WATE . ANALYSIS REPO .

COMPANY Cabot Corp. ADDRESS Lovington, NM DATE: 11/20/80

SOURCE Howard Fleet #1 Wolfcamp DATE SAMPLED 11-19-80 ANALYSIS NO.

Analysis		Mg/L		*Meq/L	
1. PH	5.8				
2. H_2S (Qualitative)	Neg.				
3. Specific Gravity	1.175				
4. Dissolved Solids		241,332			
5. Suspended Solids		None			
6. Phenolphthalein Alkalinity ($CaCO_3$)		-0-			
7. Methyl Orange Alkalinity ($CaCO_3$)		180			
8. Bicarbonate (HCO_3)	HCO_3	220	÷61	4.0	HCO_3
9. Chlorides (Cl)	Cl	144,504	÷35.5	4070	Cl
10. Sulfates (SO_4)	SO_4	725	÷48	15.0	SO_4
11. Calcium (Ca)	Ca	4000	÷20	200	Ca
12. Magnesium (Mg)	Mg	486	÷12.2	40	Mg
13. Total Hardness ($CaCO_3$)		12000			
14. Total Iron (Fe)		185			
15. Barium (Qualitative)		150			
16.					

*Milli equivalents per liter

PROBABLE MINERAL COMPOSITION

200	Ca ←	→ HCO_3
40	Mg →	→ SO_4
3885	Na →	← Cl

40
15
4070

Saturation Values Distilled Water 20°C

$CaCO_3$	13 Mg/L
$CaSO_4 \cdot 2H_2O$	2,090 Mg/L
$MgCO_3$	103 Mg/L

Compound	Equiv. Wt.	X	Meq/L	=	Mg/L
$Ca(HCO_3)_2$	81.04		40		3242
$CaSO_4$	68.07		15		1021
$CaCl_2$	55.50		145		8047
$Mg(HCO_3)_2$	73.17		-0-		
$MgSO_4$	60.19		-0-		
$MgCl_2$	47.62		40		1905
$NaHCO_3$	84.00		-0-		
Na_2SO_4	71.03		-0-		
NaCl	58.46		3885		227,117

REMARKS

cc: W. Roberts, B. Gray

Respectfully submitted
TRETOLITE COMPANY

Mike Brewer

WATER ANALYSIS REPORT

COMPANY

Cabot Corporation

SOURCE

State "C" 1 & 2, Reed #2
Well Howard Fleet Comingled
Sample point: 50/50 mixture of the
Devonian two (2) waters

Submitted by: Brewer, M.
Sampled by: Brewer, M.
Distribution Center: Midland

Sample date: 10/31/80
Analysis Date: 11/ 7/80
Analysis No.: 5056

SAMPLE ANALYSIS

Appearance: Clear
Sp. Conductivity: 110000 micromhos/cm
pH: 7.5

Color: Colorless
Chem. Treatment: N/A
H2S (Qualitative): Neg.

constituent **	ppm	meq/l	method	comments
Sodium (Na+)	29100	1270	icp	
Potassium (K+)	695.	18.	icp	
Lithium (Li+)	10	1.	icp	
Calcium (Ca++)	2880	144.	icp	
Magnesium (Mg++)	517.	42.6	icp	
Barium (Ba++)	3.	0.04	icp	
Strontium (Sr++)	100	2.	icp	
Aluminum (Al+++)	7.3	-	icp	
Silver (Ag+)	<0.2	-	icp	
Arsenic (As+++)	<5.	-	icp	
Chromium (Cr+++)	<0.6	-	icp	
Copper (Cu++)	0.86	0.03	icp	
Iron (Fe++)	6.84	0.2	icp	
Mercury (Hg++)	<2.	-	icp	
Lead (Pb++)	<3.	-	icp	
Antimony (Sb+++)	<20	-	icp	
Tin (Sn++)	<6.	-	icp	
Titanium (Ti++++)	<0.1	-	icp	
Zinc (Zn++)	3.10	0.0948	icp	
Boron (B) ***	9.60	2.7	icp	
Phosphate (PO4---)	<5.	-	icp	
Chloride (Cl-)	51900	1460	titr	
Sulfate (SO4--)	1520	31.5	turb	
Bicarbonate (HCO3-)	466.	7.6	titr	
Carbonate (CO3--)	<1.	-	titr	
Silica (SiO2)	55.	-	icp	

