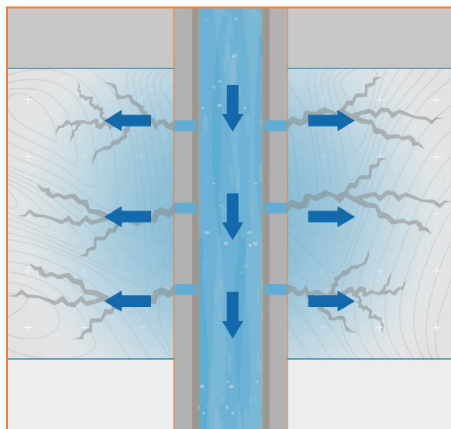


# CASE STUDY

## Kraken Perforating Transforms SWD Completions



- Increased injectivity 71%
- Reduced pressure 35%
- Decreased completion time 33%
- Immediate payback, ROI 57%
- Total savings over 3 years \$517K

### Project Challenge

A leading Delaware Basin operator, who owns and operates its own water infrastructure, needed to maximize SWD injection performance as well as minimize capital expenditures and overall operating costs.

### SWD Kraken® Solution

Enhanced Energetics applied Kraken-enhanced perforating technology during the initial completion of the SWD well. Kraken propellant boosters improve perf injection efficiency when compared to traditional perforating and reduce the volume of acid required for stimulation. This well was completed with Kraken-enhanced perforating guns and a three-stage acid job. Offset wells in the same formation were completed using traditional SWD completion techniques consisting of traditional perforating guns and a five-stage acid job requiring twice the volume of acid.

Kraken progressively burning propellant fractured the formation and cleared near-wellbore damage during the perforating process. The acid was then needed only to clear the remaining cement in the perforations and wellbore. By using Kraken technology, the injected fluid was able to access the formation through the perforations more efficiently compared to traditional perforating and acidizing techniques.

### High ROI Kraken Results

The step-test proved the success of Kraken technology by achieving an injection rate of 28 bbl/min at 1,866 psi. The step-test results indicated this SWD well had approximately 35,000 barrels of daily capacity at a permitted pressure of 1,500 psi. Compared to offset wells, this 71% increase in injection volume was achieved at the same pressure. Kraken perforating also allowed the operator to use 50% less acid and decrease rig time by 5 days. The drastically reduced pressure needed to achieve permitted rates reduced horizontal pump size and associated power consumption. **The result was a savings of \$230K in year 1, and a projected savings of \$517K over the next 3 years.**

### Application

New SWD completion

### Gun design

4-in. OD Kraken

### Formation

Delaware Basin  
Canyon Sands

### Location

Pecos, TX

### Max step-test injection rate

28 bbl/min

### Max step-test pressure

1,866 psi

### Injection rate at permitted pressure

24 bbl/min (1,500 psi)

### Interval depth

6,000 – 7,741 ft  
(3,039 perforations)

### Casing diameter

9 $\frac{5}{8}$  in.

### Tubing diameter

5 $\frac{1}{2}$  in.

