APPENDICES

APPENDIX A

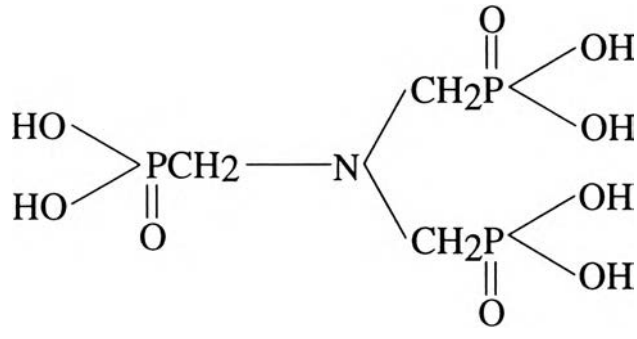
The Advantages and Disadvantages of Inhibitor Squeeze Treatment

Advantages	Disadvantages
1. Treat near well bore formation to prevent plugging during draw down.	1. A squeeze generally must be repeated from every two weeks to two years.
2. All steel surfaces at the well bottom are protected from scale.	2. The rule-of-thumb is that only about one-third of the added inhibitor is actually effective: one-third generally flows back with the first production and about one-third is never returned, although these ratio may improve upon repeated squeezes.
3. A squeeze can be done one old wells without pulling tubing.	3. There is virtually no control on the concentration of inhibitor which flows back with the brine.
4. During routine production, little maintenance is required and no on-site power is needed.	4. Performance on a new system is highly unpredictable.
5. Generally, a squeeze is a simple procedure for most service companies.	5. Once a squeeze is started, it is not possible to change the concentration or the chemical, as it is with a treat string.
6. The potential lifetime of a squeeze is virtually unlimited, in theory.	6. There is a real potential for formation damage.
7. Only periodic (about weekly) brine analysis is necessary to detect when to resqueeze.	7. It is difficult and expensive to treat corrosion due the different chemical nature of corrosion inhibitors and the higher concentrations often needed.
	8. It is difficult to analyze for most scale inhibitors at the concentrations. typically needed.

* Oddo and Tomson (1989) , SPE 19763.

APPENDIX B

Typical properties of *Aminotri(methylene phosphonic acid)*



Dequest 2000 (Acid solution)

Physical properties

Molecular weight	299
Apperance	Clear water , white to pale yellow aqueous solution
Abbreviation	ATMP
Active content	50 % (as acid)
Specific gravity,20/20°C	1.33
pH, 1 % solution at 25°C	< 2
Freezing point, °C	-15
Chloride as Cl	< 1 %
Iron (Fe) , ppm	< 35

Functional properties

$CaCO_3$ Inhibition	Excellent
$CaSO_4$ Inhibition	Good
Calcium compatibility	Good
Iron control	Yes
Sequestration	Good
Steel corrosion inhibition (formulated)	Excellent

* Above referred specifications are belonged to Monsanto.

APPENDIX C

EXPERIMENTAL DATA

A) Conditions of Precipitation in Micromodel Experiments

pH	Type of Precipitate	Conc. of ATMP (M)	Amount of ATMP (ml)	Conc. of Calcium (M)	Amount of Calcium (ml)
1.5	1:1	0.1672	100	0.5	21
6.0	2:1	0.1672	100	0.5	33.44
7.0	3:1	0.1672	50	0.5	83.6

Flow rate in elution : 0.05 ml/min
Elution fluid : DI water, pH 6.0
Volume of etched glass : 0.1 ml.

