

INTECHNO

RESULTS OF WORK ON CLEANOUT OF
SECTIONS, MILLING OUT HYDRAULIC
FRACTURING SLEEVES IN SMALL
DIAMETER LINERS OF HORIZONTAL
WELLS

Vasilii Nikitin



TRENDS

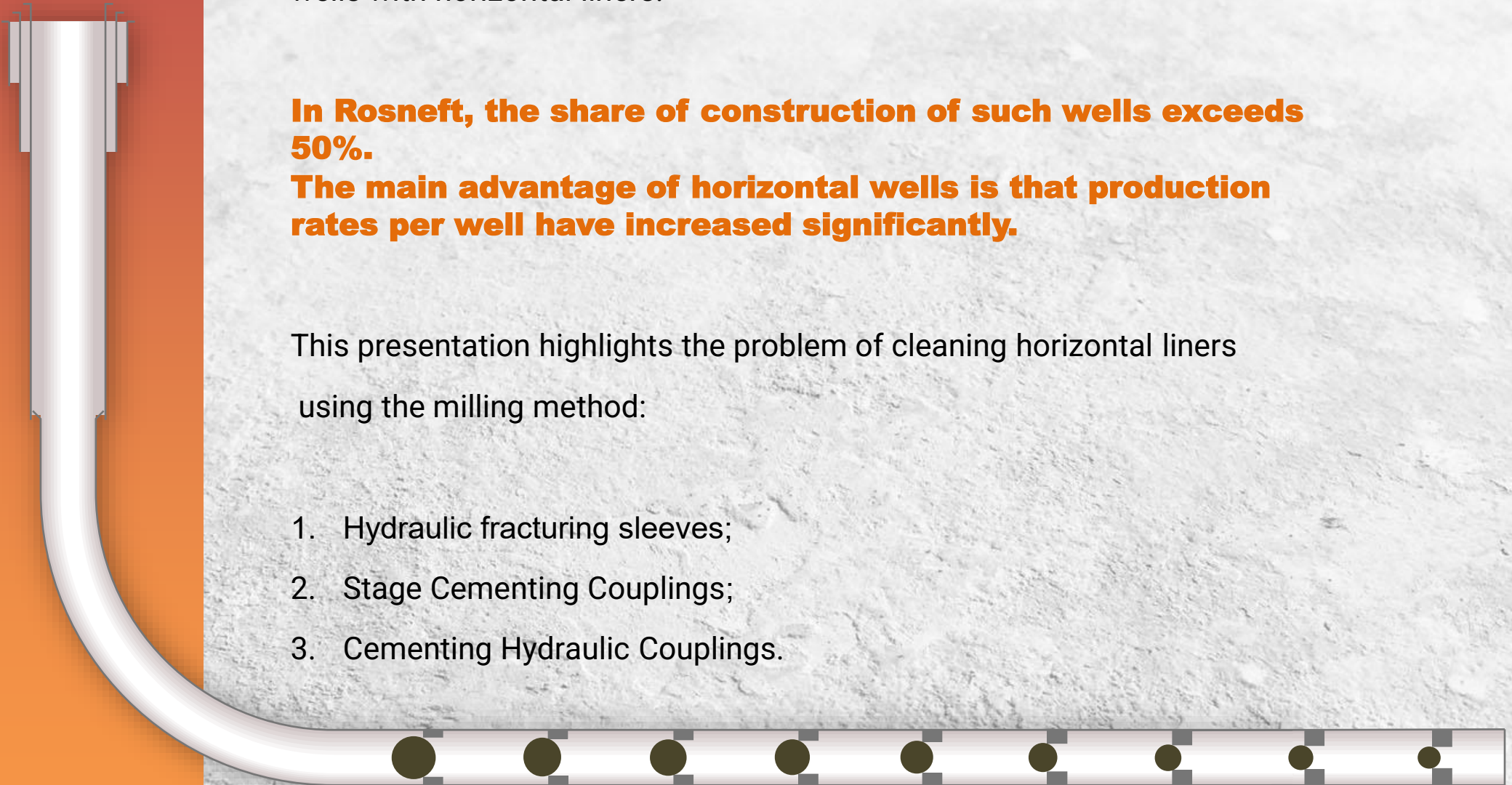
The trend of the last decade is an increase in the share of construction of wells with horizontal liners.

In Rosneft, the share of construction of such wells exceeds 50%.

The main advantage of horizontal wells is that production rates per well have increased significantly.

This presentation highlights the problem of cleaning horizontal liners using the milling method:

1. Hydraulic fracturing sleeves;
2. Stage Cementing Couplings;
3. Cementing Hydraulic Couplings.



CLEANING OUT PROBLEMS OF

horizontal liners, milling out of complex objects in liners, including hydraulic fracturing sleeves.

