



## BOTTOMHOLE TREATMENT



### Research:

Development of fracturing fluids thickeners and structurants based on polymer-free surfactants, acid fracturing fluids, thickened fracturing fluids destructors (including encapsulated)

Development of acid compositions for specific types of complications

Development of reagents for integrated chemicalization of oil production

Development of bottom-hole formation zone treatment technologies

### Production:

Production of fracturing fluids thickeners and structurants based on polymer-free surfactants, acid fracturing fluids, fracturing fluids destructors

Production of high purity acid compositions, dry salt systems and heavy well-killing fluids without solid phase

Production of integrated chemicals:

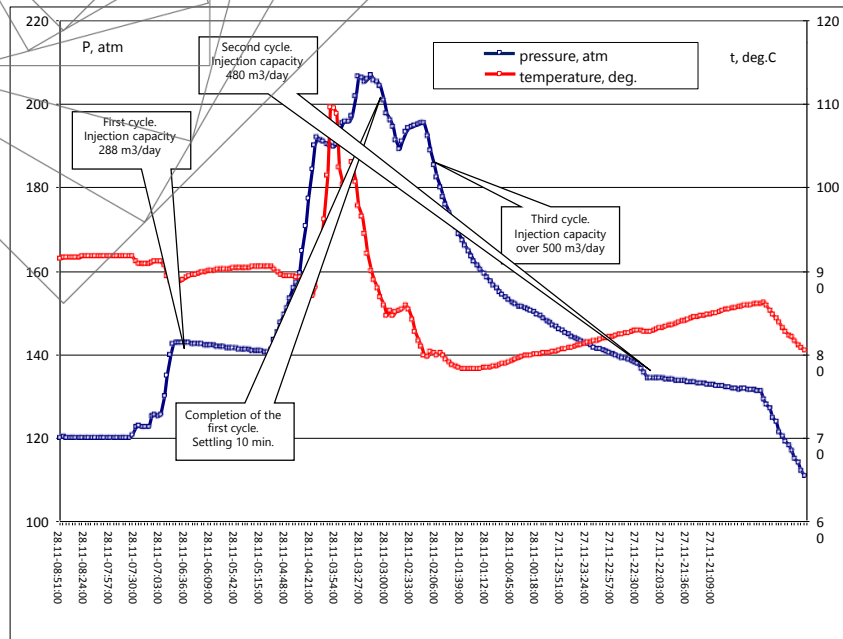
- Hydrocarbon and mutual solvents
- Hydrocarbon, biopolymer and polysaccharide diverting systems
- Inhibitors of asphalt, resin, paraffin deposits, scale inhibitors, hydrate formation, corrosion inhibitors
- Demulsifiers
- Bactericides

### Service:

- Oil production Stimulation
- Well killing
- Blocking compositions for well intervention operations
- Squeeze cementing and water isolation
- Hydraulic fracturing
- Technical solutions

## Technology essence:

- Generation of foam (N<sub>2</sub>-70%, CO<sub>2</sub>-30%) occurs
- on the bottom hole at mixing of hydrochloric acid with foam generating salt composition.
- A barrier of foam provides selective by permeability feed of acid by means of predominant destruction of foam in the low permeable (colmated) part of the collector.
- Saturation selectivity is provided by predominant foam destruction in the oil-saturated part of the collector.

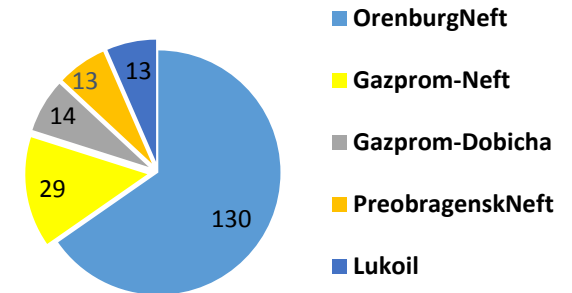


## Impact factors:

- Foam-acid filtration is followed by an increase in pressure by 58,8-66,7 bar (rejection of acid by the foam).
- Rejection selectivity by saturation and permeability.
- Impossibility of colmatation.
- The temperature of the floating fuel station is increased to 284 F (thermal effect on the asphalt-resin-paraffin deposits and viscous oils).

