Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2013, 5(12):789-792

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Study and application of ZeroWash tracer fracture monitoring

Dongjin Xu[1], Ruiquan Liao[2], Junliang Li[1] and Zhuanhong Li[3]

[1]*Key Laboratory of Exploration Technologies for Oil and Gas Resources, Ministry of Education, Yangtze University, Jingzhou, China*
[2]*The Branch of Key Laboratory of CNPC for Oil and Gas Production, Yangtze University, Jingzhou, China*
[3]*Oil &Gas Technology Research Institute, Changqing Oilfield Company, Xi'an, China*

ABSTRACT

Hydraulic fracturing is an effective technique for increasing the productivity of wells producing from low permeability formations. Tracer fracture monitoring technique is near-wellbore zone frctures direct test method that can monitor the height and width of hydraulic fractures in the near-wellbore section. ZeroWash Tracer uses a medium strength ceramic proppant which is mainly used in fracturing process. It can make three different energy levels of tracer into the fracturing fluid and pump into formation, to monitor wellbore proppant distribution and identify fracture height. The application of ZeroWash Tracer in Changqing oilfield has been a great success. ZeroWash Tracer is used to monitor wellbore proppant distribution and evaluate fracturing effects in Hydraulic Fracturing.

Keywords: Tracer; low permeability; fracture monitoring technique; ZeroWash Tracer; hydraulic fracturing.

INTRODUCTION

The oilfield tracer technology has been carried out since 1950s, and it has experienced four stages of development, i.e. Chemical tracer, radioactive isotope tracer, non-radioactive isotope tracer and micro-matter tracer[1].

Currently/Generally the chemical tracers used in oilfield tests were sodium bromide, potassium iodide, isopropyl alcohol, etc. The main disadvantages of them were large amount, high cost and significant detection-error. Radioactive isotope tracer, which mainly is tritiated compounds, can be used as tracers of water, oil tracer gas tracer or tracers water allocation, and it is commonly used in oilfield tests[2,3]. Non-radioactive isotope tracer are those that no radioactive isotope tracer, such as ^{12}C,^{13}C,^{15}N,^{18}O,etc.Compared to the former, the latter has no high temperature conversion, no radioactive hazard, less dosage, convenient operation, and high measurement precision, etc[4]. Micro-matter tracer technology is to inject tracer into the well according to the rule to sampling[5], and then using inductively coupled plasma mass spectrometry to analyze the sample, and draw out the production curve of each well. Reservoir parameters are analyzed by the characteristics of production curve. Finally, the study of reservoir heterogeneity and distribution was studied through a comprehensive analysis of mathematical models and interpretation.

ZeroWash Tracer technology is an advanced technology developed by American Corelab company, and it is mainly used in fracturing process. It can join three different energy levels of tracer to the fracturing fluid and pumped into formation, to monitor wellbore proppant distribution and identify fracture height, in order to evaluate fracturing effects.

EXPERIMENTAL SECTION

2.1. Principle and Characteristic

ZeroWash Tracer using a medium strength ceramic proppant, and in the production of the proppant, non-radioactive heavy metal(such as antimony oxide or iridium,or scandium oxide) will be injected. Standard hybrid technology are used to mix metal salt and clay, add water in the mixture made spherical as figure1, and then baked in the kiln, cooled and sieved, graded according to size, cleaned and polished to remove traces of dust. After sieving again, using neutron bombardment to active the heavy metal material, it can be put into application after packaging.

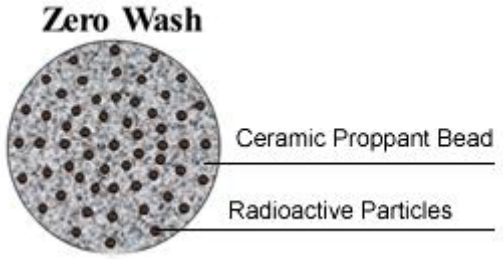

Fig. 1. Zero Wash Coating tracer structure diagram

NaI scintillation detector is used by Tracer imaging technology to detect gamma radiation, and electron multiplier photo tube to measure gamma and to send it to the download multiband analyzer, which can store and sort according to different energy level. According to tracer particles distance and isotope infusion concentration, the amount of proppant can be determined within the scope of detecting. According to the theory of cylindrical around wellbore and the number of proppant and size of cylinder, the assuming proppant is limited to a certain crack, and fracture proppant concentration inside can be calculated. The dimension of the theory cylinder was determined by the vertical resolution of test-tool and depth of detection. Detection of the depth was in proportion to isotope radiation energy level.

