Oilfield reagents for integrated provision of technology oil production

«New Technologies» LLC (Russia, Kazan),
8 800 555 84 32

The current technology of commercial oil production is a chain made of three basic processes (production, treatment & transportation), each of which requires special reagents to be use. The most necessary reagents are as follows:

- **Corrosion inhibitors - reduce the rate of process-equipment corrosion;**
- **Demulsifiers - destroy the water-oil emulsion that is formed in the process of crude oil production and pipeline transport, and provide the necessary degree of oil dehydration (no more than 0.5%);**
- **Paraffin inhibitors - prevent the asphalt-resin-paraffin deposition in oil pipelines.**

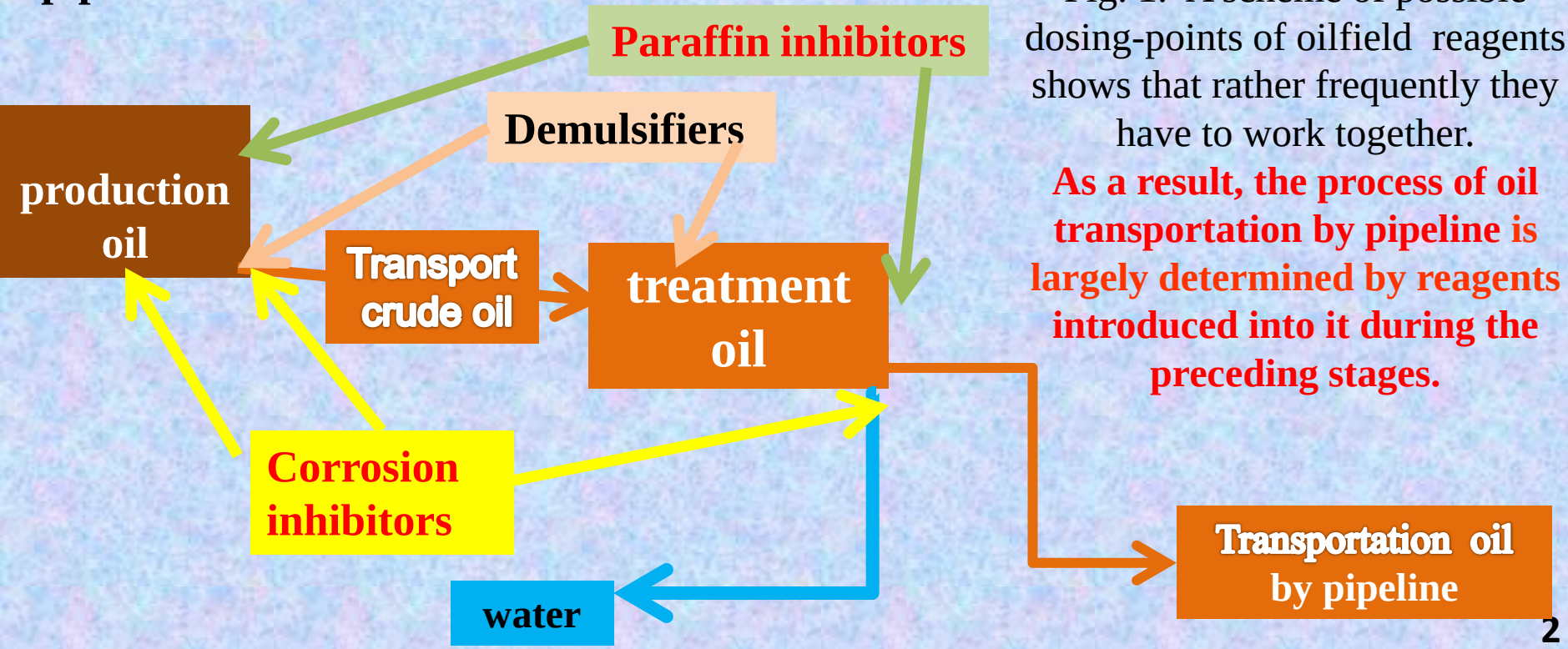

Fig. 1. A scheme of possible dosing-points of oilfield reagents shows that rather frequently they have to work together.

As a result, the process of oil transportation by pipeline is largely determined by reagents introduced into it during the preceding stages.

However, the simultaneous use of different-type reagents in case of their incompatibility may cause actually complete self-neutralization of their technological effects. This problem is not received due attention at many oilfields.

Fig. 2-3 on example of the corrosion inhibitor and demulsifier, show possibility so significant incompatibility between the reagents, it leads to a change even the sign of these reagents' effects.

