Research analysis of mechanical impurities of wells

I A Pogrebnya and S V Mikhailova
Industrial University of Tyumen, 38 Volodarskogo st., Tyumen, 625000, Russia
E-mail: ya.irina0607@yandex.ru

Abstract: The article is devoted to the investigation of the mineralogical and granulometric composition of mechanical impurities which destroy the pipeline network and the pumping hydraulic system in the fields of Western Siberia. Premature failure of the productive work of the equipment is due to the aggressiveness of groundwater pumped into the reservoir. A physicochemical analysis of the compositions of solid deposits on the damaged parts of oilfield equipment was performed. Measures were proposed to prevent the processes of saline deposits.

1. Introduction
Since the development of Western Siberia, over sixty years have passed. Pipeline transportation of oil and gas industry is pretty dilapidated. In injection wells, reservoir pressure is maintained by pumping sewage into the reservoir, which is pumped through the pipeline. Fields in the Far North have changed considerably - the share of reservoir water with oil extracted from the fields is over 95%. This fluid has an aggressive environment, leading to the destruction of the pipeline network and the hydraulic pumping system.

The cause of aggressiveness, leading to the destruction of oilfield pipes and equipment, is the mineralization and granulometric composition of the pumped liquid.

2. Research
On the basis of the Nizhnevartovsk Research and Design Institute of the Oil Industry (NIPIneft), determination of the mineralogical and granulometric composition is carried out in the laboratory "Physics of Oil and Gas Reservoirs and Systems". Under the microscope, a complete analysis of the mechanical impurities of the disintegrated metal entering the exploration from the fields is determined. Microscopic analysis makes it possible to determine the shape, structure and characteristics of the destroyed surface, as well as optical properties, which makes it possible to decide on the expediency of a method of inhibitors of sediments and destruction of the pipes under investigation. To prepare an inhibitor for research under a microscope, less than 1 mg of the substance is required. Measurement of spherical particles under the microscope delivers reliable and accurate values.

Measurement of grains size is carried out using a petrographic microscope “Polam”. In this case, the scale with the divisions or the grid located on the eyepiece is projected onto a sample to measure the granulometric composition of the cuttings. To determine the magnification of the microscope, an object micrometer is placed under the lens. To count the number of particles in an automatic mode using a photocell, the particles in the field of view are measured and recorded, and by the result they are assigned to the selected classes of a certain range of sizes. From these data, the frequency distribution of the number of particles is constructed. The granulometric composition is shown in the histograms of the report.
3. Results and discussion

3.1. Sample No. 1

Reason for failure and defects:

In the control laboratory came in a detail of the pump - the tip of a dark color as a result of electrical breakdown in the cable entry clutch, while the extension cable heated.

| Field | Well pad | Well | Reservoir | Stop reason | Operating time, days | Sampling date | Sampling point |
|-------|----------|------|-----------|-------------|---------------------|--------------|---------------|
| AC10, AC12 | 4738 | Geological and technical actions-bottom-hole treatment | 359 | 23.04.2016 | Core sampling |

Table 3.1. Mineral composition. Sample No. 1.

| Mineral composition, % | Content, % |
|------------------------|------------|
| Carbonate              | 81         |
| Barite                 | 12         |
| Iron hydroxides        | 7          |

The mineral composition of mechanical impurities is represented by microcrystalline carbonate, barite and iron hydroxides. The size of the micro-grain of the carbonate is smaller than 0.02 mm. Carbonate forms compressed lamellae, with irregular and isometric micrometers, with irregular jagged edges. Sphericity is 0.9. Roundness is 0.5. Barium admixture is noted, in the form of thin lamellar, acicular and scaly aggregates, no larger than 0.15 mm. Iron hydroxides colored in a rusty brown color are found in the form of colloidal and amorphous accumulations, up to 0.03 mm in size.

