine ions content.

Determining the chlorine ions content

GROUND MARBLE. CHALK.

Ground marble is used in drill muds as weighting agent and colmatant. Depending on the size of formation pores the fractional composition of chalk and marble is selected. The following rates are tested:
- Weight ratio of carbonate of lime in accordance with GOST 8253-79;
- Wetness;
- Grain composition.

Laser particle analyzer

For determining grain composition the laser analyzer HOEIBA is used. With the help of laser the device evaluates the particle size and within 10 minutes provides differential and integral distribution of particle size in the range from 0,1 to 600 microns.

Typical distribution of chalk grain composition
2.2.4 DRILL MUD REAGENTS QUALITY CONTROL IN ACCORDANCE WITH NONSTANDARD METHODS

ANTIFOAMERS
Antifoamer is the reagent able to destroy stable foam in all types of muds. Mostly there are spirits with high molecular weight or silicones. For determining operational characteristics of antifoamers several methods are used.

Bubbling method. Foamed water solution of foam former is transferred to station where air with constant speed is supplied through the glass filter. Foaming ability is defined by measurement the maximum head by means of graduated scale on the station. Antifoaming ability is defined by means of measuring height of residual foam column after adding antifoamer.

Determination of defoaming performance indicator created by reagents – deflocculants. By means of measuring cylinder is measured foam volume before and after defoaming.

Determination of defoaming ability by measuring mud density. Determination of effectiveness of antifoamer is made from the difference between specific weight of foamed mud and specific weight of mud after defoaming.

DETERGENTS (ANTI BALLING REAGENTS)
Detergent is the set of water soluble surface-active materials which exercise anti balling effect by means of breakage and dispersion cuttings in mud.

Besides the general surface-active materials researches there is accretion test with rotating metal rod for detergents. Clean metal rod, standard mud, detergent and cuttings are placed into testing cell. The cell is closed and put to lab roller furnace OFI-5 where it is rotated with 36,5 revolutions per minute at room temperature for 20 minutes. At the end of set time the rod is taken out and flushed. Rod with cake and cuttings retained in mud are taken to desiccator and are dried at 105°C for 24 hours. Dried cuttings are removed from rod and weighed. The weight of non dispersed cuttings is found separately. Effectiveness of detergent is calculated according to the formula.
CLAY SWELLING INHIBITORS

Clay swelling inhibitors effectiveness comparison is made with the help of clay-slate longitudinal swelling tester OFI. To inhibitor-water solution with various concentrations are placed pressed clay or cuttings samples with known moisture. Inhibitor solutions are mixed by magnetic stirrers and if necessary are heated. Samples height change is automatically measured by micrometers and logged to computer memory. Test length is from several minutes to several days. Effectiveness of inhibitor performance is calculates by formula; the bigger sample height change the less effectiveness of inhibitor.

CORROSION INHIBITORS

Determination of inhibiting ability of corrosion inhibitors is carried out in accordance with GOST 9.905-82. Metal plates Ct3 are used in the tests. Metal plates with known weight are placed to flasks with acid solution and inhibitor and with continuous stirring and heating (up to 60°C) is hold within specific time. At the end of the test metal plates again weighed and there is calculated weight change indicator of metal K and corrosion rate P.
SURFACTANTS

Surfactants represent complex organic compounds with unsymmetrical molecular structure containing in molecules hydrocarbon radical and active functional groups. In drilling surfactants are used for: decreasing formation hardness; increasing muds lubricating abilities and its thermostability; emulsification of oil in muds; muds aeration. The range of investigations is made to define surfactants properties.

Foaming capacity of water soluble surfactants is defined by decreasing basic mud density.

Determination of non-ionic surfactant cloud temperature received on the basis of ethyleneoxide is made by visual method using mercury thermometer.