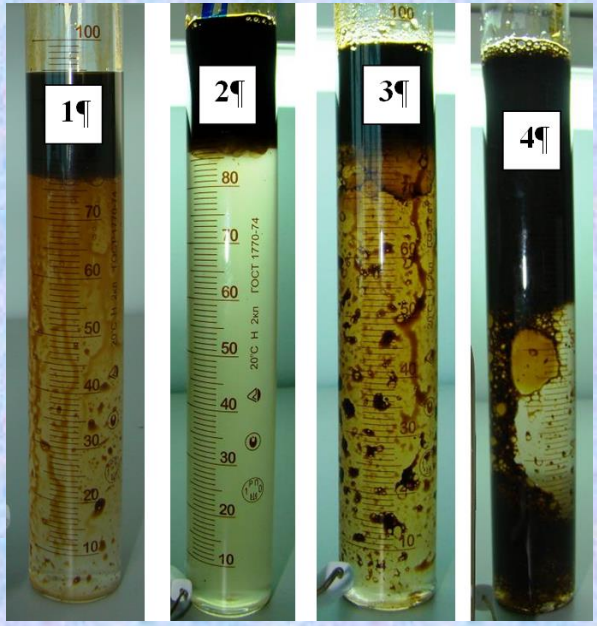

Fig. 2. Photos of water-oil emulsions after their separation at 22°C: 1- Without reagents; 2 - With demulsifier; 3- With corrosion inhibitor , but without demulsifier; 4 - With corrosion inhibitor in water and demulsifier

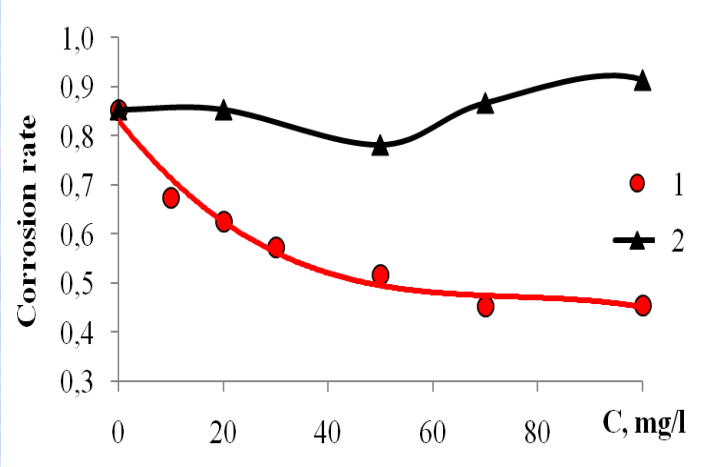

Fig. 3. Corrosion rate of steel (mm/year) in mineralized water in concentration dependent of corrosion inhibitor therein: 1- without demulsifier, 2-with demulsifier (20g/ton water).

Water emulsions stability (Fig. 2) and the corrosion rate (Fig. 3) when these reagents were used together appeared to be not lower, but even higher than without reagents. As a result, on the oilfield faced severe problems.

The essence of our innovation

In order to rectify such problems, we propose to carry out an integrated reagents' provision of all basic processes at oilfields through selection reagents 'set with a positive synergetic effect between them.

In this case, while using the several reagents jointly, synergy rather than decline in the technological efficiency of each reagent will occur. This may reduce a dosage of the applied reagents by several times, and therefore lower the cost oil-produced.

Even more significant reduction of a reagent dosage at the oilfields may be achieved by the use of complex-effect reagents that have a combined technological effect of several reagents.

The essence of our innovation

This proposal is based on our pilot production of such reagents, high efficiency of which is ensured by our new research method that has no analogue in the world

This method is based upon the registration the physical and chemical parameters of reagents, between which for all oilfield reagents there is a good correlation with their technological efficiency.

