

PERMIAN

Treating Chemicals, Inc.

P. O. BOX 815
TATUM, NM 88267
PHONE (505) 398-4111

August 13, 1988

Murphy Operating Corporation
P. O. Drawer 2648
Roswell, NM 88202-2648

Subject: Compatibility of fresh and produced waters from State BF -
produced, Tucker and State BF, Moore and State BF, Howard
and State BF, Tucker #2 and State BF, and fresh water
samples.

Gentlemen:

We have ran analysis on produced, fresh, and comingled waters from
the above mentioned leases (see attached copies.)

We at Permian Treating Chemicals, Inc. feel that these waters injected
seperately or comingled are very compatible.

If we can be of any further assistance, please call myself or Mr. Gale
Blackwell at anytime.

Sincerely,



David Nailon
Permian Treating Chemicals, Inc.

PERMIAN

Treating Chemicals, Inc.

P.O. BOX 728
LOVINGTON, NM 88260
PHONE (505) 396-5674

WATER ANALYSIS REPORT

Company Murphy Operating Corporation Date Sampled 8-13-88
Field Chaveroo County
Lease Unit B & Howard Sec 3, T7S, R32E State NM
Well State BF Sec 3, T8S, R33E Formation San Andres & FW
Type of Water Comingled Water, B/D
Sampling Point Sampled By Nailon

DISSOLVED SOLIDS

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	27186	23
Calcium, Ca++	10280	20
Magnesium, Mg++	3475	12.2
Barium, Ba++		68.7
Iron, Fe (Total)		

ANIONS

Chloride, Cl-	70000	35.5
Sulfate, So ₄ ⁼	275	6
Carbonate, Co ₃ ⁼		30
Bicarbonate, HCo ₃ ⁻	195	61

OTHER PROPERTIES

pH 6.0
Specific Gravity 1.07
H₂S Positive
Total Dissolved Solids 111361
Total Hardness 40000

Remarks and Recommendations

STABILITY INDEX CALCULATIONS
(Stiff-Davis Method)
CaCO₃ Scaling Tendency

SAMPLE

Company Murphy

Address _____

Sample Comingled - Howard + State SF

Sample Test No. _____

Sample Date 8-13-88

Submitted By Naile

Field _____

$$S. I. = pH - pCa - pAlk - K$$

where S. I. = stability index

pH = pH as measured on fresh sample

pCa = negative logarithm of calcium concentration

pAlk = negative logarithm of total alkalinity

K = constant, depends upon temperature and salt content

$$pH = \underline{6.0} \quad pCa = \underline{.6} \quad pAlk = \underline{2.5}$$

CALCULATION OF IONIC STRENGTH AND K VALUE

Na	(<u>.27186</u>) X (2.2 X 10 ⁻⁵) =	<u>.5980</u>
Ca	(<u>.10280</u>) X (5.0 X 10 ⁻⁵) =	<u>.5140</u>
Mg	(<u>.03425</u>) X (8.2 X 10 ⁻⁵) =	<u>.2849</u>
Cl	(<u>.70000</u>) X (1.4 X 10 ⁻⁵) =	<u>.9800</u>
HCO ₃	(<u>.00195</u>) X (0.8 X 10 ⁻⁵) =	<u>.0015</u>
SO ₄	(<u>.00225</u>) X (2.1 X 10 ⁻⁵) =	<u>.0057</u>

$$\text{TOTAL IONIC STRENGTH} = \underline{2.3}$$

$$K = \underline{3.3} \quad @ \quad \underline{80} \quad ^\circ\text{F.}$$

$$K = \underline{2.7} \quad @ \quad \underline{120} \quad ^\circ\text{F.}$$

$$SI \text{ at } (\underline{80})^\circ = (\underline{6.0}) - (\underline{.6}) - (\underline{2.5}) - (\underline{3.3}) \text{ or } \underline{-.4}$$

$$SI \text{ at } (\underline{120})^\circ = (\underline{6.0}) - (\underline{.6}) - (\underline{2.5}) - (\underline{2.7}) \text{ or } \underline{-.2}$$

$$SI = 0 \text{ or water is relatively stable at } \underline{160} \quad ^\circ\text{F.}$$

Remarks: _____

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Treating Chemicals, Inc.