In the majority of cases, horizontal liners are equipped with hydraulic fracturing sleeves.

However, during the operation the following problems of horizontal wells emerged:

1

It became necessary to mill out hydraulic fracturing sleeves for re-fracturing.

2

The problem of milling out the completion tool in horizontal liners, as well as cement plugs during drilling and sidetracking has intensified.

3

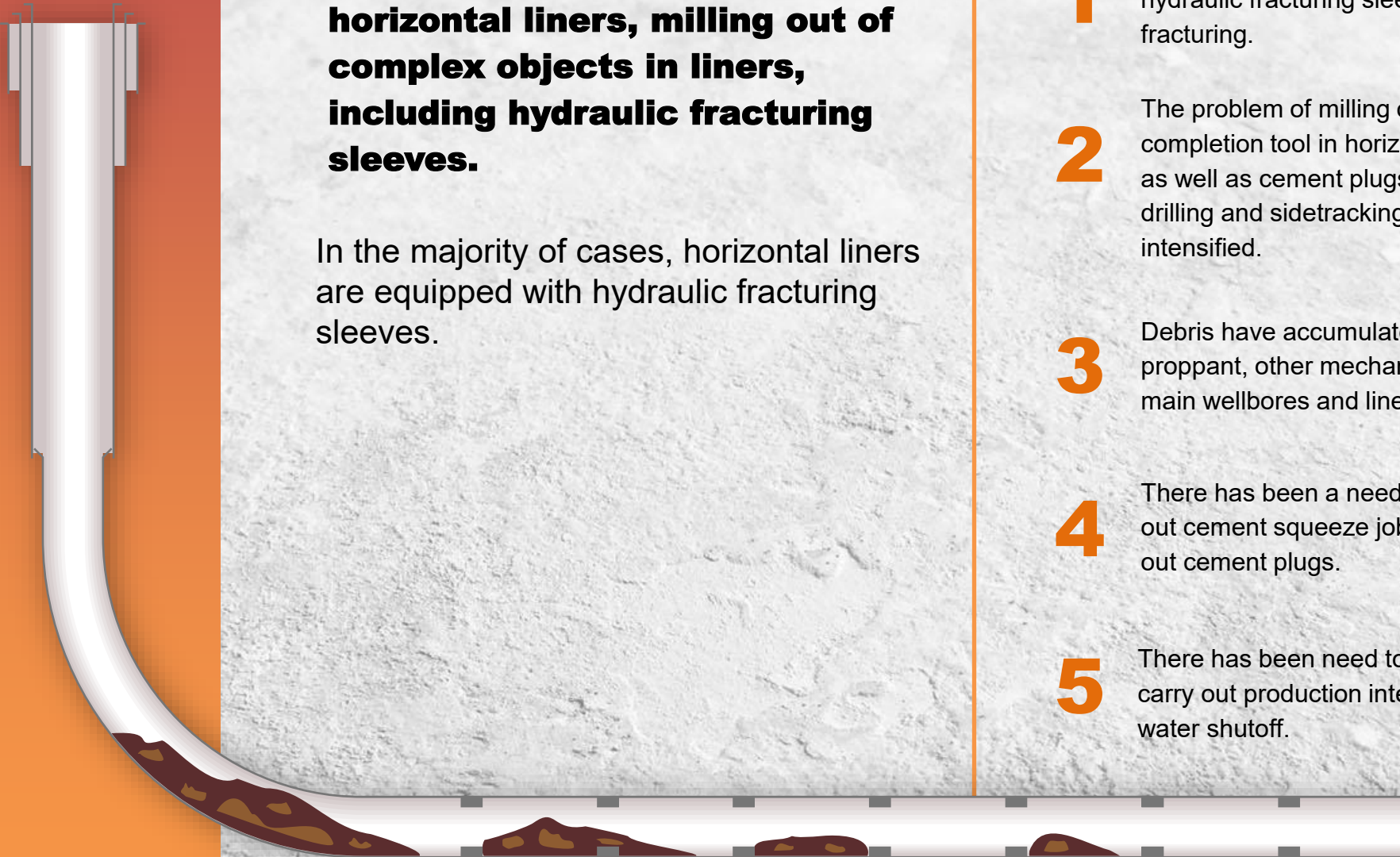
Debris have accumulated - sand, proppant, other mechanical particles in main wellbores and liners.

4

There has been a need to carry out cement squeeze jobs and drill out cement plugs.