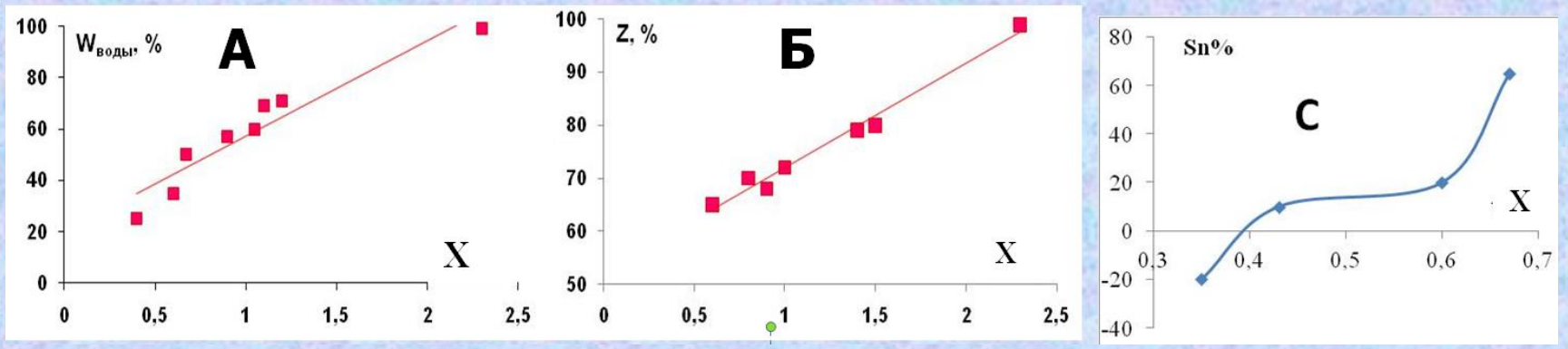

Fig. 4 demonstrates the existence of such similar correlation between the parameter «X», characterizing the inter-molecular interactions in reagent solutions at a nano-scale and their ability to:

A - Dehydrate crude oil for the demulsifiers of oil-water emulsions,

B – Reduce steel corrosion for the corrosion inhibitors;

C - Reduce asphalt-resin-paraffin deposition for the paraffin inhibitors.

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The essence of our innovation

The detection physical & chemical parameters of the reagents, which characterize their technological efficiency, give us a possibility very quickly:

✓ Select the most prospective chemicals for their further use in a composition of the oilfield reagents under formulation;
✓ Choose the reagent collections with a positive synergistic effect;
✓ Accurately define such compositions of multi-components mixtures chemicals, which will be having the maximum efficiency.

In addition, discovered correlations, actually blur the boundary between the different-type reagents and form a scientific basis for development of highly effective reagents with properties of several infield reagents (complex-effect-reagents or “all-in-one”).

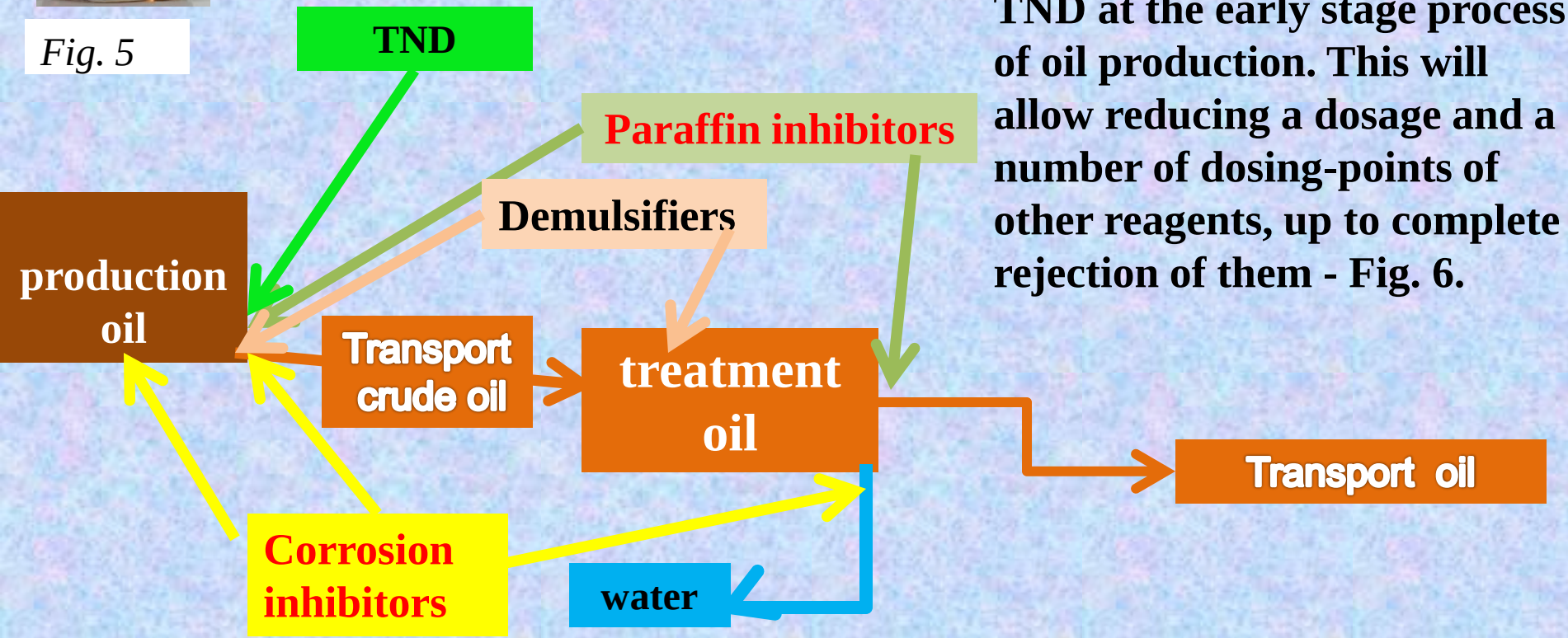
OUR EXPERIENCE:

Company «New Technologies» LLC (Russia, Kazan) for some years produces reagent "TND", which is the complex-effect-composite, which has been successfully tested in labs and at some oilfields in Russia, Kazakhstan, Tatarstan and Turkmenistan.

Fig. 5

The photo on Fig. 5 shows the external appearance of this reagent.

We propose to introduce the TND at the early stage process of oil production. This will allow reducing a dosage and a number of dosing-points of other reagents, up to complete rejection of them - Fig. 6.



Efficiency TND as a corrosion inhibitor

TND is able to reduce the steel corrosion as corrosion inhibitors of the best world-class (fig. 7). And this is achieved with its very low dosage - no more than 20 mg in a liter of water - Fig. 8.

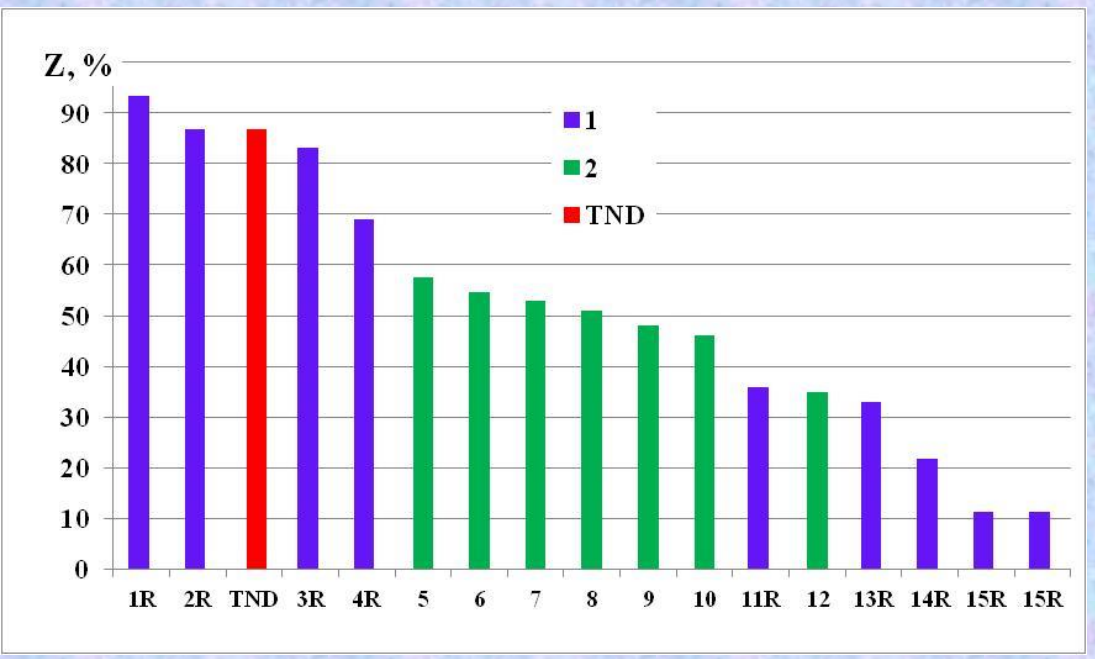


Fig. 7. Compared protective effect from steel corrosion for TND and 15 corrosion inhibitors: 1- Russian production; 2- foreign production