## Results of the introduction of technology by KREZOL Group:

1. Over 70 oil wells treated. Effectiveness - 93%
2. The technology is adapted for gas and gas-condensate wells - 6 wells treated. Effectiveness - 87%
3. The technology is adapted for oil, gas and gas condensate wells horizontal boreholes - 4 wells treated. Effectiveness - 91%

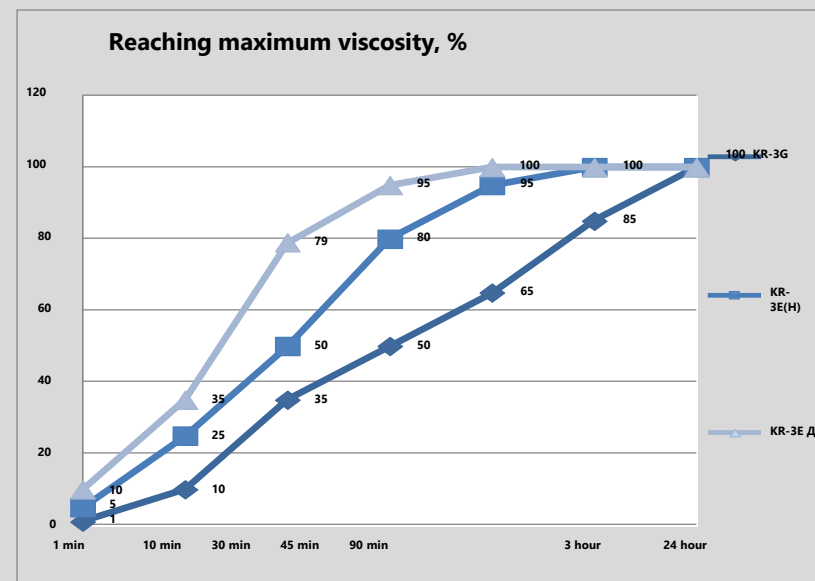
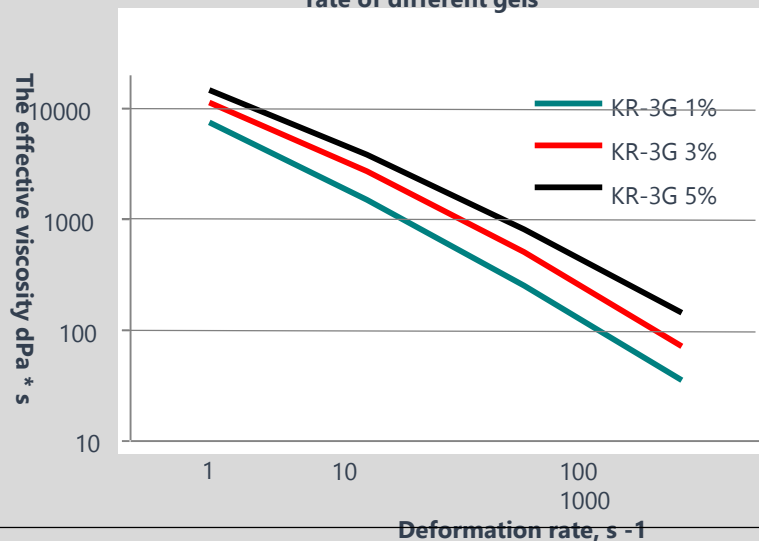


## SELECTIVELY-DIRECTED TREATMENT OF ABSORBING WELLS WITH KR-3G HYDROPHOBIC GEL

### Engineering foundation:

- KR-3G reagent – is an aqueous solution of hydrophobized biopolymer containing breaker;
- The technology of using a hydrophobic bio-gel KR-3G is water diverting selective bottom-hole treatment of the wells with abnormally low formation pressure, absorption zones, water interlayers, uneven injectivity profile;
- The technology is suitable for injection and production oil wells, and has potential for application in gas and gas condensate wells;
- Bio-gel is suitable for non-damaged well killing operations.

The dependence of the effective viscosity from deformation rate of different gels



### Advantages of KR-3G:

- KR-3G bio-gel contains breaker activated on contact with an acid (NEW);
- KR-3G bio-gel is water-soluble and hydrophobic at the same time (NEW);
- Easily prepared on the wellhead, controlled physicochemical characteristics;
- Minimum-time set of effective viscosity;
- Maintains mobility even at maximum viscosity - ease of injection and development;
- Has no solid phase, forms no colmatants, doesn't mix with the products of reaction between the acid and the rock;
- Thermally stable at 266 F;
- Non-toxic, fire and explosion safe;
- Low cost compared to analogues.