B) Conditions of Precipitation in Coreflood Experiments

pH	Type of Precipitate	Conc. of ATMP (M)	Amount of ATMP (ml)	Conc. of Calcium (M)	Amount of Calcium (ml)
1.5	1:1	0.05	100	0.2	25
4.5	2:1	0.03	100	0.15	20
7.0	3:1	0.005	100	2.0	2.5

Flow rate in elution : 1.0 ml/min
Elution fluid : DI water, pH 6.0
Length of core : 6.55 cm.
Diameter of core : 2.4 cm.
Volume of core : 12.35 cm^3

C) Elution Fluid Flowrate Experiment in Micromodel of the 1:1 Precipitate

Type	Precipitate 1:1	
Conc. of $CaCl_2$	0.5 M	21 ml
Conc.of ATMP	0.1672 M	100 ml
pH used	1.5	
Flowrate	0.05 ml/min	
Elution	DI water , pH 6.0	

Time	PV	Conc. of ATMP
0	0	
5	2.5	13971.513
10	5	14313.627
20	10	12580.983
30	15	3231.326
40	20	2819.133
50	25	2866.036
60	30	2868.795
80	40	1548.620
100	50	1445.158
120	60	1450.952
140	70	1009.789
160	80	426.264
190	95	265.415
250	125	61.801
310	155	32.556
360	180	16.140
420	210	14.071
480	240	17.106
540	270	10.429
600	300	9.353
660	330	10.319

D) Elution Fluid Flowrate Experiment in Micromodel of the 2:1 Precipitate

Type	Precipitate 2:1	
Conc. of $CaCl_2$	0.5 M	33.44 ml
Conc.of ATMP	0.1672 M (5%)	100 ml
pH used	6	
Flowrate	0.05 ml/min	
Elution	DI water , pH 6.0	

Time	PV	Conc. of ATMP
0	0	
10	5	12028.000
20	10	2839.000
30	15	1927.360
50	25	1878.330
60	30	1103.330
80	40	1081.670
100	50	650.000
120	60	437.190
140	70	458.510
180	90	187.940
200	100	135.950
220	110	128.957
260	130	143.950
300	150	120.490
340	170	98.101
360	180	84.905
400	200	89.037
440	220	82.373
500	250	77.570
620	310	49.580
740	370	35.508

Time	PV	Conc. of ATMP
980	490	34.548
1160	580	27.351
1220	610	37.400
1280	640	35.918
1340	670	33.738
1520	760	17.270
1760	880	15.746
1940	970	15.620
2060	1030	13.110
2360	1180	13.540
2480	1240	8.743
2600	1300	7.270
2720	1360	7.965
2780	1390	5.246
2900	1450	7.326
3020	1510	8.195
3080	1540	5.860
3100	1550	
3200	1600	
3300	1650	

E) Elution Fluid Flowrate Experiment in Micromodel of the 3:1 Precipitate

Type	Precipitate 3:1	
Conc. of $CaCl_2$	0.5 M	83.6 ml
Conc.of ATMP	0.1672 M (5%)	50 ml
pH used	7	
Flowrate	0.05 ml/min	
Elution	DI water , pH 6.0	

Time	PV	Conc. of ATMP
0	0	
10	5	1349
20	10	314.5
30	15	463.5
50	25	150.6
60	30	197.48
80	40	131.77
100	50	111.325
120	60	101.39
140	70	99.32
180	90	78.63
200	100	69.25
240	120	70.63
320	160	58.49
360	180	51.59
400	200	41.38
540	270	41.38
560	280	42
600	300	43.24
800	400	32.44
890	445	38.24

Time	PV	Conc. of ATMP
1070	535	26.65
1430	715	22.09
1610	805	23.34
1700	850	21.6
1970	985	21.32
2060	1030	21.81
2150	1075	18.54
2240	1120	17.82
2330	1165	28.84
2510	1255	23.39
2600	1300	21.19
2780	1390	18.374
2960	1480	17.017
3140	1570	16.769
3320	1660	14.42
3680	1840	11.5
4040	2020	12.19
4790	2395	17.26
5060	2530	9.849
5420	2710	9.187
5780	2890	7.532
5960	2980	7.82
6140	3070	8.22
6500	3250	5.958
6860	3430	5.435
7040	3520	4.966
7220	3610	5.4
7400	3700	4.966

Time	PV	Conc. of ATMP
7760	3880	5.214
8030	4015	4.497
8480	4240	3.917
8660	4330	5.049
9020	4510	3.06
9200	4600	2.593
9380	4690	2.4
9470	4735	2.51

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