Determination of interfacial tension is made by stalagmometer by drops volume pressed on the line method: surfactants solution in water - nonpolar fluid. Also defined liquid tension on the line with air which characterizes its cohesive properties. Stalagmometer principle of operation is as follows: during micrometer rotation the tip pressures on movable piston plunger which presses from syringe by capillary the fluid in form of drop. The drop volume is measured by micrometer and according to the formula is calculated surface tension.

Emulsifying capacity of surfactant is defined visually by stability (lifetime) of emulsion at different surfactant concentrations.

CONTACT ANGLE DETERMINATION

Principle of measurement based on measurement of angle value between the solid surface and the tangent to hydrocarbon drop in point of contact with fluid. Thereat hydrocarbon liquid drop contacts (floats up) with metal surface dipped under water level or surfactant water solution. The drop is photographed at high magnification and interfacial angle is defined by method if direct drop measurement on metal.
THERMOSTABILIZING REAGENTS
These reagents provide excellent control over high temperature high pressure (HTHP) filtration of water based mud together with stability of rheological properties. Operational characteristics of reagent are checked using basic bentonite solutions: fresh and mineralized. Also there are measured plastic viscosity and yield point after aging at 230°C and HTHP filter value at 230°C.

BRIDGING MATERIALS
Ability of material to plug loss zone is important during defining material properties. Depending on formation there are measured hole sizes of loss zone therefore to appropriately close hole the particles of material must have certain size.

For defining operational characteristics of material there are conducted tests in special cell with chinks of different size on the bottom and tests with filling layer of metal balls of different diameter. The objective of tests is to determine the necessary size and concentration of plugging material at which the chinks of balls layer will be plugged and further mud loss will from cell be prevented.

DILUENTS
For comparative valuations of diluents deflocculation test is carried out. This test is meant for valuation relative effectiveness of diluents in medium with high content of solids. For test is prepared viscous bentonite slurry bring pH up to necessary level, add investigated diluent and measure solution parameters and filter value. If necessary solution with diluent can be subjected to aging at high temperature.
**XANTHANE GUM**

Xanthane gum is water soluble biopolysaccharide with high molecular weight. It is used as thickening agent in both fresh and mineralized muds.

The following parameters are rated:
- Presence of starch and its derivatives;
- Presence of guar gum;
- Viscosimeter readings at low rpm are defined by Brookfield viscosimeter at 0.3 and 60 rpm;
- Plastic viscosity and yield point – are defined from readings of 8-speed viscosimeter;
- Filter value.

**LUBRICATING ADDITIVES**

Provision of mud lubricating properties is defined by operational characteristics of lubricant comprising it particularly its lubricating ability, thermal stability, salt aggression stability, low foaming.

The following set of tests is carried out for studying additives properties. Dynamic friction coefficient is defined on ultimate pressure and lubricating ability tester OFITE.

Influence of additives on rheological and filtrating parameters is defined under standards methods for muds.

**Acid number is defined under GOST R 50497-52.**

Definition of pour point.
Definition of flash-point.
Definition of kinematic viscosity.
Definition of water content.
Additives tolerance to pH change and hardness.

Emulsifying capacity in muds in the presence of mineral oil.
Foaming capacity is determine by mud density change after adding lubricant and thorough mixing.
ANTI ADHESION ADDITIVES

Anti adhesive additives represent set of surfactants solved in base oil. Creating the film on metal of bit and collars they prevent bailing and tool sticking. Besides standard tests for surfactants and hydrocarbons there is test for adhesion which determines operational characteristics of anti adhesion additives. Results received with the help of adhesiometer allow estimating influence of additives on adhesion force of pressed clay material with metal surface in mud medium.

SODIUM POLYACRYLATE (SP)

Sodium polyacrylate is chemical compound with low and medium molecular weight. It provides control over filtration in fresh and mineralized mud (except for calcium presence), has high stability to bacterial aggression and stability at temperatures higher than 200°C. The following characteristics are researched:

- Effective viscosity of SP solution in distilled and mineralized water;
- Rheological parameters of fresh and mineralized mud before and after high temperature aging;
- Filter value of fresh and mineralized mud before and after high temperature aging.