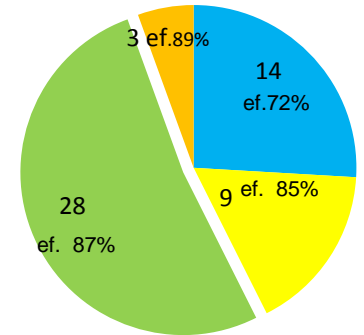


# SELECTIVE PROCESSING OF ABSORBING WELLS WITH KR-3G HYDROPHOBIC GEL

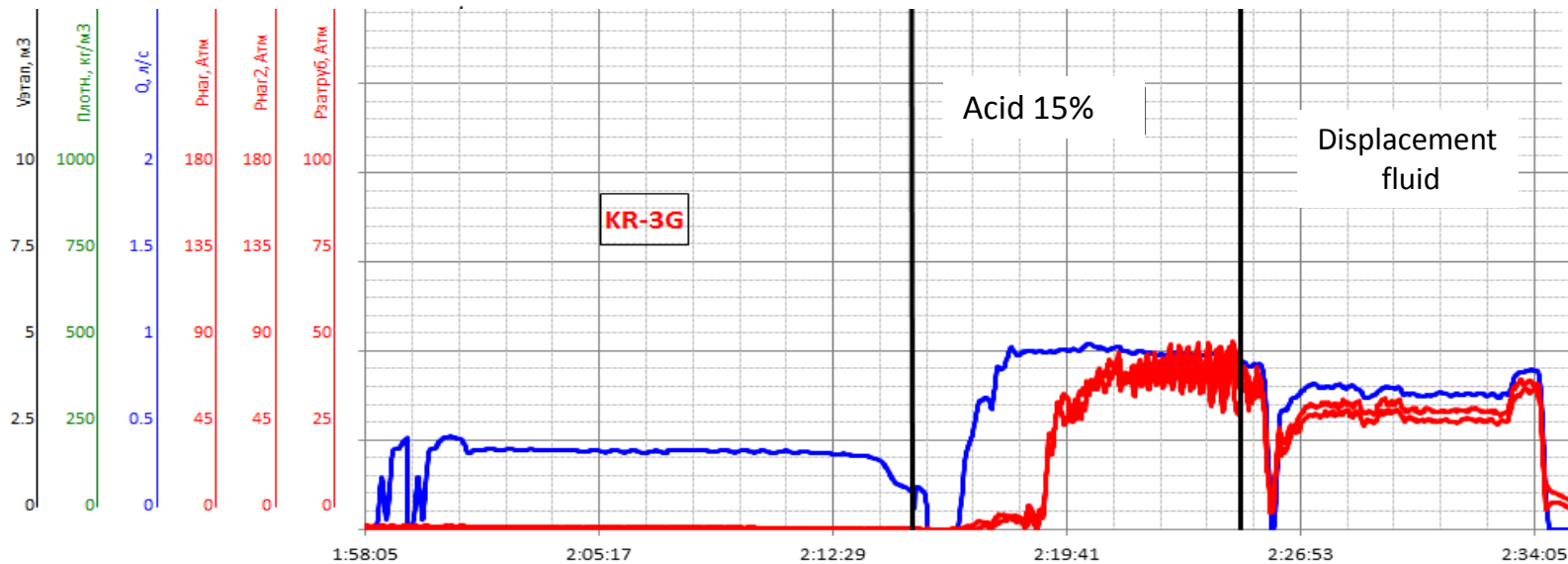
## Target objects for bottom-hole treatment:

- Pressure wells with uneven profile injectivity, absorption zones;
- Producing oil, gas and gas hydrate wells:
- with abnormally low formation pressure, absorption zones;
- after hydraulic fracturing;
- with water interlayers - the effect of temporary water shutdown