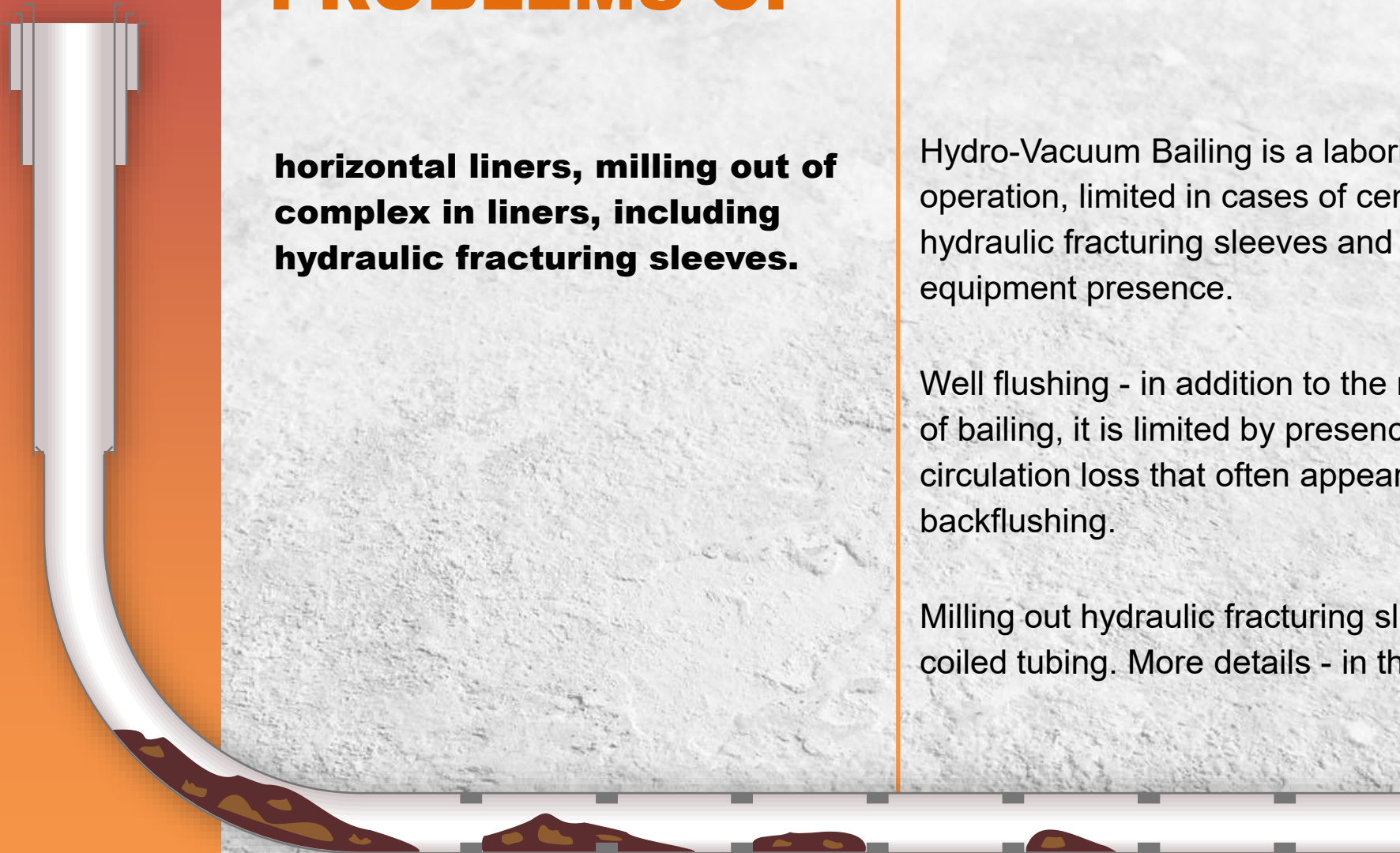
5

There has been need to survey liners and carry out production intensification and water shutoff.



CLEANING OUT PROBLEMS OF

horizontal liners, milling out of complex in liners, including hydraulic fracturing sleeves.



Prior to the implementation of the INTEHNO technology, RN-Nyaganneftegaz used the following liner cleaning methods:

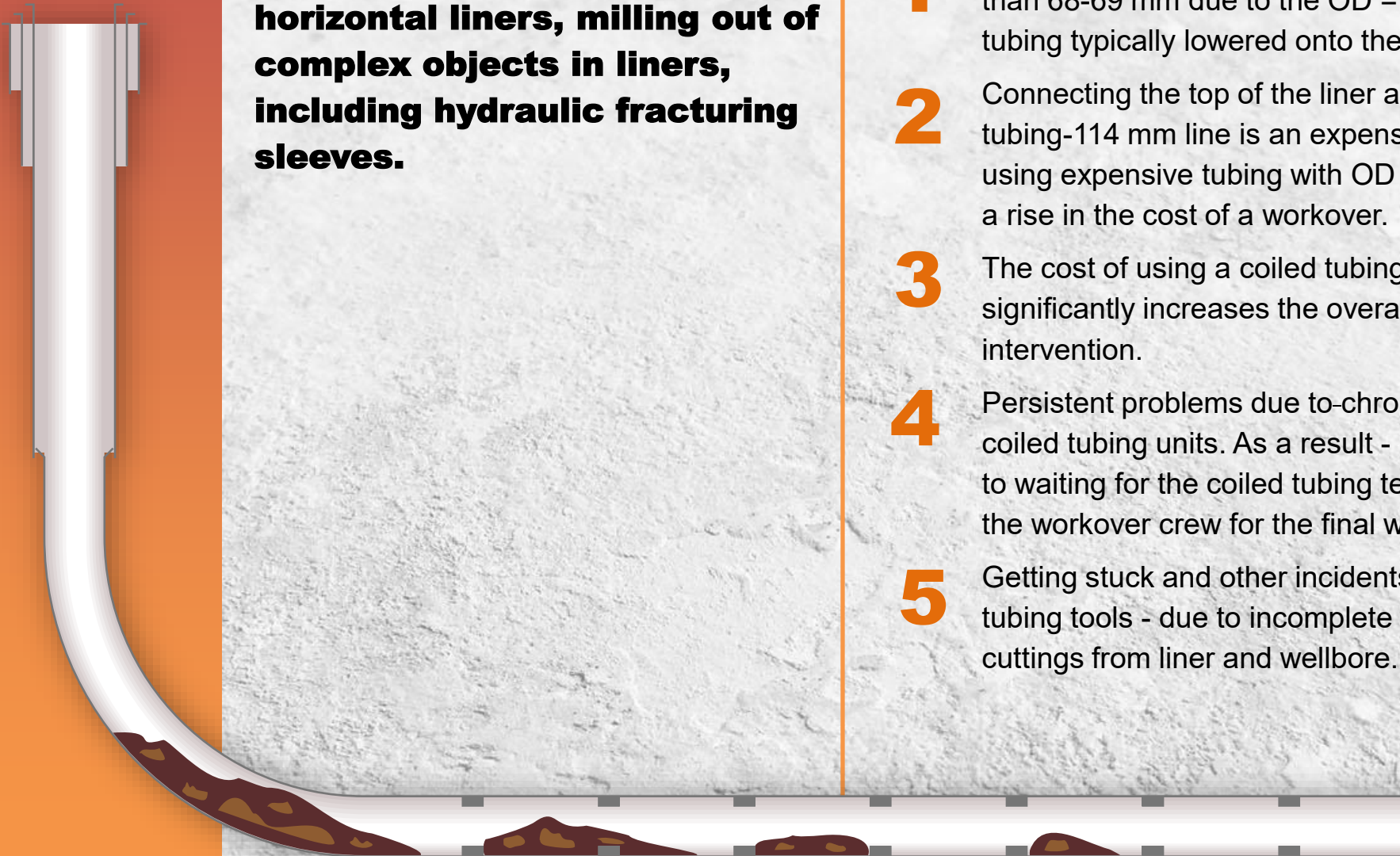
Hydro-Vacuum Bailing is a laborious operation, limited in cases of cement plugs, hydraulic fracturing sleeves and other equipment presence.

Well flushing - in addition to the restrictions of bailing, it is limited by presence of circulation loss that often appears during backflushing.

Milling out hydraulic fracturing sleeves using coiled tubing. More details - in the next slide.

CLEANING OUT PROBLEMS OF

horizontal liners, milling out of complex objects in liners, including hydraulic fracturing sleeves.



The use of a coiled tubing unit to clean out liners is complicated by the following:

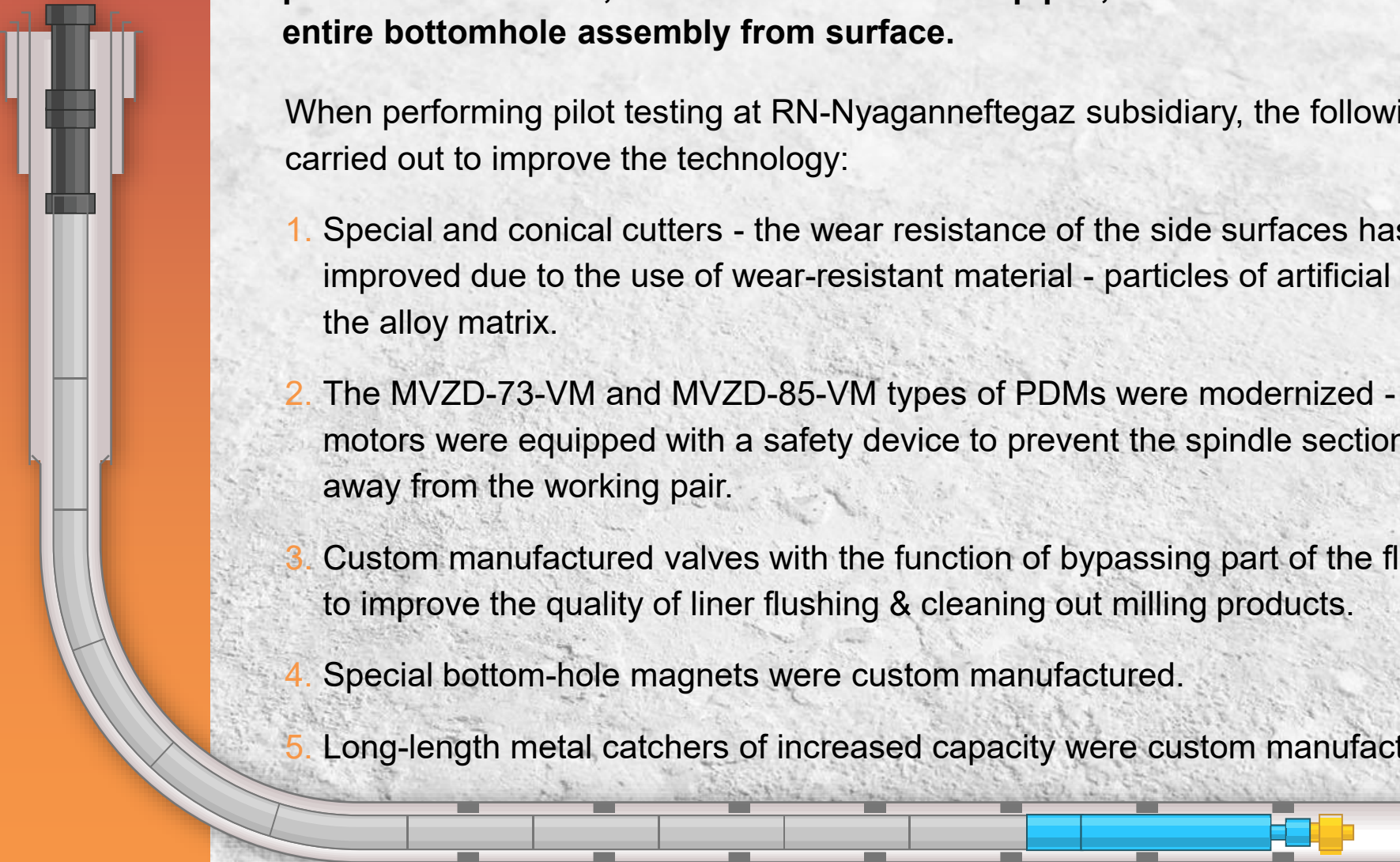
- 1** It does not allow drilling the flow area of more than 68-69 mm due to the OD = 89 mm oil-well tubing typically lowered onto the top of adapter.
- 2** Connecting the top of the liner adapter with tubing-114 mm line is an expensive operation using expensive tubing with OD = 114 mm and a rise in the cost of a workover.
- 3** The cost of using a coiled tubing unit fleet significantly increases the overall cost of well intervention.
- 4** Persistent problems due to chronic shortages of coiled tubing units. As a result - loss of time due to waiting for the coiled tubing team, as well as the workover crew for the final workover.
- 5** Getting stuck and other incidents with coiled tubing tools - due to incomplete washout of cuttings from liner and wellbore.

The INTEHNO technology was offered for pilot testing

cleaning out of horizontal liners with OD = 114mm, milling out multi-stage hydraulic fracturing sleeves in OD = 114 mm liners. The technology included utilizing high-power low-bit PDMs, lowered on smooth drill pipes, with additional rotation of the entire bottomhole assembly from surface.

When performing pilot testing at RN-Nyaganneftegaz subsidiary, the following work was carried out to improve the technology:

1. Special and conical cutters - the wear resistance of the side surfaces has been improved due to the use of wear-resistant material - particles of artificial diamonds in the alloy matrix.
2. The MVZD-73-VM and MVZD-85-VM types of PDMs were modernized - the downhole motors were equipped with a safety device to prevent the spindle section from turning away from the working pair.
3. Custom manufactured valves with the function of bypassing part of the fluid were used to improve the quality of liner flushing & cleaning out milling products.
4. Special bottom-hole magnets were custom manufactured.
5. Long-length metal catchers of increased capacity were custom manufactured.