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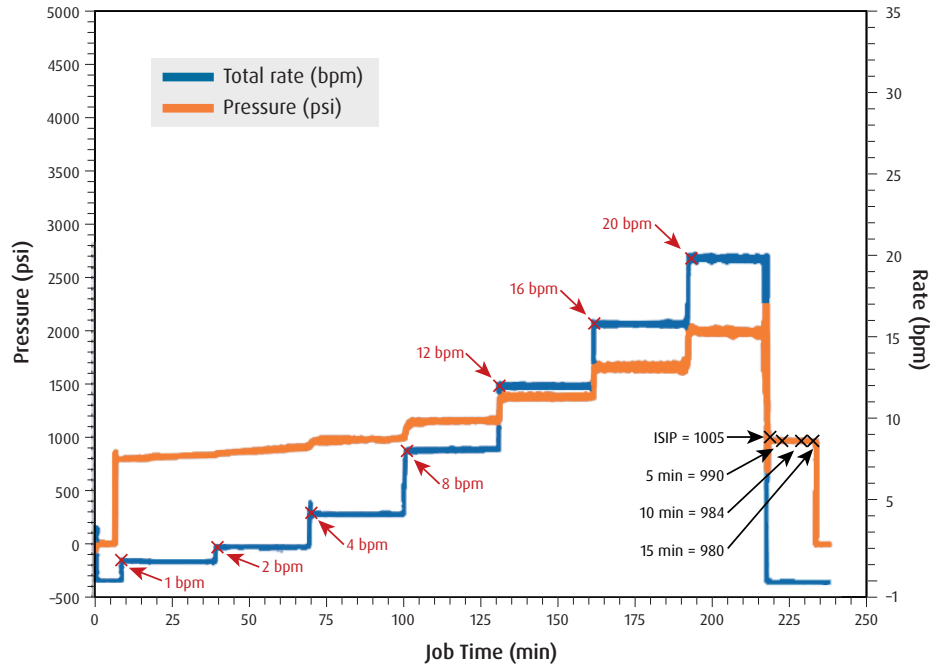
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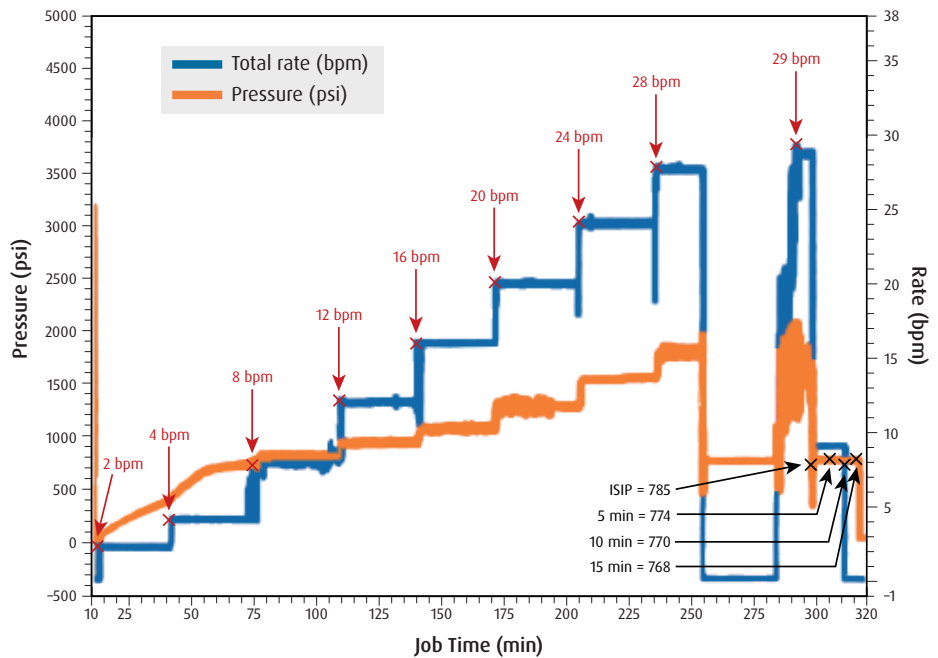


▲ Kraken

### Offset SWD Completion - Traditional Perforating and 5-Stage Acid Job



### New SWD Completion - Kraken Perforating and 3-Stage Acid Job



Offset well with traditional perforating and 5-stage acid treatment (top) vs Kraken-enhanced perforating and 3-stage acid job step-test results prove that higher injection volume was achieved.

	Traditional Perforating with 5-stage Acid Job	Kraken-enhanced Perforating with 3-stage Acid Job	Difference
First perf depth	6,000 ft	6,000 ft	—
Perforated zone length	1,900 ft	1,741 ft	-159 ft
Max step-test injection rate	20 bpm	28 bpm	8 bpm
Max step-test pressure	2,036 psi	1,866 psi	-170 psi
Injection rate at 1,500 psi*	14 bpm	24 bpm	10 bpm
Max daily capacity**	20,160 bbl	34,560 bbl	14,400 bbl
Rig spread cost	\$225,000	\$150,000	\$75,000
Acid cost	\$150,000	\$75,000	\$75,000
H-pump cost	\$320,000	\$235,000	\$85,000
Kraken perforating cost	—	\$149,000	(\$149,000)
H-pump power cost, 1 yr	\$404,000	\$261,000	\$143,000
1 yr savings	\$1,099,000	\$870,000	\$230,000
H-pump power cost, 3 yr	\$1,213,000	\$783,000	\$431,000
3 yr savings	\$1,908,000	\$1,392,000	\$517,000

\*The maximum permitted pressure is 1,500 psi for the offset well and 1,493 psi for the Kraken well.

\*\*Assumes daily injection capacity is not limited by lower permitted capacity.

*The table above, comparing two SWD wells in the Delaware Basin, each having 9½-in. casing and 5½-in. tubing, demonstrates a 71% improvement in SWD capacity with Kraken-enhanced perforating.*

*Kraken-enhanced perforating helped to achieve:*

- Rig days reduced from 15 days to 10 days
- 50% reduction in acid volume (121 kgal to 61 kgal)
- H-pump horsepower reduced from 1,550 hp to 1,000 hp
- Annual power costs cut by 34%, with operating efficiency assumed to be 75% and cost/kWh \$0.07.

*Underperforming SWDs will incur an additional cost of \$0.30/bbl to \$0.40/bbl through third-party disposal.*

**Bottom line:** *An incremental investment of \$149,000 in Kraken-enhanced perforating saves \$230,000 in year 1 for a return on incremental investment (ROI) of 154%, and over 3 years a savings of \$517,000 for an ROI of 347%.*



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