Cleanout Time Cost Savings, KDP vs. Composite Plugs

Overview

Two operators in the Bakken area reached out to Kureha Energy Solutions (KES) requiring a reliable 10k dissolvable frac plug that can degrade in their wellbore conditions for their plug-and-perf frac operations. The operators needed a reliable degrading frac plug that can degrade in a multitude of wellbore environments and fluids to help decrease the coiled tubing mill-out timing and plug debris. Slashing mill-out times is an immense focus when coil tubing costs are on the rise. The operators requested to run the Kureha Degradable Frac Plug (KDP) in full wellbore applications at 220°F (operator 1) and 290°F (operator 2) on their pads. A total of 240 KDP's were run for operator 1 and 340 KDP's were run for operator 2. Operator 2 compared the mill-out time data of the KDP vs. composite plugs.

KDP Design

The KDP is designed to eliminate the risk of costly plug mill-out operations. It is manufactured from the industry's original degrading material that is field tested and highly suitable for frac plug material. The KDP hybrid design includes a degradable polymer (Polyglycolic acid, PGA) and dissolvable sealing element that predictably degrades to provide a clear wellbore for production without intervention, and assists in reaching longer laterals that coil tubing cannot reach.

The degradation behavior of PGA and the degradable sealing element is much simpler than 100% Mg alloy frac plugs. PGA is temperature dependent only, whereas Mg alloy degradation depends on temperature, chloride level, and can be affected by other well conditions, such as sand insulation. The KDP can degrade in all water types, oil, water moisture, and sand.

Operators are also consistently impressed with the plug's frac performance. The KDP's dual slip design and traditional full-length sealing element provides exceptional sealing performance in wells with harsh environments such as casing deformation, large temperature ranges, or high differential pressures.

Results

Operator 1

The 3.62" KDP was run in a full wellbore with 4.5" 11.6# casing. No problems were reported or seen during the frac operations, and the operator was very pleased with the KDP performance. After frac, the operator soaked the KDP's for 6 days, then the operator ran in hole with coil. There were no tags or debris when cleaning out all four wells on this pad.

KDP Features

- PGA based plug
- Traditional Frac Plug Design
  - Dual Slips
  - Large Sealing Element
  - Bottom Set Plug
- Max differential pressure of 10,000 psi
- Optimized pumpdown speeds
- BHT range of 150F – 450F
- Ball-in-place and pumpdown ball options

CASE STUDY DATA

PLUG LOCATION
Full Wellbore

WATER TYPE
Fresh Water

REGION
Bakken

OPERATOR 1 PAD DATA

CASING SIZE
4.5'' 11.6#

STAGE COUNT
240 Stages

BHT
220°F

SOAK TIME
6 days

CLEANOUT REPORT
No tags or debris

OPERATOR 2 PAD DATA

WATER TYPE
4.5'' 13.5#

STAGE COUNT
340 Stages

BHT
290°F

SOAK TIME
8 days

CLEANOUT REPORT
Four small tags less than 1 minute, no debris

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Operator 2

The 3.62” KDP was run full wellbore in four wells with 4.5” 13.5# casing, and full wellbore with composite plugs in three wells to compare the mill-out times of the KDP versus composite plugs. Data from the first two KDP cleanouts was given to KES from the operator to compare to the composite plug wells. No problems were reported or seen during the frac operations and the operator was very pleased with the KDP performance. After frac, the operator soaked the KDP’s for 8 days, then ran in hole with coil.

The data in the charts compare the KDP cleanouts vs. the composite cleanouts. There were 64 KDP’s run on each well on pad 1, and 65 composite plugs run on each well on pad 2 (2 KDP’s were run in the toe of each well on pad 2). Once both pads were finished, the operator was thrilled by the KDP cleanout performance. Ignoring run in hole and pull out of hole data and comparing the lateral operations data (mill-out timing in the lateral), the KDP cleanout operations averaged a little over half a day per well (0.58 days), while the composite plugs averaged over a day per well. The KDP saved the operator over 10 hours of mill-out time per well. On a three well pad, that is over 30 hours of mill-out time. With coil tubing costs climbing to around $90,000 per day and rising, running the KDP full-wellbore and eliminating costly composite mill-out times saved the operator around $90,000 - $180,000 (1-2 days of mill-out time costs).

The results of this trial are a good example of the great frac performance and stable degradation of the KDP. PGA based degradable plugs perform and degrade stably under a variety of conditions. PGA degradation does not stop, even in the conditions that have less liquid water or have a lot of sand. Please contact KES for more information in regards to your frac plug solution today.

Model	Total Plugs	MIA: %	Total Plugs MIA	Total Plugs Milled	Avg Plug Trip	Avg Trip Speed	Avg Mill Time
Kureha Degradable Plug	128	97	124	4	11.44	15.92	1.26
Total	**128**	**97**	**124**	**4**	**11.44**	**15.92**	**1.26**

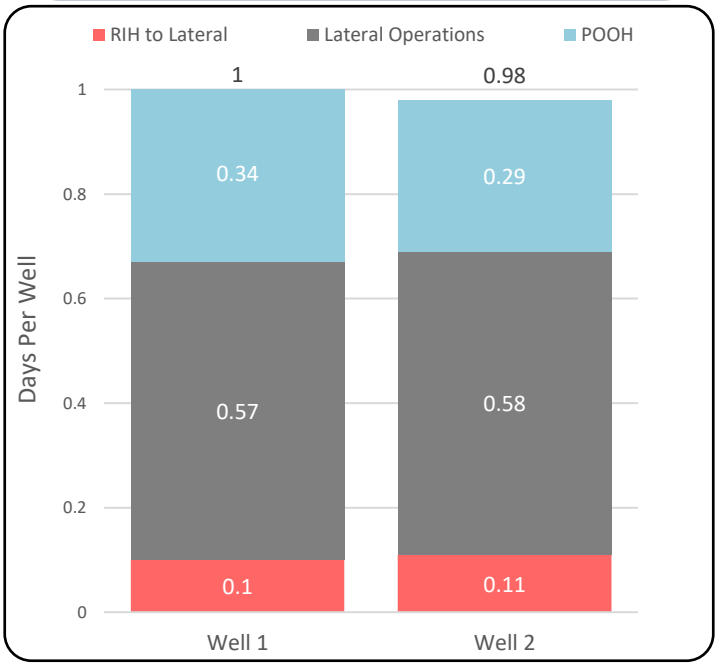

Figure 1: KDP Cleanout Data, Operator 2, Pad 1

Model	Total Plugs	MIA: %	Total Plugs MIA	Total Plugs Milled	Avg Plug Trip	Avg Trip Speed	Avg Mill Time
Composite Plug	195	5.00	9	186	16.88	10.32	3.91
Kureha Degradable Plug	6	100.00	6		28.33	5.02	
Total	**201**	**7.00**	**15**	**186**	**17.22**	**10.16**	**3.91**

Figure 2: KDP Cleanout Data, Operator 2, Pad 2

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