## Bottomhole treatment with KR-3G



■ Bashneft  
■ KazMunaiGas  
■ Orenburgneft  
■ Preobragenskneft



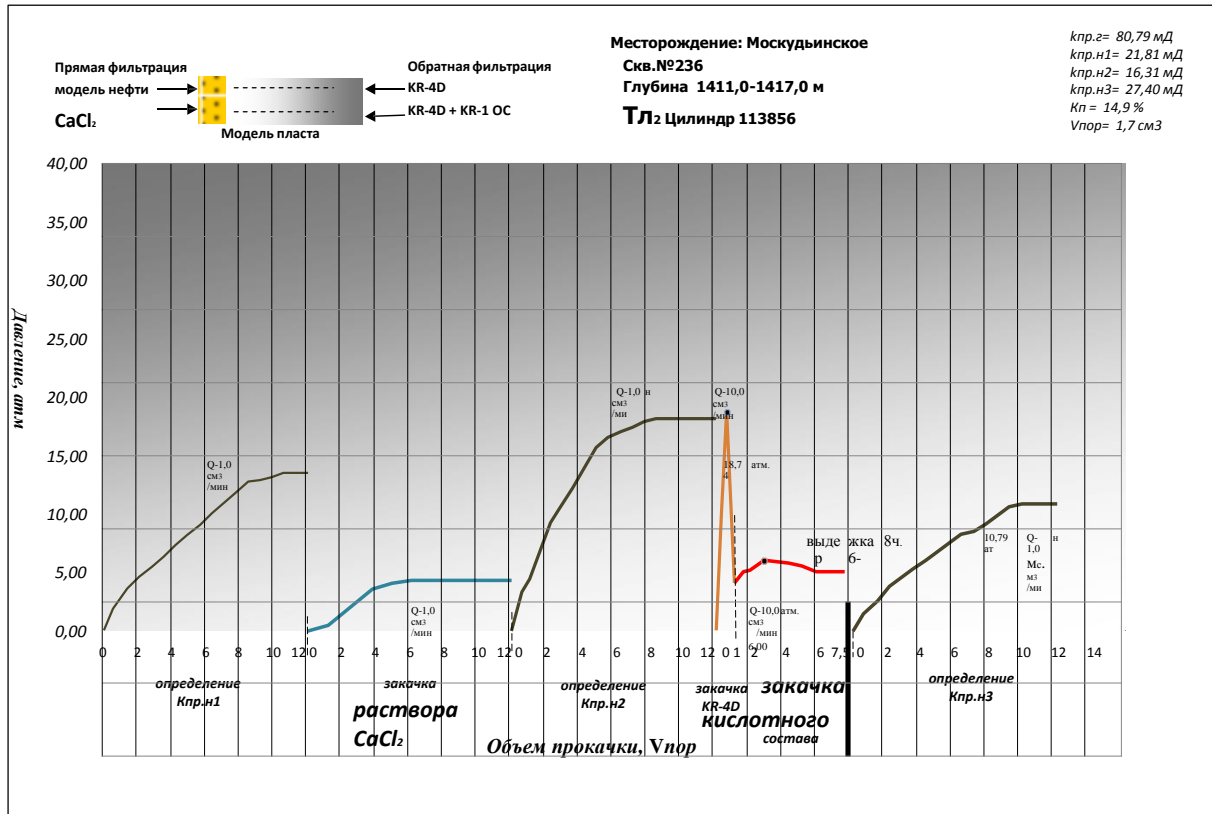
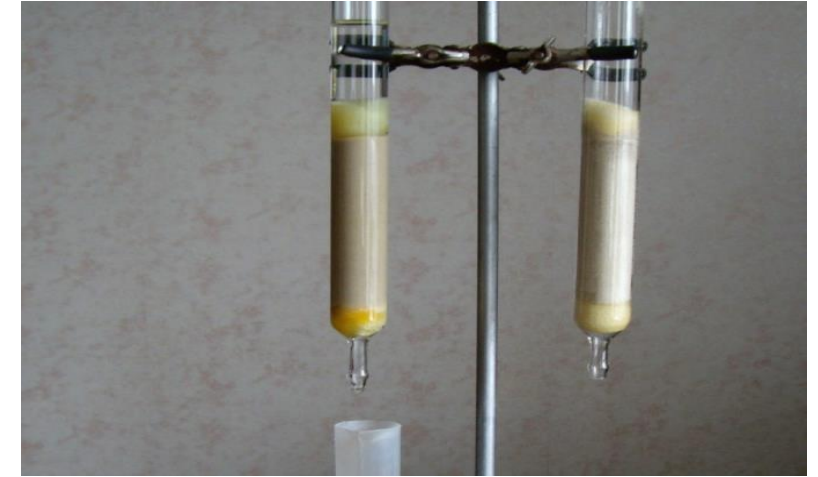
Injection parameters recorded by deck control station

# KREZOL TECHNOLOGY OF FOAM-ACID FORMATION TREATMENT WITH KR-4D DETERGENT



## Engineering foundation:

- KR-4D detergent is a complex mutual solvent, affined for both oil and aqueous phase;
- Used:
  - together with the acidic composition for bottom hole treatment of oil, gas and gas hydrate wells;
  - as an independent agent for the separation of complex fluids, dehydrating wells.