REAGENTS FOR MUD CONTAMINATION REMOVAL

To such reagents refer: reagents for binding calcium and magnesium, reagents for neutralizing hydrogen sulfide, reagents for neutralizing carbon dioxide. For investigating reagents properties the basic mud is contaminated with necessary materials (for example hydrogen sulfide or carbon dioxide), part of mud is treated with reagent for neutralization. Muds are subjected to high temperature aging then their parameters are compared and effectiveness of neutralizer is estimated.
2.3 MUDS AND PROCESS LIQUIDS EXPOSURE TO BOTTOMHOLE FORMATION ZONE PROPERTIES RESEARCH
2.3.1 CORE RESEARCH

PREPARATION OF NECESSARY GEOMETRIC SHAPE CORE

Lab specialists have necessary tools for drilling 30mm diameter samples from full-size core, make facing and grinding-in.

EXTRACTION OF SAMPLES, DETERMINATION OF WATER AND OIL SATURATION (SOXHLET AND ZACS APPARATUS)

SOXHLET APPARATUS, ZACS APPARATUS (DIN STARK)

Determination of water and oil saturation is made under the standard method

CHARACTERISTICS
Sample diameter – 30mm
Sample length – 30-100mm

METHOD
GOST 26450-85 “Rocks”

Standard result
Content of water and oil in sample, % mass
CORE RESEARCH

VACUUM DRYING
VACUUM DRYER MEMMERT

CHARACTERISTICS
Temperature up to 200°C
Vacuum creation up to 0.001 MPa

METHOD
GOST 26450-85 “Rocks”

CORE SAMPLE ABSOLUTE PERMEABILITY DEFINITION BY AIR. DARCYMETER

ADVANTAGES
Rate of measurement. Ability of measuring in stationary and non-stationary filtration modes. Control using PC. Ability of database maintenance of samples.

CHARACTERISTICS
Measuring range from 0 to 9000 mD
Sample diameter – 30mm
Sample length – 30-100mm

METHOD
GOST 26450-85 “Rocks”

STANDARD RESULT
Measured value of absolute permeability of core sample by air in mD

CORE SAMPLE DENSITY, OPEN POROSITY DEFINITION ANALYTICAL BALANCES AND GH-252

ADVANTAGES
Direct method of parameters measuring

CHARACTERISTICS
Maximum weighing limit 101g / 250g
Minimum measurement value 0.01mg / 0.1mg
Sample diameter – 30mm
Sample length – 30-100mm

METHOD
GOST 26450-85 “Rocks”

STANDARD RESULT
Sample porosity under saturable fluid, volumetric and mineralogical density
RESIDUAL WATER SATURATION AND WETTABILITY DETERMINATION.
CENTRIFUGE CRS-8

Allows determine pore size distribution, sample wettability character. Also allows creating residual-water saturation in core sample.

ADVANTAGES
Wide implications. High precision system of temperature control. Gyroscopic gear allows using rotors for big volumes.

CHARACTERISTICS
Maximum rotation speed – 8000 rpm
Fidelity of the rotation speed - ≥ 50 rpm
Operating time range – 0-23 hours 59 minutes
Sample diameter – 30mm
Sample length – from 30 to 80mm

METHOD
OST 39-204-86 “Oil. Lab method for determination oil and gas reservoirs residual water saturation by saturation-capillary pressure dependency”.