P. O. BOX 728
LOVINGTON, NM 88260
PHONE (505) 396-5674

WATER ANALYSIS REPORT

Company Murphy Operating Corporation Date Sampled 8-10-88
Field Moore County Moore
Lease Sec 25, T6S, R32E State NM
Well State BF Sec 3, T 8S, R 33E Formation San Andres & FW
Type of Water Comingled Water, B/D
Sampling Point Well Sampled By Nailon

DISSOLVED SOLIDS

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	28198	23
Calcium, Ca++	11360	20
Magnesium, Mg++	3305	12.2
Barium, Ba++		68.7
Iron, Fe (Total)		

OTHER PROPERTIES

pH 5.9
Specific Gravity 1.08
H₂S Positive
Total Dissolved Solids 116322
Total Hardness 42000

ANIONS

Chloride, Cl-	73000	35.5
Sulfate, So ₄ =	300	48
Carbonate, Co ₃ =		30
Bicarbonate, HCo ₃ -	159	61

Remarks and Recommendations

STABILITY INDEX CALCULATIONS
(Stiff-Davis Method)
CaCO₃ Scaling Tendency

SAMPLE

Company Murphy Operating
Address _____
Sample Combined - Moore + STBF

Sample Test No. _____
Sample Date 8-10-88
Submitted By Dailman
Field _____

$$S. I. = pH - pCa - pAlk - K$$

where S. I. = stability index

pH = pH as measured on fresh sample

pCa = negative logarithm of calcium concentration

pAlk = negative logarithm of total alkalinity

K = constant, depends upon temperature and salt content

$$pH = \underline{5.9} \quad pCa = \underline{.5} \quad pAlk = \underline{2.6}$$

CALCULATION OF IONIC STRENGTH AND K VALUE

Na	(<u>.28198</u>) X (2.2 X 10 ⁻⁵) =	<u>.6203</u>
Ca	(<u>.11340</u>) X (5.0 X 10 ⁻⁵) =	<u>.5680</u>
Mg	(<u>.03305</u>) X (8.2 X 10 ⁻⁵) =	<u>.2710</u>
Cl	(<u>.73000</u>) X (1.4 X 10 ⁻⁵) =	<u>1.0220</u>
HCO ₃	(<u>.00159</u>) X (0.8 X 10 ⁻⁵) =	<u>.0012</u>
SO ₄	(<u>.00300</u>) X (2.1 X 10 ⁻⁵) =	<u>.0063</u>

$$\text{TOTAL IONIC STRENGTH} = \underline{2.5}$$

$$K = \underline{3.1} \quad @ \quad \underline{80} \quad ^\circ\text{F.}$$

$$K = \underline{2.7} \quad @ \quad \underline{120} \quad ^\circ\text{F.}$$

$$SI \text{ at } (80)^\circ = (\underline{5.9}) - (\underline{.5}) - (\underline{2.6}) - (\underline{3.1}) \text{ or } \underline{-.3}$$

$$SI \text{ at } (120)^\circ = (\underline{5.9}) - (\underline{.5}) - (\underline{2.6}) - (\underline{2.7}) \text{ or } \underline{+.6}$$

SI = 0 or water is relatively stable at 110 °F.