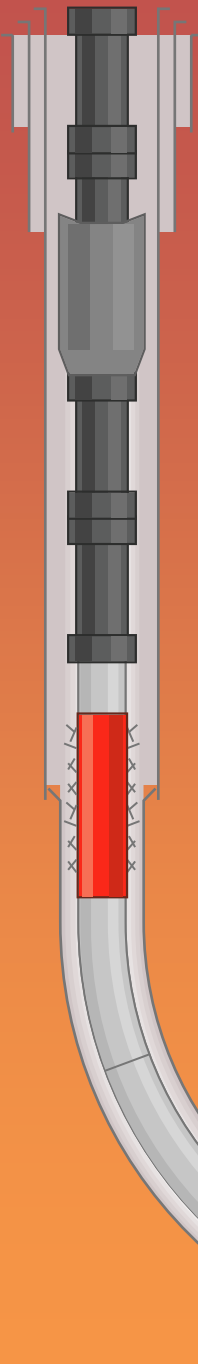
**The technology currently
looks like this:**

Proposed technology features

cleaning out of flow areas in horizontal liners of small diameter,
milling out hydraulic fracturing sleeves

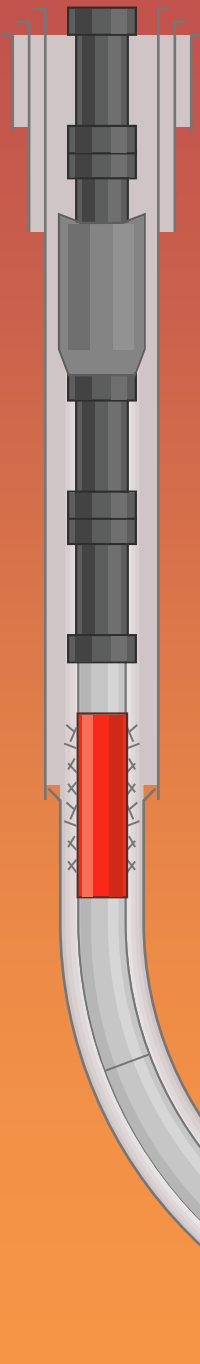
- 1 Use of block fluid.
- 2 Application of a special milling bit, with a pilot part (or without it), specially made for milling out multistage hydraulic fracturing sleeves.
- 3 MVZD –VM is a small-sized downhole motor (PDM) of high power and high flow rate.
- 4 A bypass valve can be used to increase the rate of fluid rise and improve flushing performance. (extra pump unit may be needed).
- 5 Smooth drill pipes with hardened tool joints hidden inward and having-special thread hardening **.

** - EMP installation (technology of Bauman Moscow State Technical University). The EMO unit belongs to INTECHNO

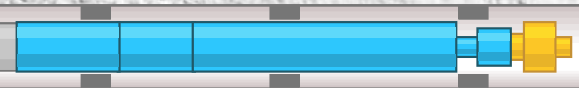


Proposed technology features

cleaning out of flow areas in horizontal liners of small diameter,
milling out hydraulic fracturing sleeves



- 6** Lifting devices for trips - special equipment of INTECHNO for working with smooth drill pipes.
- 7** Heavy-weight drill pipe with 73 mm OD - from the head of the smooth drill pipes to the wellhead.
- 8** Mechanical rotor equipped with a torque control sensor.
- 9** Flushing - with units SIN-35 or SIN - 35.64, ensuring a liquid flow rates of up to 28-32 l / s.
- 10** Filters, check valves of a special design, magnets, long-size metal catchers (working with a rotating arrangement).
- 11** Engineering and technological support of works by a specialist of INTECHNO.



ADVANTAGES AND DISADVANTAGES

of the technology for milling out cement plugs, as well as multistage hydraulic fracturing sleeves in liners with OD 102- 114 mm

ADVANTAGES:



Obtaining equal liner's inner diameter after milling out, with cutters of OD up to 95-96 mm (it depends on the liner's wall thickness, it can be OD = 93-94 mm).



Providing the possibility of carrying out successful re-fracs, cement squeeze jobs etc. in the liners using selective packers and hydraulic fracturing packers of small diameter

DISADVANTAGES:



Risks caused by abnormally low formation pressures when catastrophic circulation losses are likely.

