Available online at http://jess.esrae.ru/

"Journal of Economics and Social Sciences"

# Application of gravel pack technology to the "x" field on Sakhalin island

Tomsk Polytechnic University

Sin D.C.[a,b]

[a] School of Natural Resources Engineering, Tomsk Polytechnic University
[b] Faculty of Geology, Exploration and Resource Development, Tomsk State University

**Abstract**

One of the factors that complicates the operation of wells is the content of mechanical impurities in the reservoir fluid. The removal of mechanical impurities along with oil occurs in many oil-producing regions of Russia and some foreign countries. In such conditions, the inter-repair period of downhole equipment is sharply reduced.
Hydrocarbons obtained from poorly fortified reservoirs may contain small bodies such as clays and sand. Installing sand control equipment without affecting productivity, flow control and mineral extraction is a complex and expensive task. However, repair costs are very high, especially for deep-water wells. At the "X" field, it is necessary to use reliable methods of sand control in wells, the gravel pack method provides an effective solution.

*Keywords:* Gravel-pack, sand control, repair, equipment;

## 1. Introduction

If we analyse the state of the country's oil and gas industry, we can trace the gradual deterioration of the resource base, an increase in the percentage of HTR reserves in the structure of companies and constantly occurring complications in the operation of fields. All this leads to the fact that there is a need to develop technologies for mining reserves in the conditions of depletion of deposits.

One of the most common problems in the conditions of depletion of deposits is sand manifestation. Sand occurrences lead to a huge number of overhauls, which puts the well out of operation for an indefinite period.

## 2. Method for selection of filter parameters

An expert-statistical approach to the selection of technologies for protection against mechanical impurities, based on the use of technology application matrices.

According to the method proposed by D. Tiffin, the choice between well and gravel filters depends on the content of clay fine particles <44 μm in the formation, the uniformity coefficient (d10 / d90) and the sorting coefficient (d10 / d95) of the reservoir rock grains. The uniformity is an indicator of the variation in grain size from large to small. Sorting is a measure of the change in the size of rock grains from coarse to fine - grained. The screen cell size is selected equal to the particle size $D_{10}$ or slightly smaller. When using gravel packings, the size of gravel grains is chosen to be $D_{50}=d_{50}*6$ (this criterion is proposed by R. J. Saucier and described in the article SPE 4030 "Considerations in Gravel Pack Design") [3,7].

Thus, in order to choose a sand control system according to the method of D. Tiffin, it is enough to have the granulometric composition of the rock (Fig. 1) that makes up the formation.

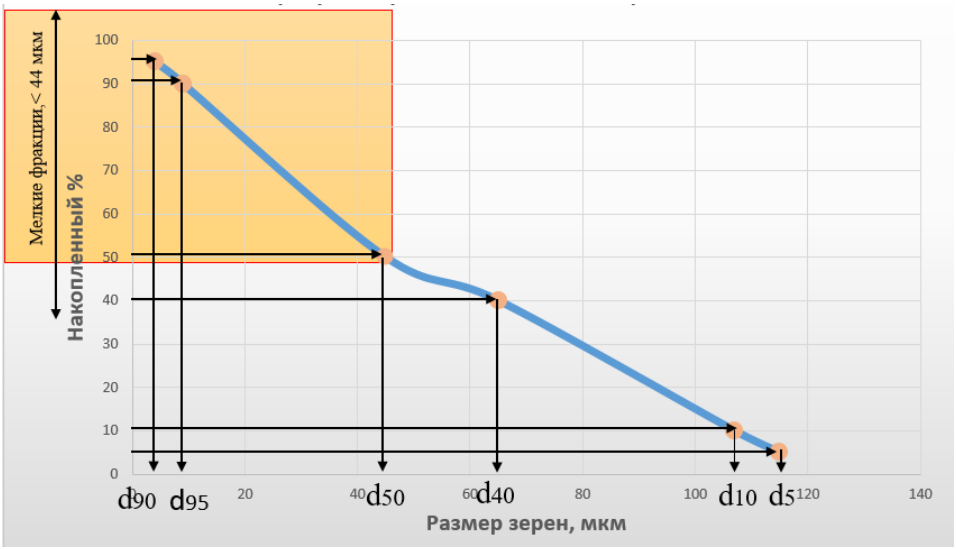


Fig. 1. cumulative grading curve

*2.1 About the method*

Table 1 shows the average data of the median size of reservoir sand fractions for a number of wells in the fields by X-l, horizon, the coefficient of sorting and homogeneity of particles, as well as the content of small sand fractions with a size of less than 44 microns [6].