Remarks: _____

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P. O. BOX 728
LOVINGTON, N.M. 88260
PHONE (505) 396-5674

WATER ANALYSIS REPORT

Company Murphy Operating Corporation Date Sampled 8-13-88
Field Tucker County Curry
Lease Sec 25, T 6S, R 32E State NM
Well St BF SWD Sec 3, T 8S, R 33E Formation San Andres & FW
Type of Water Comingled Water, B/D
Sampling Point Well Sampled By Nailon

DISSOLVED SOLIDS

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	31211	23
Calcium, Ca++	12640	20
Magnesium, Mg++	2989	12.2
Barium, Ba++		68.7
Iron, Fe (Total)		

OTHER PROPERTIES

pH 6.0
Specific Gravity 1.09
H₂S Positive
Total Dissolved Solids 126335
Total Hardness 43900

ANIONS

Chloride, Cl-	79000	35.5
Sulfate, So ₄ =	300	48
Carbonate, Co ₃ =		30
Bicarbonate, HCo ₃ -	195	61

Remarks and Recommendations

STABILITY INDEX CALCULATIONS
(Stiff-Davis Method)
CaCO₃ Scaling Tendency

SAMPLE

Sample Test No. _____

Company Murphy

Sample Date 8-13-88

Address _____

Submitted By Nelson

Sample Tucker & State BF Comingled

Field _____

Sec 25 T6S R32E

S. I. = pH - pCa - pAlk - K
where S. I. = stability index
pH = pH as measured on fresh sample
pCa = negative logarithm of calcium concentration
pAlk = negative logarithm of total alkalinity
K = constant, depends upon temperature and salt content
pH = 6.0 pCa = .5 pAlk = 2.5

CALCULATION OF IONIC STRENGTH AND K VALUE

Na	(<u>.31211</u>) X (2.2 X 10 ⁻⁵) =	<u>.6866</u>
Ca	(<u>.12640</u>) X (5.0 X 10 ⁻⁵) =	<u>.6320</u>
Mg	(<u>.02989</u>) X (8.2 X 10 ⁻⁵) =	<u>.2450</u>
Cl	(<u>.79000</u>) X (1.4 X 10 ⁻⁵) =	<u>1.1060</u>
HCO ₃	(<u>.00195</u>) X (0.8 X 10 ⁻⁵) =	<u>.0015</u>
SO ₄	(<u>.00300</u>) X (2.1 X 10 ⁻⁵) =	<u>.0063</u>

TOTAL IONIC STRENGTH = 2.6

K = 3.1 @ 80 °F.

K = 2.6 @ 120 °F.

SI at (80)° = (6.0) - (.5) - (2.5) - (3.1) or -.1

SI at (120)° = (6.0) - (.5) - (2.5) - (2.6) or +.4

SI = 0 or water is relatively stable at 90 °F.

Remarks: _____

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WATER ANALYSIS REPORT

Company Murphy Operating Corporation Date Sampled 8-13-88
Field Chaveroo Tucker County
Lease School Sec 36, T6S, R32E State NM
Well State BF SWD Sec 3, T8S, R33E Formation San Andres & FW
Type of Water Comingled Water, B/D
Sampling Point Well Sampled By Nailon

DISSOLVED SOLIDS

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	26197	23
Calcium, Ca++	9800	20
Magnesium, Mg++	2916	12.2
Barium, Ba++		68.7
Iron, Fe (Total)		

ANIONS

Chloride, Cl-	66000	35.5
Sulfate, So ₄ ⁼	275	48
Carbonate, Co ₃ ⁼		30
Bicarbonate, HCo ₃ ⁻	171	61

OTHER PROPERTIES

pH 5.9
Specific Gravity 1.07
H₂S Positive
Total Dissolved Solids 105359
Total Hardness 36500

Remarks and Recommendations

STABILITY INDEX CALCULATIONS
(Stiff-Davis Method)
CaCO₃ Scaling Tendency

SAMPLE _____ Sample Test No. _____
 Company Murphy Operating Sample Date 8-13-81
 Address _____ Submitted By Nailon
 Sample Comingled - Tucker & STBF Field Chaveroa
Sec 36 T6S R32E

S. I. = $\text{pH} - \text{pCa} - \text{pAlk} - K$
 where S. I. = stability index
 pH = pH as measured on fresh sample
 pCa = negative logarithm of calcium concentration
 pAlk = negative logarithm of total alkalinity
 K = constant, depends upon temperature and salt concentration
 pH = 5.9 pCa = 1.6 pAlk = 2.5