In the fracturing process, prepad fluid and carrying fluid are pumped in the first half and second half, with three different kinds of tracers to pump into the formation. After fracturing and flowback, in order to determine the fracture height and width, test system of monitoring tools are used to measure tracer radioactivity.

2.2. ZeroWash Tracer Fracture Monitoring design

ZeroWash Tracer fracture monitoring technology use low pressure creep displacement pump to inject, the principle and characteristics are as follows: using the roller axial of low pressure creep displacement pump to move along the pipe and drive the fluid in the tube. The main advantage of this pump is the fluid could not contact the pump body, and the pump would not be polluted, and there is no risk of dismantling the pump, time delay and cost waste when pump components are needed to be replaced. What's more, low pressure injection can eliminate various danger of high pressure injection during injection, it can be more flexible to change or increase the tracer.

In the fracturing process, three different radioactive tracers are pumped in three different stages, and different tracers are marked with different colors on the logging map, Sb-124 in blue, Sc-46 in yellow, Ir-192 in red. The injection procedure design is as table 1 showed.

Table 1. The tracer injection procedure design

Stage	Liquid type	Output volue m^3/min	Liquid volume m^3	Concentration of proppant kg/m^3	tracer	Concentration of tracer mCi	Cumulative time Min:Sec
prepad fluid	slickwater	0.3-0.5	6.2				
Packer	slickwater	0.5-1.6	1.5				
Pad fluid	Crosslinked guar gum	1.6	16.0		Sb-124	5	10:13
Slurry fluid	Crosslinked guar gum	1.6	8.0	243	Sc-46	5	15:42
	Crosslinked guar gum	1.6	12.0	405	Sc-46	5	24:25
	Crosslinked guar gum	1.8	23.0	486	Ir-192	15	39:41
	Crosslinked guar gum	1.8	14.0	567	Ir-192	10	49:14
	Crosslinked guar gum	1.8	10.0	648	Ir-192	10	56:14
Displacement fluid	guar gum based fluid	1.6	6.0				59:59

RESULTS AND DISCUSSION

3.1. Test Results

The well is a production well located in a structure of Changqing Oilfield. The fractured layer is CL3, and its thickness is 9.0 m. The reservoir porosity is 8%, and the permeability is 0.04 mD. Sand fracturing technology was

applied in this well. The perforation interval was from 2017.0m to 2020.0 m, and 40m^3 quartz sand was pumped into the well with a pump rate of 2.4 m^3/min. Fig.2 shows the result of tracer fracture monitoring technique used in this well. Different colours represent different gamma values of the tracers. The tracer which was pumped at the end of the injection always exists in the near wellbore place. As a result, there may be one, two or three tracer curves, and it depends on how many kinds of tracers were used in this well. The picture in the left shows the logging date, perforation interval, formation, and tracer profiles along the wellbore. The right one is a mirror symmetry picture showing a double wings fracture system. The fracture height is about 11m from the monitoring result.

3.2. Discussion

Analysis of fracturing tracer test result as following:

(1)The mud shale from 2010m to 2015m makes the fracture cannot be further extended upward.

(2)The radioactivity of tracers in pad fluid between 2016m and 2019m is very strong. It means that large number of fracturing fluid leaked into the formation or the fracture near wellbore distorted.

(3)The distribution of proppant changes over time shows that the placement of proppant in early time is the same as that in late time.

(4)The fracture height: from 2015m to 2026m.

(5)At 2030 m, the fracture extendes down only at the preflush stage. It indicates that cement channeling occurred in that place.