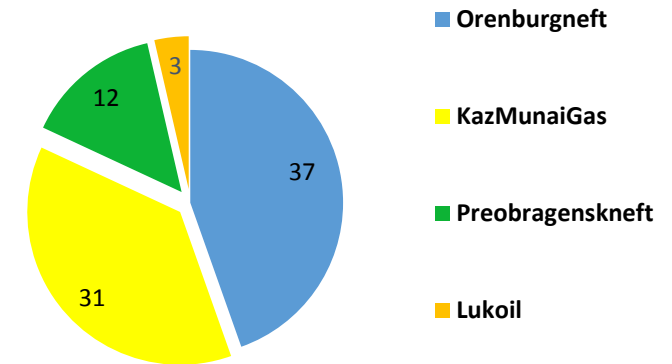


## Main properties of KR-4D detergent:

- The ability to sharply reduce the surfactant tension at the oil-water, oil- acid, oil-rock interface - promotes deeper penetration of the acid into the rock;
- KR-4D is a powerful hydrophilizing agent - increases the speed of active acid passing through the oil-wet core;
- Increase in the speed of active acid passing from 4 to 10 times without the formation of precipitation.

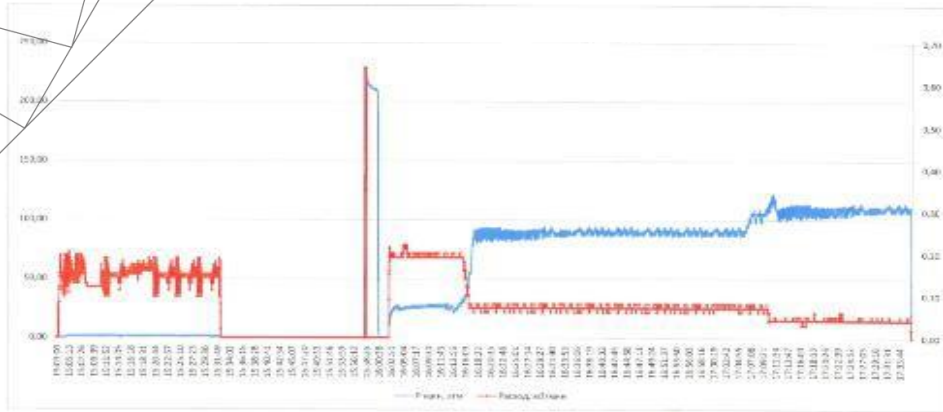
# KREZOL TECHNOLOGY OF FOAM-ACID FORMATION TREATMENT WITH KR-4D DETERGENT

Results of the introduction of foam-acid treatment technology by KREZOL Group from 2010 to 2016:



## Application potential

- Production well stock with low and medium permeable terrigenous reservoirs:
  - with low injectivity index;
  - with low formation temperature;
  - with high viscosity oils;
  - with the presence of persistent water-oil emulsions.
- Production gas and gas hydrate well stock:
  - complicated by gas hydrates;
  - flooded after killing;
  - with low-permeability gas-saturated reservoirs.



*By Kozlov B.M.*



*By Kozlov B.M.*



## Reasons for the use of KR series high-purity acids

KR series high-purity acidic compositions are multicomponent mixtures with synthetic and reactive hydrochloric acid, characterized by:

- Long-term storage with the absence of "salting out" and precipitation

- Extremely low iron content and absence of harmful impurities

- Saving the components of the saturating additives pack (iron Fe<sub>3</sub> + content controller, inhibitor, demulsifier, antislack, retardant) maintaining predetermined efficiency

- Lower cost

- Proved higher efficiency compared to the inhibited hydrochloric acid

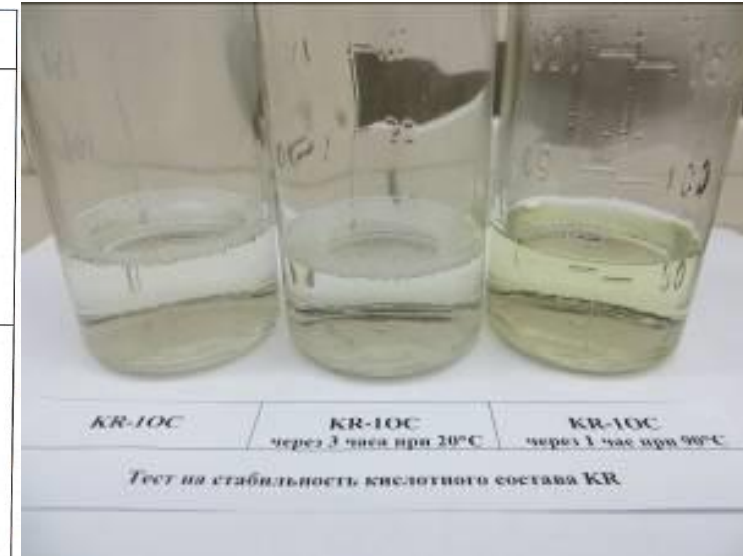
- Available saturating additives pack provides compatibility with formation fluids - oil and water, iron Fe<sub>3</sub> + content control prevents the formation of acid-oil emulsions and insoluble precipitates