Table 3.2. Granulometric composition. Sample No. 1.

| Siltstone fraction, % | Pelitic fraction, % |
|-----------------------|---------------------|
| Coarse-grained        | Coarse-grained      | 85 |
| Medium-grained        | Medium-grained      | 0  |
| Fine-grained          | Fine-grained        | 0  |

Figure 3.1. Histogram of granulometric composition. Sample No.1.
3.2. Sample No. 2
Reason for failure and defects:
1. The washers were completely worn out (51-100%);
2. The sleeves were worn;
3. Working wheels had average wear out (21-50%);
4. The guiding devices were completely worn out (51-100%)

| Field | Well pad | Reservoir | Stop reason               | Operating time, days | Sampling date     | Sampling point     |
|-------|----------|-----------|---------------------------|----------------------|-------------------|--------------------|
| 41332 | AC12     | Seismic   | prospecting              | 23                   | 16.05.2016        | Gas well, ESP     |

Table 3.3 Mineral composition. Sample No. 2.

| Mineral composition | Content, % |
|---------------------|------------|
| Carbonate           | 89         |
| Iron hydroxides     | 11         |
| Coal substance      | 7          |

Mineral composition of mechanical impurities is represented by carbonate, iron hydroxides and carbonaceous matter. Micro-grained carbonate is distributed in the form of grains of irregular, tapered form, with uneven, sinuous edges, up to 0.03 mm in size. Iron hydroxides of amorphous and colloidal composition are distributed unevenly in the form of clusters, up to 0.05 mm in size with the sphericity...
0.7 and roundness 0.7. The carbon bearing substance (in reflected light - black) is distributed by formless spreads, up to 0.05 mm in size.

Table 3.4. Granulometric composition. Sample No. 2.

| Pelitic fraction, % |   |
|--------------------|---|
| Coarse-grained      | 100 |
| Medium-grained      | 0   |
| Fine-grained        | 0   |

Figure 3.3. Histogram of the particle size distribution. Sample No. 2.

Figure 3.4. Photo of sample No. 2.
Mineral composition of mechanical impurities is represented by carbonate, iron hydroxides and carbonaceous matter.

The analysis of the studied mechanical impurities of wells in the mineralogical relation is represented by the presence of carbonate salts and a small amount of iron hydroxides admixed with carbonaceous matter. Of all the examined samples, the presence of clastic grains of quartz and rarely plagioclase was noted in the wells: Priobskoye, Omskoye and Malobalykskoe West Siberian fields, where the percentage ratio was 61% to 24%, respectively. The fragments of plagioclase were not more than 5%. The admixture of iron hydroxides did not exceed 3-32%, and the carbonaceous matter did not exceed 7-33%.

According to the granulometric composition, the studied mechanical impurities of oil were represented by the psammo-aleurite fraction, with a predominance of coarse-grained siltstone fraction, with grain sizes from 0.05 to 0.1 mm. The large-medium-fine-grained psammite fraction was noted in the range from 15 to 69%. The pelitic fraction was 21-100%.

Samples contained a mixed composition with a predominance of the psammitic and siltstone fraction in an equal ratio.

Deposits of calcium and magnesium carbonate, calcium sulfate, barium, strontium, chlorides and other salts in wells, equipment, etc. occur during the development and exploitation of fields. On the deposit, calcium carbonate CaCO₃ and, in rare cases, deposits carried up from the reservoir are noted. The sedimentation of inorganic salts occurs when all methods of well operation - fountain, pump, gas lift, but most when pumping one. Of the total number of wells with saline deposits, about 60% of the fields in Western Siberia are equipped with submersible ESP pumps.

Aggressiveness of groundwater is formed due to the presence in them of a certain chemical composition - dissolved components that enhance the dissolution of carbonate-clay cement, with subsequent removal of rocks. Aggressive waters affect the chemical composition and concentration of certain chemical components. Great influence is exerted by temperature and filtration rate of the reservoir solution.

4. Conclusion

Thus, the physics-chemical analysis of the compositions of saline deposits allows to draw the following conclusions:

Firstly, the presence of samples with a clear advantage of a particular type of sediment indicates the corresponding process of formation of hardness deposition;

Secondly, carbonate salts are present in all types of deposits, which indicates that the process of deposition of carbonate salts takes place at all points of sampling, but with different rates of reaction of their formation;

Thirdly, in order to combat carbonate-type sediments, it is necessary to influence the production of wells in order to prevent their formation processes, to carry out salt deposition prevention measures on them, namely, inhibitors of saline deposits LEYSAN 3003 make 3, IPRODENT.

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