STANDARD RESULTS
Residual water saturation %
Reservoir wettability
Carbonates and clay content definition in formation

CHARACTERISTIC
Sample mass (ground core sample) – not more than 10g

METHOD
Carbonate content is defined by gasometric method
Clay content is defined by cation exchange capacity method (MBT API)
GOST 28177-89 “Montmorillonite weight ratio determination”

STANDARD RESULTS
Carbonate content on conversion to lime
Clay content in formation
PRODUCING CHARACTERISTICS RESEARCH USING EXPERIMENTAL UNIT FDS-350

FDS-350 Vinci technologies

ADVANTAGES
Allows simulate the process of tailing-in in conditions close to formation conditions. Injection pump control and fixation of results is made with the help of AppliLab software.
Core holder allows washing core face with mud thus simulating the process of mud filtration to formation during circulation. Ability of defining pressure decrease which allows evaluating filtrate depth of penetration up to 300mm.

OPERATIONS
• Determination of initial return permeability (formation – well).

• Studying mud penetration to formation (well – formation) in static and dynamic filtration modes.

• Determination of return permeability recovery (formation – well) after mud effect.

• Experimental selection of colmatant in conditions analogous to formation conditions.

• Evaluation and minimization of negative effect of mud to productive reservoir.

• Test of impact of acid of other treatment on productive reservoir samples at formation pressure and temperature.

CHARACTERISTICS
Temperature up to 300°F (150°C)
Ground pressure up to 10000 psi (=700atm)
Pore pressure up to 5000 psi (=350atm)
Core washing speed by mud flow up to 0.9m/s (6 l/m)
Oil model consumption 0.001-25 ml/min
RESULTS

1. Mud loss dynamics at action on core (dynamic and static modes). Calculation of filtrate depth of penetration.

2. Mud filter cake removal

3. Core permeability determination results.
Permeability determination results before and after actions on core by mud (which are received during above mentioned tests) are represented in form of diagram. Vertical lines are the borders between groups of measured results before mud pollution, after pollution and after simulating secondary tailing-in.
Initial permeability before action on core is represented in left part of diagram, permeability of oil after action on core in middle section, and permeability after removing colmation zone or acid treatment in the left.
FORMATION GRAIN COMPOSITION DETERMINATION
LASER ANALYZER HORIBA LA-300,
SCREEN ANALYSIS

ADVANTAGES
Analysis time is less than 2 minutes. Built-in ultrasonic device. Control is made through the software system.

CHARACTERISTICS
Measured particles range of sizes:
0,1-600 micron – laser analyser
>600 micron – screen analysis
Sample quantity from 10 mg to 1 g per 300ml in flow-cell
Ultrasonic processing time is 0-30 minutes

METHOD
API 13A

RESULTS
Integral and differential distribution frequency of particles by size. Information about median and medium pore size.

ground marble

![Graph showing differential and integral distribution of particles](image-url)
2.3.2 FORMATION FLUIDS RESEARCH

OIL PRODUCT DENSITY DETERMINATION WITH DENSIMETER. DENSIMETERS AOH

ADVANTAGES
Direct measuring method

CHARACTERISTICS
Range of density measurement 700-1800 kg/m³

METHOD
GOST 3900-85 “Oil and oil products. Density determination methods”

RESULTS
Oil products density

RHEOLOGICAL PROPERTIES DETERMINATION

OIL PRODUCT VISCOSITY DETERMINATION BY CAPILLARY RHEOMETER

VISCOSIMETERS ADVANTAGES
Direct measuring method

CHARACTERISTICS
Range of viscosity measurement from 0,6 to 30000mm²/s

Method
GOST 33-2000 “Determination of kinematic viscosity and calculation of dynamic viscosity”

RESULTS
Fluids viscosity

WATER CONTENT IN OIL PRODUCT DEFINITION

AKOV-10

ADVANTAGES
Direct measuring method

METHOD
GOST 2477-65 “Oil and oil products. Water content determination methods”