Table 1. The particle parameters

| Parameter | Size, μm |
|---|---|
| $d_5$ | 114 |
| $d_{10}$ | 106 |
| $d_{40}$ | 64 |
| $d_{50}$ | 44 |
| $d_{90}$ | 8 |
| $d_{95}$ | 5 |
| Sorting coefficient $d_{10}/d_{95}$ | 27 |
| Uniformity coefficient $d_{40}/d_{90}$ | 7 |
| Fraction of fine particles, % | 51 |

Analysis of the table data shows a slight difference in the composition of the removed rock from the productive horizons, characterized by a high percentage of small clay fractions. According to the basic Tiffin matrix, the sandstones of the considered horizons are classified as very poorly sorted, reaching relatively high values ($K_{d10/d95} = 27$ ) [2].

The selection of filtration equipment parameters (cell size, width of slotted holes, the required number of layers, granulometric composition of gravel packing, etc.) is based on databases on the Deposit of geometric parameters of mineral particles of the rock [1,5].

The diameter of the proppant particles is selected based on the distribution curve of the rock particle size. In this case, we use such a concept as the homogeneity coefficient, which is calculated as the ratio between $d_{40}$ (40% have a particle size equal to this value or greater) and $d_{90}$ (90% of particles have a size equal to this value or less). The $D_{50}$ parameter is also used (50% of particles have a size equal to this value) [4].

*2.2 Proppant sizing*

The recommended ratio between the proppant particle size ($D_{50}$) and the average sand particle size ($d_{50}$) is 5-7 (maximum permeability), as well as acceptable values between 7-9. This size exposure is necessary to create a full downhole filter. Calculation of the diameter of the filter holes.

*2.3 Calculation of the diameter of the filter holes*

Absolute stopping criterion: gap size df <d10, where df is the diameter of the filter openings, d10 - 10% of the sand particles have a size equal to this value or larger.

*2.4 Proppant mass calculation*

$$V_p = V_{sr} + V_{sa}$$

where Vsr – volume of rat hole, Vsa – volume of annular space.

## 3. Conclusion

To solve the problem with sand ingress, it is recommended to install a gravel – pack in an openhole.

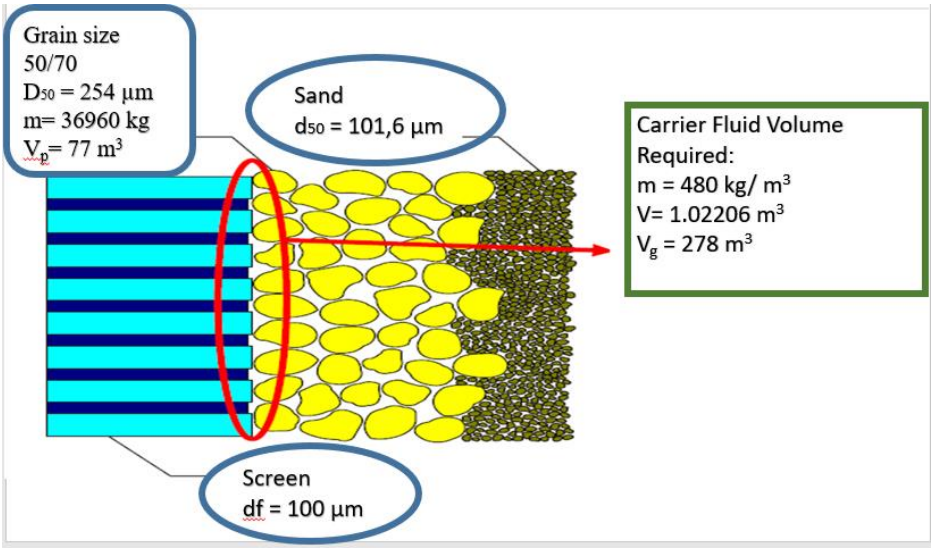


Fig. 2. screen option

**Acknowledgement**

I would like to express my special thanks of gratitude to English language adviser, Liudmila M. Bolsunovskaya.

**References**


1. Bennett, CL. (1999). Sand Control Design for Open Hole Completions. SPE Distinguished Lecturer Program presentations. Pau. France.
2. Recommended methods for choosing the method of completion in the conditions of sand development. Corporate scientific and technical center of Rosneft. New Technology Office 2011
3. Saucier, R.J. (1974). Considerations in Gravel Pack Design. [Available at https://www.onepetro.org/journal-paper/SPE-4030-PA] [Viewed on 12.03.2020]
4. Shell International Exploration and Production B. V. Sand control. Gravel Pack Design and Gravel Pack Operational Aspects. 2006
5. Syed, Ali. (2001). High-Productivity Horizontal Gravel Packs. Oilfield Review.
6. Tananykhin, D.S. (2013). Justification of the technology for attaching weakly cemented sandstones in the bottomhole zone of oil and gas wells by a chemical method. Abstract of dissertation for the degree of candidate of technical sciences. - St. Petersburg, 2013.
7. Tiffin, D.L., King, G.E., Larese, R.E., Britt, L.K. (1998). New Criteria for Gravel and Screen Selection for Sand Control. SPE 39437. 1998.