Information on the cleaning out of liners in RN-Nyaganneftegaz subsidiary:

№	Well	Well cluster	Field	Work start date	Number of intervals	Drilling time with MVZD-85-VM, MVZD-73-VM, hours									average time for 1 interval
						1 st interval	2 nd interval	3 rd interval	4 th interval	5 th interval	6 th interval	7 th interval	8 th interval	9 th interval	
1	14834H	80	Kamenniy	15.10.2018	5	6	4	4	4	4					4,40
2	8381H	49	Kamenniy	18.01.2019	9	5	5	12	4	2	2	2	2	2	4,00
3	14827H	88	Kamenniy	14.05.2019	5	5	4	4	3	4					4,00
4	2924	49	Talinskiy	04.05.2019	3	24	technical complication								24,00
5	4744	31	Kamenniy	12.06.2019	4	4									4,00
6	4296	32	Kamenniy	19.07.2019	4	4,5	3	2,5	2,5						3,13
7	5736-2H	124	Talinskiy	17.09.2019	5	4	3	3	4	5					3,80
8	6630	258	Talinskiy	26.09.2019	3	7	above the frac sleeve, there was unknown metal blockage.							7,00	
9	6778	274	Talinskiy	28.02.2020	4	3,5	3,2	3,8	4						3,63
10	8436H	49	Kamenniy	12.04.2020	7	4	3	3,3	4,2	3,75	3,67	3,67			3,66

*Average drilling time for 1 interval in successful wells = 3.8 hours

Re-fracturing was carried out in 4 wells* with the following results:

Well cluster	Well #	Stopping parameters before geological and technical works				Parametres after stimulations				Daily oil production increase , bbl/ day
		Method of operation	Q _{oil} , bbl/ day	Q _{liq} , m ³ / day	Water cut, %	Method of operation	Q _{oil} , bbl/day	Q _{liq} , m ³ / day	Water cut, %	
80	14834H	ESP	72,6	74	84	ESP	158,3	161	84	85,7
49	8381H	ESP	89,4	208	93	ESP	172,3	401	93	82,9
88	14827H	ESP	134,1	59	63	ESP	244,0	153	74	109,9
31-2	4744	ESP	143,7	102	77	ESP	245,6	445	91	101,8

*Oil producer wells with horizontal liners



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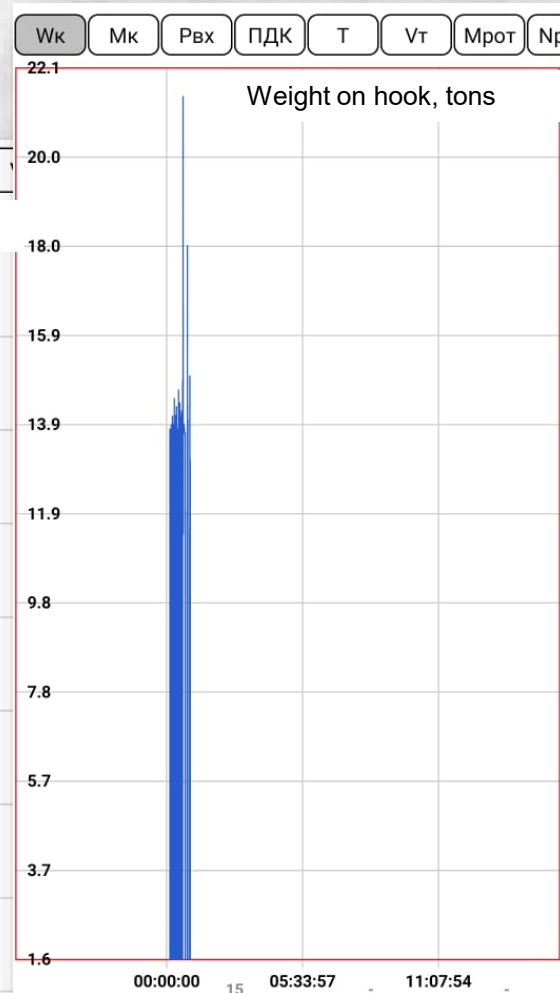
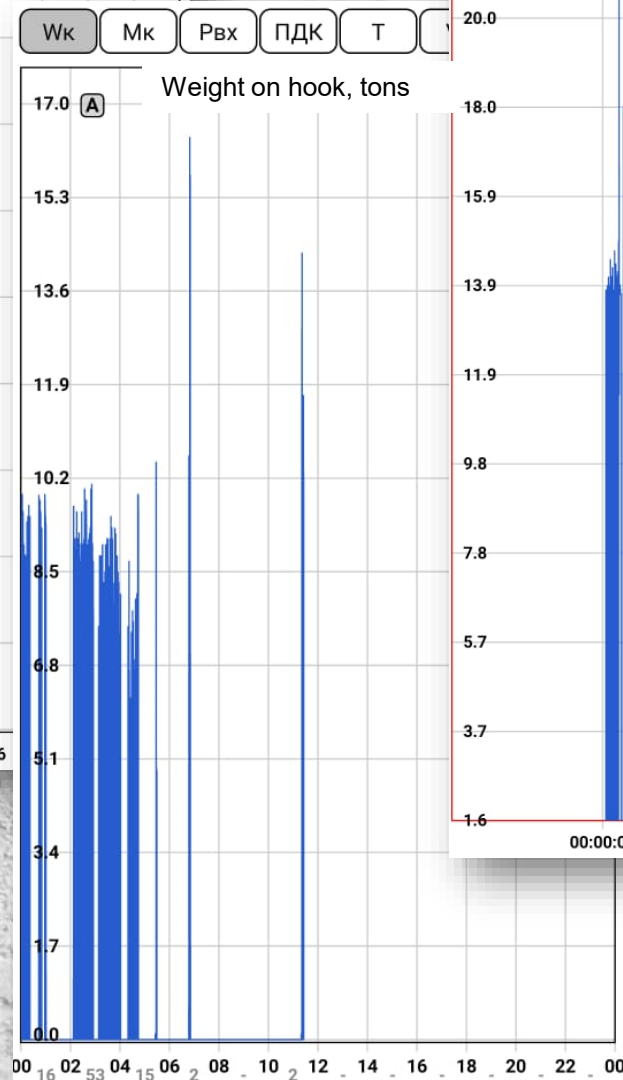
DISCLAIMER