RESULTS
Weight ratio and volume ratio of water
«BURINTEKH», Ltd Cementing Laboratory is a research facility with the full complement of research on the development and introduction of promising new products in the field of cement materials and displacement fluids. Laboratory specialists develop formulations of materials with expanding properties to both improve quality of zone isolation within zones of interest and to prevent cross flows while implementing casing jobs. Laboratory facilities allow us to analyze the quality of casing processes, to identify the root causes of poor quality of casings and to determine the right ways to improve quality. It allows us to select components for cement materials to develop formulations for specific applications. Also, Cementing Laboratory allows us to resolve and fix problems related to cementing services and installation of cement plugs.
MAIN LINES OF WELL CEMENTING LAB WORK

- Development of materials with expanding properties for running casing string into zones of interest within production and injection wells. Cementing materials with expanding properties are being developed in order to improve the quality of casing jobs by increasing the contact pressure of cement ring between casing string and the wellbore.

- Input analysis of basic cement materials which are being used for cementing; chemicals and additives. Quality control of agents used in the cementing materials.

- Optimization and selection of additives and agents for cementing materials.

- Development of buffer fluids to improve the quality of the borehole before cementing processes.
Cementing Laboratory, created in May 2011, is equipped for quality control of cementing materials and chemicals for cementing jobs. Controlling parameters of cement materials is conducted in accordance with GOST 1581-96 (WELL CEMENTS Technical conditions), GOST 26798.1 (WELL CEMENTS Test methods).

Well lab provides the following standard tests and analysis:

- Determination of rheological parameters of cement slurries
- Determination of filtration properties
- Identification of thickening time
- Determination of cement bending and compression strength
- Determination of the fineness of cement grinding
- Identification of water separation of cement slurry
- Determination of the density of cement slurry
- Determination of the permeability of cement with gas
- Determination of setting up time.
CEMENT SLURRIES AND ITS COMPONENTS TEST METHODS

CEMENT SLURRIES MAIN PARAMETERS MEASURED UNDER STANDARD METHODS

DENSITY, TRUE DENSITY

Beam scales under pressure API 13B. It increases accuracy by means of air removal from mud.

Beam scales OFITE API 13B

RHEOLOGICAL PARAMETERS

Viscosimeter 8-speed OFITE 800 API 13B Allows measuring slurry rheological parameters at normal temperature.

From values are calculated:

- Plastic viscosity (sP)
- Yield point (pound/foot²)
- Gel strength (pound/foot²)

Also this device is used while researching displacement fluids washing capacities.
FILTER VALUE

TABLE FILTER PRESS API 13B-1
Designed for measuring static filtration at room temperature and pressure drop 0.7 MPa

DETERMINATION OF FILTER VALUE AT HIGH TEMPERATURE AND PRESSURE
Water loss tester of Fann Instrument Company
This device allows estimating water loss of slurry at 1000 Psi pressure differential and temperature up to 100°C.

THICKENING TIME
CONSISTOMETER ZM-1002M
It is designed for defining thickening time (consistence) of slurries used during cementing of oil and gas wells with bottomhole flowing temperature up to 95°C.
FILTER VALUE

CEMENT FRACTION COMPOSITION

Diffusing machine
Restch AS200 Control
It allows defining fraction composition of slurry clinker and different additives. Defining setting up time.

CEMENT STONE COMPRESSION/BENDING TEST

Strength test machine Matest E158
This machine is used for testing cement samples for compression and bending.

Vic Device
Defining setting up time in normal temperature range.
DEFINITION OF CEMENT EXPANSION CAPACITY

Expansion ring-pattern Halliburton
It is used for simulation expanding properties of cement sample placed to ring-pattern.

DEFINITION OF SET CEMENT PERMEABILITY

Darcymeter Ecogeosprom
Device is designed for defining absolute gas permeability factor of samples both in stationary and non-stationary filtration. It is corresponds to GOST 26450.2-85.

DEFINITION OF FLUSHING FLUIDS WETTABILITY

Wettability measuring device model C1001 of Fann Company
This device is purposed for estimating wettability of displacement fluids, flushing fluids and combination of displacement fluid and surfactant.