# RESULTS OF THE COMPATIBILITY TEST OF KR-1 ACID COMPOSITIONS

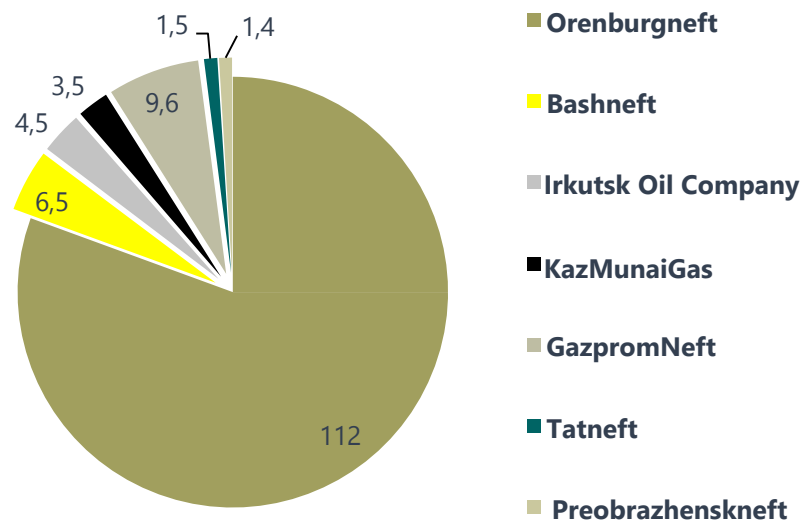


Соотношение «кислота:нефть»	KR-1HK	KR-1OC
50:50		
25:75		



Кислотный состав	Месторождение			
	Мишкинское	Гремихинское	Киегнопское	Лиственское
KR-1HK				
KR-1OC				

### EXPERIENCE OF THE PERFORMED WORK, Th. tonnes



### Intended use:

- Basic KR-1 K and KR-2T acid compositions - for the treatment of "uncomplicated" and pressure maintenance wells stock;
- KR-1OC and KR-1OC specialized acid compositions – for reservoirs treatment with fluids prone to the formation and stabilization of persistent oil emulsions;
- KR-1HK and KR-2HK - for reservoirs treatment with fluids prone to precipitation of secondary colmatant.

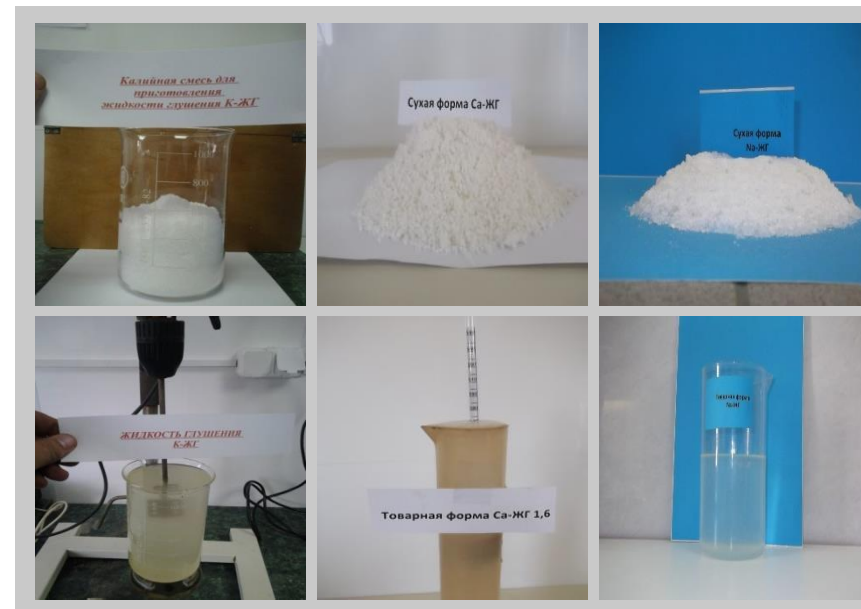
- **All acid composition prior to use are being adapted to the specific formation fluids and borehole environment;**
- **Developed logistics for the delivery of compositions to the Customers' fields and wells;**
- **Dry forms of acid compositions designed for hard-to-reach oil fields.**

KREZOL Group produces a wide range of saturated liquids for non-destructive killing of injection and production well stock, aimed at reducing the negative impact of highly mineralized solutions on the collector, preservation of filtration-capacitive properties of bottomhole formation zone, restoration of permeability after the completion of the well workover, well servicing.