CALCULATION OF IONIC STRENGTH AND K VALUE

Na	(<u>.26197</u>) X (2.2×10^{-5}) =	<u>.5763</u>
Ca	(<u>.09800</u>) X (5.0×10^{-5}) =	<u>.4900</u>
Mg	(<u>.02916</u>) X (8.2×10^{-5}) =	<u>.2391</u>
Cl	(<u>.66000</u>) X (1.4×10^{-5}) =	<u>.9240</u>
HCO ₃	(<u>.00171</u>) X (0.8×10^{-5}) =	<u>.0013</u>
SO ₄	(<u>.00275</u>) X (2.1×10^{-5}) =	<u>.0057</u>

TOTAL IONIC STRENGTH = 2.2

K = 3.3 @ 80 °F.

K = 2.7 @ 120 °F.

SI at (80)° = (5.9) - (1.6) - (2.5) - (3.3) or -1.5

SI at (120)° = (5.9) - (1.6) - (2.5) - (2.7) or -.9

SI = 0 or water is relatively stable at 145 °F.

Remarks: _____

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P. O. BOX 728
LOVINGTON, NM 88260
PHONE (505) 396-5674

WATER ANALYSIS REPORT

Company Murphy Operating Corporation Date Sampled 8-12-88
Field Chaveroo County Chaves
Lease State BF SWD State NM
Well Unit B Sec 3, T8S, R33E Formation San Andres
Type of Water Produced Water, B/D _____
Sampling Point SWD Sampled By Nailon

DISSOLVED SOLIDS

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	53590 ÷ 23	2330
Calcium, Ca++	21800 ÷ 20	1090
Magnesium, Mg++	7217 ÷ 12.2	592
Barium, Ba++	÷ 68.7	
Iron, Fe (Total)		

OTHER PROPERTIES

pH 5.6
Specific Gravity 1.30
H₂S Positive
Total Dissolved Solids 225226
Total Hardness 84200

ANIONS

Chloride, Cl-	142000 ÷ 35.5	4000
Sulfate, So ₄ =	375 ÷ 48	8
Carbonate, Co ₃ =	-0- ÷ 30	-0-
Bicarbonate, HCo ₃ -	244 ÷ 61	4

Remarks and Recommendations _____

STABILITY INDEX CALCULATIONS
(Stiff-Davis Method)
CaCO₃ Scaling Tendency

SAMPLE _____ Sample Test No. _____
 Company Murphy Operating Sample Date 8-12-88
 Address Reserve II Submitted By _____
 Sample Produce - State BF Field Chaveros

S. I. = pH - pCa - pAlk - K
 where S. I. = stability index
 pH = pH as measured on fresh sample
 pCa = negative logarithm of calcium concentration
 pAlk = negative logarithm of total alkalinity
 K = constant, depends upon temperature and salt content
 pH = 5.6 pCa = .3 pAlk = 2.4

CALCULATION OF IONIC STRENGTH AND K VALUE

Na	(<u>.53590</u>) X (2.2 X 10 ⁻⁵) =	<u>1.1789</u>
Ca	(<u>.21800</u>) X (5.0 X 10 ⁻⁵) =	<u>1.0900</u>
Mg	(<u>.07217</u>) X (8.2 X 10 ⁻⁵) =	<u>.5917</u>
Cl	(<u>1.42000</u>) X (1.4 X 10 ⁻⁵) =	<u>1.9880</u>
HCO ₃	(<u>.00244</u>) X (0.8 X 10 ⁻⁵) =	<u>.0019</u>
SO ₄	(<u>.00375</u>) X (2.1 X 10 ⁻⁵) =	<u>.0079</u>
TOTAL IONIC STRENGTH =		<u>4.9</u>

K = 2.4 @ 80 °F.
 K = 1.9 @ 120 °F.
 SI at (80)° = (5.6) - (.3) - (2.4) - (2.4) or 1.5
 SI at (120)° = (5.6) - (.3) - (2.4) - (1.9) or 1.5
 SI = 0 or water is relatively stable at _____ °F.