Analysis No. 5056

NOTES TO ANALYSIS

Ion Balance

Sum of cations:	1480 meq/l	Standard deviation:	26.5 meq/l
Sum of anions:	1510 meq/l	Standard deviation:	29.3 meq/l

*TDS Balance

Measured:	91000 ppm	Standard deviation:	4550 ppm
Calculated:	87400 ppm	Standard deviation:	1200 ppm

# indicates that the amount of this component has changed in a statistically significant way since the last analysis
N/A= not available
meq/l= milliequivalents per liter
ppm and milligrams per liter used interchangeably
icp= inductively coupled plasma emission
titr= titration; turb= turbidimetric
TDS by gravimetric determination
Specific Conductivity by Wheatstone Bridge

* Total Dissolved Solids
** Valency given is arbitrarily chosen and is not necessarily the true valency unless indicated in the column for comments
*** TDS boron is given as ppm elemental boron, but for the purposes of an ion balance, boron is converted to BO3---

The various parameters in the above results can be usefully interpreted using the guidelines below:

1) pH value is an indication of the acidity or basicity of a brine. pH measurements provide critical information about a) the solubility of sparingly soluble compounds, b) the carbonate scaling tendency, c) iron oxidation state and d) caution needed in using some external chemical treatments.

2) Specific conductivity: this gives an approximate indication of the total amount of inorganic dissolved solids in the water sample. A simple guideline is that 10,000 micromhos/cm is equivalent to 100 meq/l of dissolved solids. However, this relationship is valid only in solutions with specific conductivities less than approximately 50,000 micromhos/cm.

3) Concentration of various ionic species: the concentrations of various ionic species give information about a) thermodynamic characteristics of the brine, b) scaling tendency of the water, and c) enthalpy of the water.

Analysis No. 5056

HISTORY OF FIELD WATER COMPOSITIONAL DATA

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Our computer record indicates that no analytical data on waters collected from this well or field have been previously added to our computer file. As more data become available and as our automated data evaluation system indicates any water-related problems in your field, the technical personnel of Tretolite will contact you immediately.

SCALE TENDENCIES OF THE ANALYZED BRINE

In the following paragraphs, the scale tendencies of the brine are analyzed by utilizing some basic thermodynamic correlations. These scale tendency considerations are different from the commonly applied Stiff-Davis Diagrams and calculation methods because those methods are not based on the critical thermodynamic conditions encountered in the field.

CaSO4

The calcium and sulfate ion concentration of the brine as reported in this analysis does not seem to pose any danger of calcium sulfate precipitation at 76 deg-F.

However, if the brine is heated to a temperature of 184.5 deg-F or higher (at water saturation pressure), this brine would have a tendency to precipitate calcium sulfate.

It has to be remembered that CaSO4 scale tendency decreases with increasing pressure. This means, if the system pressure is higher than the water vapor saturation pressure, calcium sulfate scale would form at a temperature higher than reported.

BaSO4

Analysis No. 5056

The barium and sulfate ion concentrations of the brine as reported in this analysis indicate a definite potential for barium sulfate precipitation at 76 deg-F. This indicates that barium sulfate precipitation has already occurred somewhere in this system before the wellbore brine is brought to the ambient conditions.

However, the maximum amount of BaSO4 that can be precipitated is 4.757 Mg/liter of the brine.

SrSO4

The strontium and sulfate ion concentrations of the brine as reported in this analysis indicate that there is a potential for strontium sulfate precipitation at 76 deg-F. This suggests that as the brine is brought to the ambient conditions from higher temperatures and pressures strontium sulfate scaling has occurred.

CaCO3

At 76 deg-F, the stability index is (+): implies scaling tendency.

The precise calcium carbonate scaling tendency of the brine cannot immediately be determined without the required information on temperature, pressure, pH and partial pressure of carbon dioxide above the brine. The Stiff-Davis Stability Index gives only a crude approximation of the CaCO3 scale tendencies. This stability index is given for the sake of completeness.