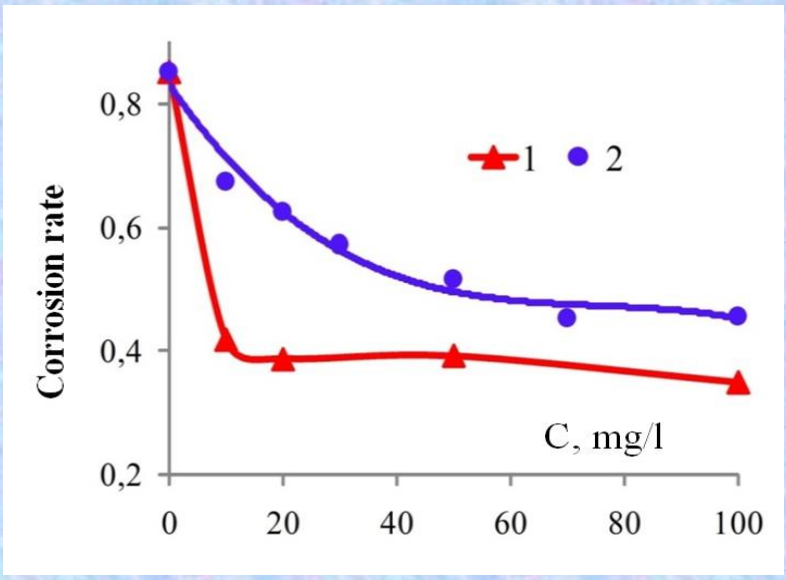


Fig. 8. Corrosion rate of a steel (mm/ year) in mineralized water in a concentration dependent therein: 1 – TND; 2 - Corrosion inhibitor

Demulsifying efficiency of TND

TND has a higher demulsifying capability compared to the currently applied demulsifiers, regardless of crude oil properties

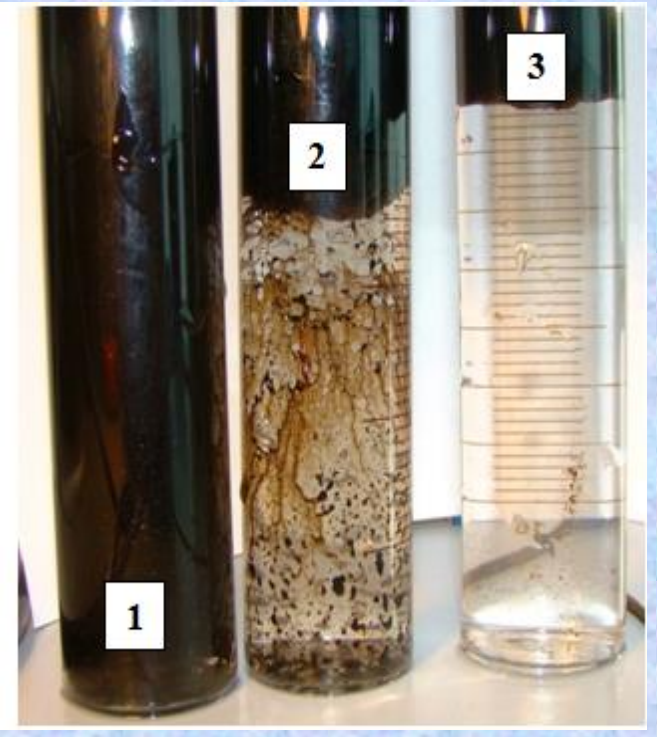


Fig. 9. Photos of the crude oil after finding in identical conditions (50°C during 2 hours):
1 - Without a demulsifier;
2 - With the best Russian analogue of the TND, selected for this oil;
3 – With the TND of a dosage 2 times less than that of the analog used.

As can be seen, demulsifying efficiency of TND in this case is higher than at the best Russian analogue with dose 2 times more.

These results were confirmed by pilot tests TND at a number of oilfields.

Fig. 10. An example pilot tests of TND at oilfields.

TND was able to provide a high-quality oil dehydration (water content less than 0.3%) and high-quality water treating from oil products (less than 20 mg / l) at a dosage about 3 times less than the analog.