(6)In general, the perforated layer has been fully fractured.

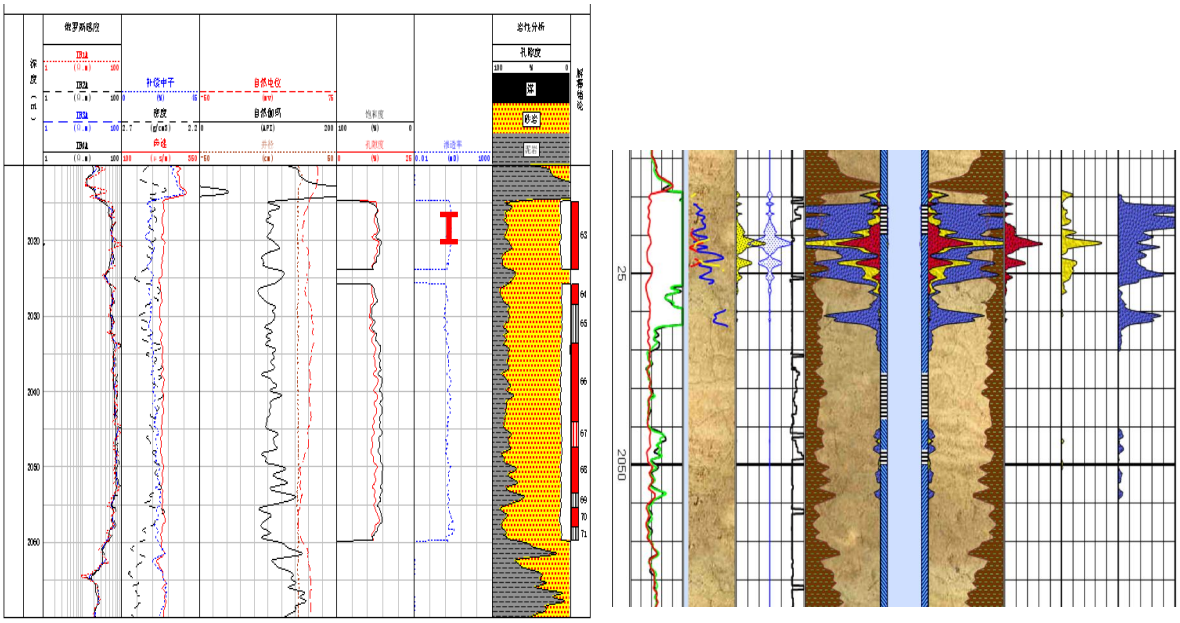

Fig.2. Integrated logging curve and diagnostic chart of tracer tests

CONCLUSION

(1) ZeroWash Tracer is helpful to recognize the fracture geometry and distribution, and to identify the scale of fracturing. It is benefit to optimize the fracturing design and fracturing process improvement.

(2) ZeroWash Tracer diagnostics is helpful to optimize reservoir parameters and to build a stimulation model. It is the foundation to improve the effectiveness of fracturing.

(3) Field application proved that ZeroWash Tracer technology was an effective diagnostic technique for well fracturing.

Acknowledgements

The support of Ph.D. Programs Foundation of Ministry of Education of China（No. 20114220110001） and the National Natural Science Foundation of China (No. 61170031) are gratefully acknowledged.

REFERENCES

[1] Li Chen, Fang Zhi-bin, and Liu Chun-lan, *Xingjiang Prtroleum Geology*, **2005**, Vol.26,No.1, 99-101,

[2] (The United States) B. Zemel forward, Oilfield Tracer Techniques.: Petroleum Industry Press: Beijing, **2005**, 50-60
[3] WU Di,HAN Yi-long,and FAN Song-wen, *Journal of Isotopes*, Vol.16,No.1, 19-22,**2003**
[4] WANG Zuoying,ZHANG Peixin, and GAO Yuan, *Journal of Isotopes*, **2000**,Vol.13, No.1, 18-21
[5] Xu Jiaxin, *Well Testing*, **2008**, Vol.12, No.4, 20-22,