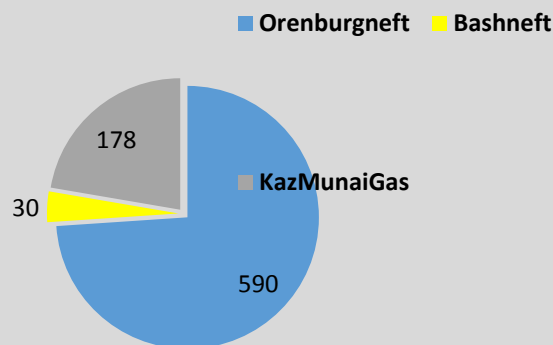
### Types of killing fluids:

- **K**-well killing heavy fluid – up to 1,52 g/cm<sup>3</sup> – potassium salts
- **Ca**-well killing fluid – up to 1,64 g/cm<sup>3</sup> – calcium salts
- **Na**- well killing fluid – up to 1,25 g/cm<sup>3</sup> – sodium salt
- **Br**- well killing fluid – up to 1,84 g/cm<sup>3</sup> – bromin salts
- **KR-3E** – up to 0,8-1,0 g/cm<sup>3</sup>

All well killing fluids do not contain solid phase, are technological in preparation, non-toxic, compatible with the blocking compositions of UfaNIPIneft; KR-3G, KR-3E of Krezol- NefteService production.



Effectiveness 100%



### Application potential

Killing of injection and production oil and gas well stock with abnormally high formation pressure:

- **K**- well killing heavy fluid - with clay reservoirs
- **Ca**- well killing heavy fluid - with carbonized reservoirs
- **Na**- well killing heavy fluid - with mixed-type reservoirs

Customer	Types of operations	№ Contract	Period
<b>Bashneft</b>	Difficult well chemicalization	№БНД/У/8/598/15/ОГТ	March 2015-December 2015
<b>Rosneft (Verkhnechonskneftegaz)</b>	Formation damage minimizing well killing	№2320615/1398Д	November 2015-
<b>Lukoil</b>	Bottomhole formation zone treatment	№15z4444	December 2015-December 2018
<b>Bashneft</b>	Acid formation treatment	№БНД/У/8/339/16/БУР	February 2016-December 2016
<b>Rosneft (Buguruslanneft)</b>	Chemical treatment of injection and production wells	№7550016/0087Д	April 2016-
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Wellhead acid fracturing	№136-18-16	April 2016-April 2017
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Heat-foam-acid bottomhole treatment	№139-09-16	April 2016-January 2017
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Bottomhole treatment using gel diverters	№137-09-16	April 2016-April 2017
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Foam acid formation treatment	№172-18-16	May 2016-May 2017
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Acid fracturing during well workover using Nitrogen System Unit	№172-18-16	May 2016-May 2017
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Engeneering support services of oil production stimulation using viscoelastic surfactant	№241-09-15	August 2016-August 2017
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Engeneering support services of heat-foam-acid formation treatment	№242-09-15	August 2016-August 2017
<b>Gazprom (Gazprom Orenburg podzemremont)</b>	Engeneering support services of heat-foam-acid formation treatment	№295-09-15	October 2016-October 2017