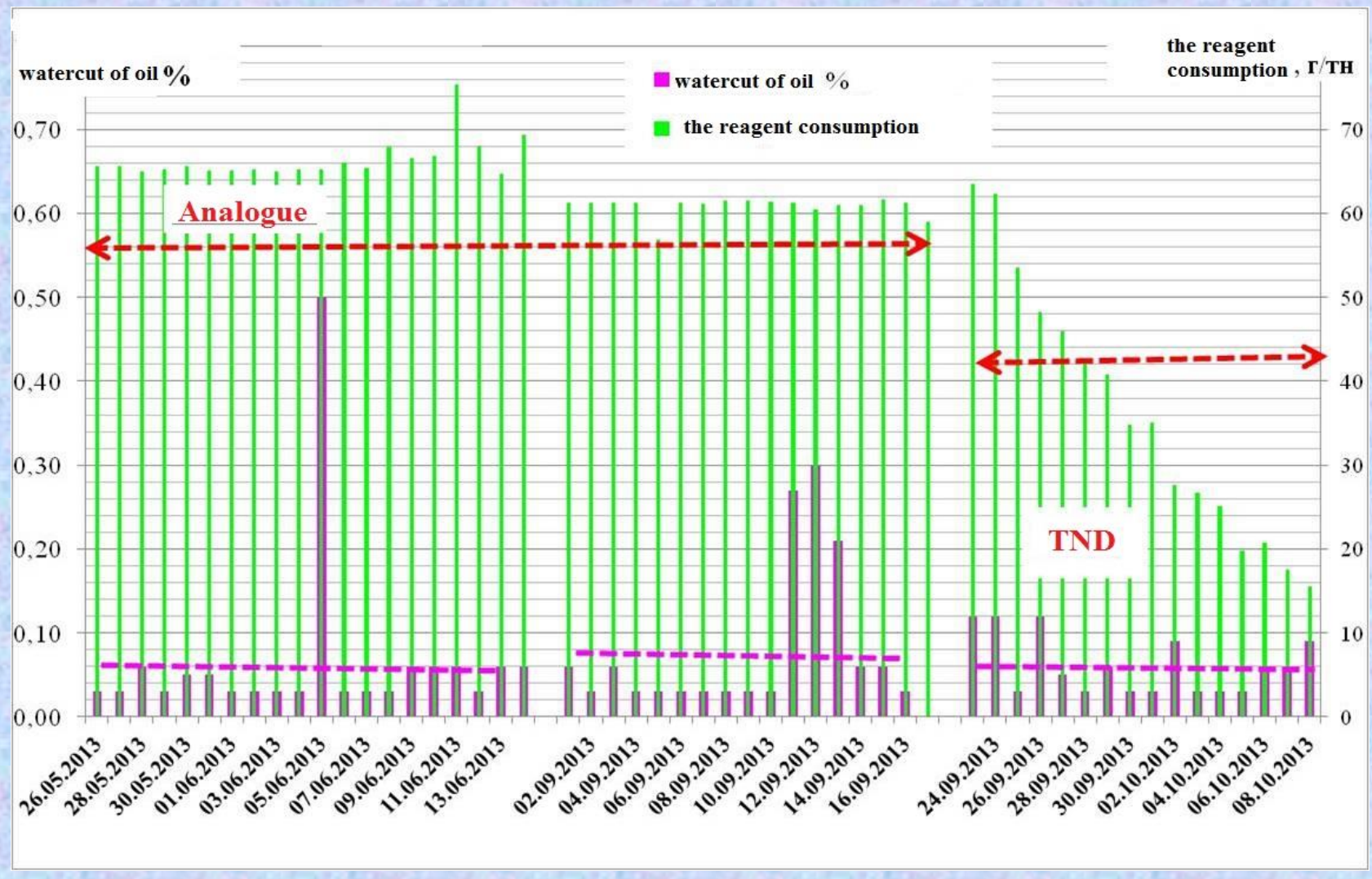


Fig. 11. An example pilot tests of TND at oilfields*: the TND provides a very high quality of oil dehydration (content water-in-oil on average 0.07%) at the dosage 4 times less than the analog demulsifier.*

Efficiency TND as a inhibitor of paraffin

The TND is able to reduce asphalt-resin-paraffin deposition by 80%.

The nature of this phenomenon is defined by the TND capability to reduce a paraffin-particle size in oil by about 50 times. For example, as shown in Figure 12, in the original oil are dominated particles with sizes of about 1000 nm (1 micron); and after input the TND - about 20nm.

The paraffin particles of such a small size will exist in oils in a suspended state, without forming depositions in oil pipelines and other oilfield equipment.