Remarks: _____

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LOVINGTON, NM 88260
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WATER ANALYSIS REPORT

Company Murphy Operating Date Sampled 8-10-88
Field _____ County _____
Lease Sec 3 T7S R32E State NM
Well Howard Formation F/W
Type of Water Fresh Water Water, B/D _____
Sampling Point Well Sampled By _____

DISSOLVED SOLIDS

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	1541	23
Calcium, Ca++	320	20
Magnesium, Mg++	97	12.2
Barium, Ba++		68.7
Iron, Fe (Total)		

OTHER PROPERTIES

pH 7.5
Specific Gravity 1.0
H₂S Neg.
Total Dissolved Solids 5268
Total Hardness 1200

ANIONS

Chloride, Cl-	3000	35.5
Sulfate, So ₄ ⁼	200	4
Carbonate, Co ₃ ⁼	0	0
Bicarbonate, HCo ₃ ⁻	110	2

Remarks and Recommendations _____

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WATER ANALYSIS REPORT

Company Murphy Operating Date Sampled 8/10/88
Field _____ County _____
Lease Sec 25 T6S R-32E State NM
Well Moore Formation F/W
Type of Water Fresh Water Water, B/D _____
Sampling Point Well Sampled By Nailon

DISSOLVED SOLIDS

OTHER PROPERTIES

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	<u>943</u>	<u>23</u>
Calcium, Ca++	<u>280</u>	<u>20</u>
Magnesium, Mg++	<u>73</u>	<u>12.2</u>
Barium, Ba++	<u></u>	<u>68.7</u>
Iron, Fe (Total)	<u></u>	<u></u>
_____	<u></u>	<u></u>
_____	<u></u>	<u></u>

pH 7.4
Specific Gravity 1.0
H₂S Neg
Total Dissolved Solids 3568
Total Hardness 1000

ANIONS

Chloride, Cl-	<u>2000</u>	<u>35.5</u>
Sulfate, So ₄ ⁼	<u>150</u>	<u>48</u>
Carbonate, Co ₃ ⁼	<u>0</u>	<u>30</u>
Bicarbonate, HCo ₃ ⁻	<u>122</u>	<u>61</u>
_____	<u></u>	<u></u>
_____	<u></u>	<u></u>

Remarks and Recommendations _____

MIAN
ing Chemicals, Inc.

P. O. BOX 728
LOVINGTON, NIA 88260
PHONE (505) 396-5674

WATER ANALYSIS REPORT

Company Murphy Operating Date Sampled 8/10/88
Field _____ County _____
Lease Sec 36 T6S R32E State NM
Well School (Tucker) Formation F/W
Type of Water Fresh Water Water, B/D _____
Sampling Point Well Sampled By Nailon

DISSOLVED SOLIDS

CATIONS

	mg/l	meq/l
Sodium, Na+(Calc)	<u>966</u> ÷ 23	<u>42</u>
Calcium, Ca++	<u>320</u> ÷ 20	<u>16</u>
Magnesium, Mg++	<u>24</u> ÷ 12.2	<u>2</u>
Barium, Ba++	<u></u> ÷ 68.7	<u></u>
Iron, Fe (Total)	<u></u>	<u></u>
_____	<u></u>	<u></u>
_____	<u></u>	<u></u>

OTHER PROPERTIES

pH 7.5
Specific Gravity 1.0
H₂S Neg
Total Dissolved Solids 3545
Total Hardness 900

ANIONS

Chloride, Cl-	<u>2000</u> ÷ 35.5	<u>56</u>
Sulfate, So ₄ ⁼	<u>150</u> ÷ 48	<u>3</u>
Carbonate, Co ₃ ⁼	<u>0</u> ÷ 30	<u>0</u>
Bicarbonate, HCo ₃ ⁻	<u>85</u> ÷ 61	<u>1</u>
_____	<u></u>	<u></u>
_____	<u></u>	<u></u>

Remarks and Recommendations _____