The Presentation outlines operations performed internationally. Certain technical details and proprietary elements of the technology have been intentionally omitted.

Frequently Asked Questions



Does the equipment get stuck when milling? How often?



Answer: Yes, sometimes it gets stuck, despite working with smooth drill pipes, mostly in the areas where the cutter and the PDM are located.

The slide shows the examples of weight spikes when cleaning out the section of the 114 mm OD liner in the well No. 8436H of the Krasnoleninskoe oil and gas condensate field.

The main thing is that when you get stuck, you should not aggravate the situation. Competent actions of the engineer (more than 20 years of experience) at the wellhead allow you to eliminate the complication, and then mill out the problematic interval at least three times.

Can you mill out with total circulation loss?

Answer:

Yes, we have experience in cleaning out the liner section in the absence of circulation. (well 8436H of the Krasnoleninskoe oil and gas condensate field). At the well, work was carried out with the supply of work fluid by tank trucks.

There is experience of carrying out work with water supply from the pipeline of an injector well.

At the same time, in your specific conditions, a specific Customer, it is necessary to look at both well conditions and the Customer's ability to provide a continuous supply of the work fluid.

Maximum well depth? Maximum liner length?

Answer:

The maximum measured depth (MD) - 4,300 meters (well 2293H of the Ust-Tegusskoye field).

The maximum liner length, in which we worked - 1230 meters (well 6778H of the Krasnoleninsky oil and gas condensate field)

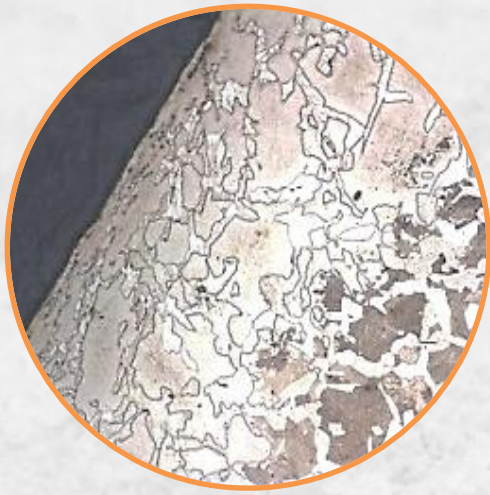
**How do you harden
the threads of your
smooth drill pipes?
What is the EMP
hardening
technology?**

EMP - technology of electromechanical surface treatment (Bauman Moscow State Technical University).

Here it is used for hardening the surface of the threads # Z-50 of smooth drill pipes. INTECHNO owns the unit. The technology allows to harden the working surfaces of threaded joints, as well as to improve their extreme pressure properties.

**CLICK ON THE
VIDEO showing
the EMP
process.**

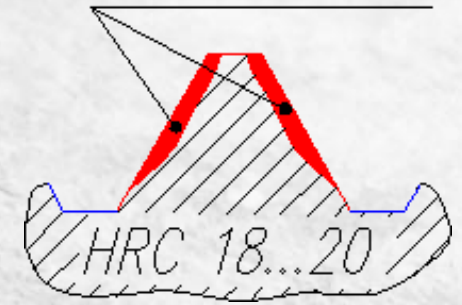




Technology of Threads Hardening by Electromechanical Processing

THREAD

HRC 48...68



** - EMP (technology of the Bauman Moscow State Technical University). The EMP unit belongs to INTECHNO