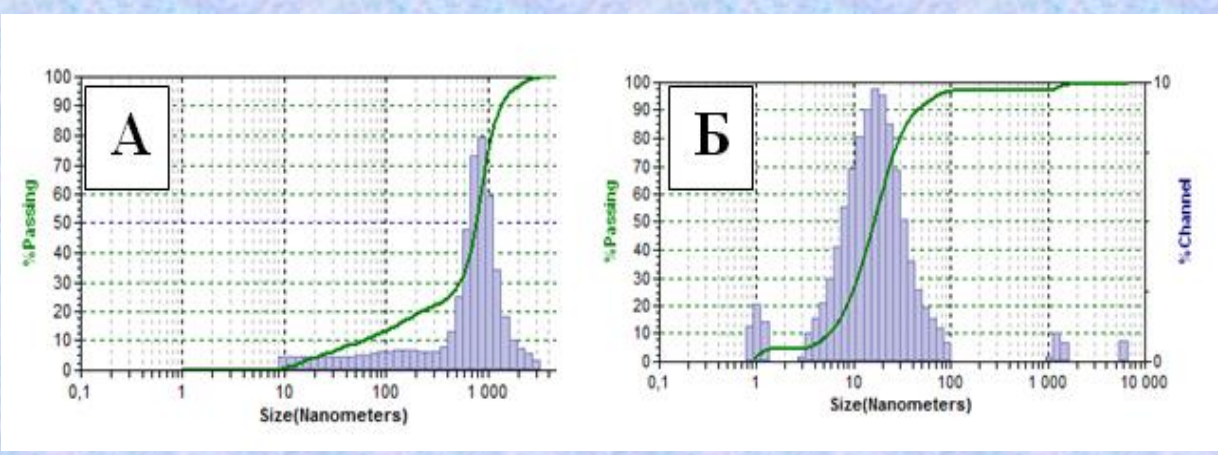


Fig. 12. The distribution sizes of asphalt-resin-paraffin particle in oil:
A) original oil;
b) with TND (100 g/ton oil)

Efficiency TND as a viscosity reducer

TND is able to reduce the oil viscosity by 30% - 50%, thus making oil pipeline transportation much easier.

The data presented in the table shows that a diversity of technological effects TND is also caused by its capability to reduce the oil viscosity by 30% - 50%, thus making oil pipeline transportation much easier.

T°C	Dynamic viscosity of oil, mPa·c		reduce the oil viscosity with TND, %
	original oil	with TND (100 g/t oil)	
30	90.9	58.9	54
35	72.9	51	43
40	58.3	42.3	38

TND is able to improve efficiency of other oilfield reagents

Fig.13 illustrates this effect on the example of a corrosion inhibitor, KO-101 used in Kazakhstan.

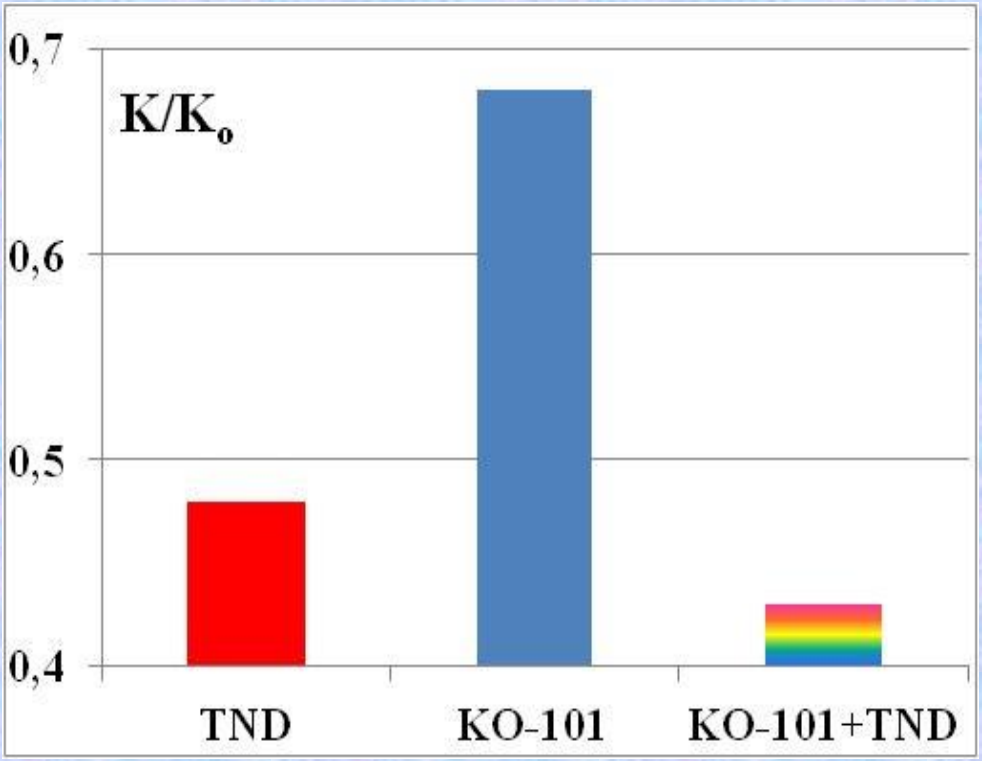


Fig. 13. The ratio corrosion rate of the steel samples in solutions of reagents on mineralized water (K) with concentration 20 mg/l to its value without reagents (K_o) for:

- *TND;*
- *corrosion inhibitor KO-101 is used in Kazakhstan;*
- *their mixtures with 20% TND.*

As we see, the steel corrosion rate K/Ko in the aqueous solution of mixture KO-101 with TND is reduced by almost two times compared to the same solution, but with only KO-101 and by the way at very low dosage -20 mg in a liter of water.

TND is able to improve efficiency of other oilfield reagents

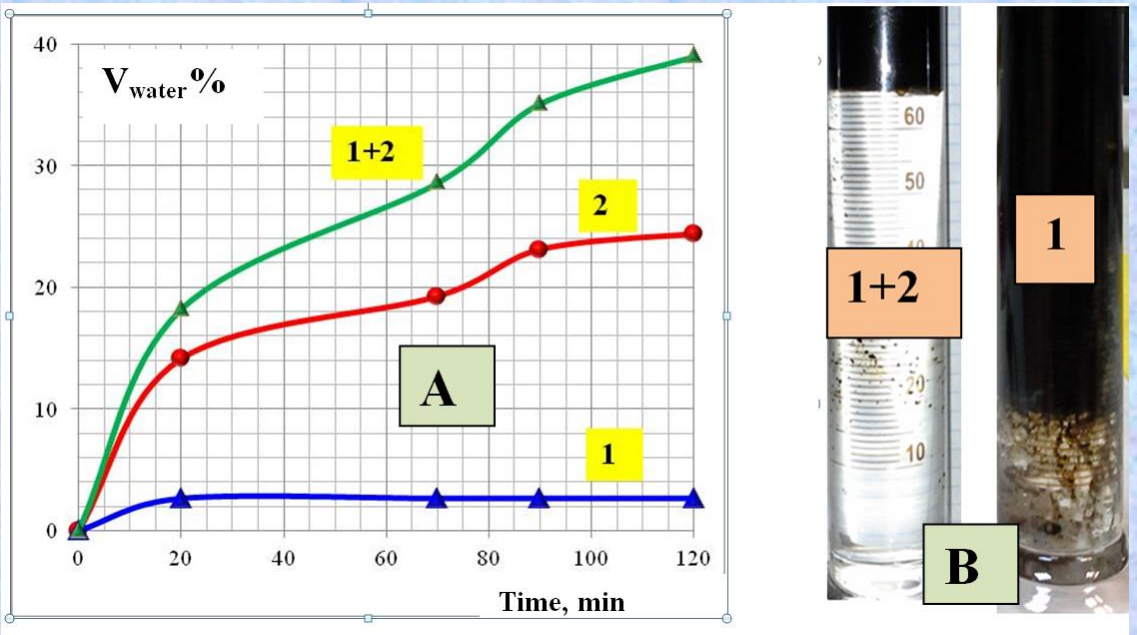


Fig. 14. A comparison of oil-water demulsifiers efficiency at two different crude oils (A and B): 1- the used in Tatarstan demulsifier; 2 - TND; 1+2 - mixture of two reagents (№1 and №2) with an optimal formulation.

Fig. 14 on the two different crude oils demonstrates the TND capability to improve the efficiency of oil-water demulsifiers on the example of its mixtures with a demulsifiers used in Tatarstan. As we can see, the efficiency of the mixture of two reagents (1+2) consisting of the used in Tatarstan demulsifier (reagent №1) and low dose TND (reagent №2), is higher than at the initial reagents. The results test of this composite reagent on oilfield even surpassed the expectations of experts.

SUMMARY:

The use of our complex-effect reagents developed by our method at oilfields in India will allow:

- ✓ **By 2-3 times reduce a dosage of other reagents, and reduce a number of their dosing-points without loss of technological efficiency;**
- ✓ **Ensure much higher quality of oil and water treatment using dosages 2 - 4 times less as compared to currently used demulsifiers, regardless of oil properties;**
- ✓ **Reduce the paraffin deposition up to 80%;**
- ✓ **By 1.3-1.5 times reduce oil viscosity, facilitating its transportation through pipelines;**
- ✓ **Reduce corrosion of pipelines at the level of the best world-class corrosion inhibitors.**

Thank you for attention