## The effectiveness of thermal-foam-acid treatment implementation at the “Orenburgneft” fields

OilField	Reservoir	Before thermal-foam-acid treatment			After thermal-foam-acid treatment			Increase		
		Water cut %	Fluid rate m3/day	Oil flow rate t/day	Water cut %	Fluid rate m3/day	Oil flow rate t/day	In oil flow rate	In fluid rate	In water cut
«Orenburgneft», JSC	Carbonate	56	76	28,9	51	140	59	30,1	64	-5
	Carbonate	20	18	12,4	22	52	35	22,6	34	2
	Carbonate	5	15	12	4	18	15	3	3	-1
	Carbonate	37	54	28	47	85	38	10	31	10
	Carbonate	21	25	16,2	25	39	23,9	7,7	14	4
	Carbonate	6	11	8,7	4	24	19	10,3	13	-2
	Carbonate	17	8	5,7	32	15	8,8	3,1	7	15
	Carbonate	38	52	27,9	52	52	21,6	-6,3	0	14
	Carbonate	30	45	25,8	32	79	40	14,2	34	2
	Carbonate	26	47	29,8	52	78	33	3,2	31	26
	Carbonate	30	24	13,8	20	53	34,8	21	29	-10
	Carbonate	35	47	27	30	68	40,6	13,6	21	-5
	Carbonate	38	55	29,2	45	60	28,3	-0,9	5	7
	Carbonate	7	58	42,5	12	69	51	8,5	11	5
	Carbonate	6	27	20,5	7	48	36,2	15,7	21	1
	Carbonate	40	42	21,7	39	63	33,2	11,5	21	-1
	Carbonate	19	17	12	18	34	23,8	11,8	17	-1
	Carbonate	19	50	29	22	65	36,5	7,5	15	3
	Carbonate	22	20	13	36	42	23	10	22	14
	Carbonate	11	27	19,6	30	46	26,4	6,8	19	19
	Carbonate	8	13	9,6	10	26	26	16,4	13	2
	Carbonate	17	25	17,8	17	35	24,9	7,1	10	0
	Carbonate	16	28	19,3	32	65	36,2	16,9	37	16
	Carbonate	21	11	7,1	26	18	10,9	3,8	7	5
	Carbonate	12	20	14,3	8	33	24,7	10,4	13	-4
	Carbonate	14	12	8,5	25	23	14,1	5,6	11	11
	Carbonate	20	15	10,1	45	27	12,5	2,4	12	25
	Carbonate	62	35	11,5	54	56	22,3	10,8	21	-8
Carbonate	26	20	12,1	26	26	15,8	3,7	6	0	
Carbonate	54	21	7,9	70	40	9,8	1,9	19	16	
Carbonate	42	7	3,3	26	21	12,7	9,4	14	-16	
Total:								291,8		
On average, per one well								9,41		

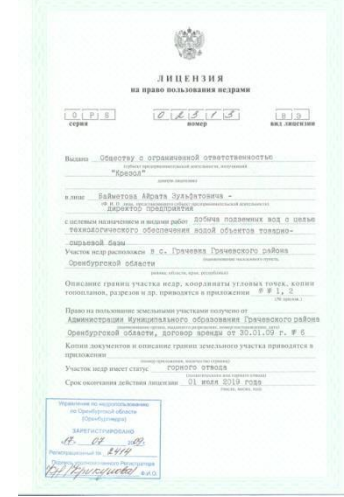
## The effectiveness of alcohol-foam-acid treatment implementation at the “Orenburgneft” fields

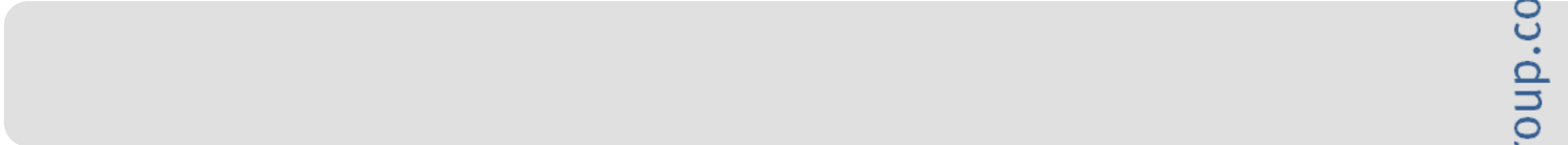
Field/well №	Before alcohol-foam-acid treatment			After alcohol-foam-acid treatment			Increase		
	Water cut %	Fluid rate m3/day	Oil flow rate t/day	Water cut %	Fluid rate m3/day	Oil flow rate t/day	In oil flow rate	In fluid rate	In water cut
“Orenburgneft”, JSC	3	155	124	1	211	172	48	56	-2
	5	200	155	1	231	184	29	31	-4
	16	140	117	16	160	134	17	20	0
	10	45	35	10	55	42	7	10	0
	12	15	11	18	25	17	6	10	6
	0,4	1,5	1,2	28	26	15,2	14	24,5	27,6
	81	48	8	81	49	9	1	1	0
	89,3	21	2	69,5	24,4	6,3	4,3	3,4	-19,8

On average, per one well



# KREZOL GROUP LICENSES ON HAZARDOUS INDUSTRIAL SITES EXPLOITATION





***Thank you for your attention!***

---

2/4, Tramvainaya st., Ufa, 450027, Russia  
Tel./fax: +7 (347) 246 45 00  
[info@krezolgroup.com](mailto:info@krezolgroup.com)