QUANTITATIVE INFORMATION ON ALL SCALE TENDENCIES

Quantitative information can be extracted on all scaling tendencies of this brine if the temperature and pressure conditions of the brine are available. The most complicated calculations have to be performed on the CaCO3 scale tendencies. The other scale tendencies are easier to determine.

WATER ANALYSIS REPORT

COMPANY	SOURCE
Cabot Producing Corporation	J.L. Reed Well S.W.D. Sample point: Discharge of Pump

Submitted by: Brewer, M.
Sampled by: Brewer, M.
Distribution Center: Midland

Sample date: 10/27/80
Analysis Date: 10/35/80
Analysis No.: 4990

SAMPLE ANALYSIS

Appearance: Clear
Sp. Conductivity: 120000 micromhos/cm
pH: 6.7

Color: Colorless
Chem. Treatment: N/A
H2S (Qualitative): Pos.

constituent **	ppm	meq/l	method	comments
Sodium (Na+)	30400	1320	icp	
Potassium (K+)	745.	19.	icp	
Lithium (Li+)	6.	0.9	icp	
Calcium (Ca++)	3010	150.	icp	
Magnesium (Mg++)	508.	41.8	icp	
Barium (Ba++)	<1.	-	icp	
Strontium (Sr++)	100	2.	icp	
Aluminum (Al+++)	<1.	-	icp	
Silver (Ag+)	<0.2	-	icp	
Arsenic (As+++)	<5.	-	icp	
Chromium (Cr+++)	<0.6	-	icp	
Copper (Cu++)	<0.1	-	icp	
Iron (Fe++)	2.0	0.07	icp	
Mercury (Hg++)	<2.	-	icp	
Lead (Pb++)	<3.	-	icp	
Antimony (Sb+++)	<20	-	icp	
Tin (Sn++)	<6.	-	icp	
Titanium (Ti++++)	<0.1	-	icp	
Zinc (Zn++)	0.47	0.0143	icp	
Boron (B) ***	7.8	2.2	icp	
Phosphate (PO4---)	<5.	-	icp	
Chloride (Cl-)	54600	1540	titr	
Sulfate (SO4--)	1460	30.4	turb	
Bicarbonate (HCO3-)	203.	3.3	titr	
Carbonate (CO3--)	<1.	-	titr	
Silica (SiO2)	48.	-	icp	

Analysis No. 4000

NOTES TO ANALYSIS

Ion Balance

Sum of cations:	1540 meq/l	Standard deviation:	27.6 meq/l
Sum of anions:	1580 meq/l	Standard deviation:	30.8 meq/l

*TDS Balance

Measured:	88000 ppm	Standard deviation:	4380 ppm
Calculated:	91100 ppm	Standard deviation:	1260 ppm

% indicates that the amount of this component has changed in a statistically significant way since the last analysis
N/A= not available
meq/l= milliequivalents per liter
ppm and milligrams per liter used interchangeably
icp= inductively coupled plasma emission
titr= titration; turb= turbidimetric
TDS by gravimetric determination
Specific Conductivity by Wheatstone Bridge

* Total Dissolved Solids
** Valency given is arbitrarily chosen and is not necessarily the true valency unless indicated in the column for comments
*** TDS boron is given as ppm elemental boron, but for the purposes of an ion balance, boron is converted to BO_3^{---}

The various parameters in the above results can be usefully interpreted using the guidelines below:

1) pH value is an indication of the acidity or basicity of a brine. pH measurements provide critical information about a) the solubility of sparingly soluble compounds, b) the carbonate scaling tendency, c) iron oxidation state and d) caution needed in using some external chemical treatments.

2) Specific conductivity: this gives an approximate indication of the total amount of inorganic dissolved solids in the water sample. A simple guideline is that 10,000 micromhos/cm is equivalent to 100 meq/l of dissolved solids. However, this relationship is valid only in solutions with specific conductivities less than approximately 50,000 micromhos/cm.

3) Concentration of various ionic species: the concentrations of various ionic species give information about a) thermodynamic characteristics of the brine, b) scaling tendency of the water, and c) enthalpy of the water.

(314) 961-3500 / TWX 910 760 1660 / Telex 44-2417

HISTORY OF FIELD WATER COMPOSITIONAL DATA

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operator in managing his waters in the field. This system is
on a comparison of water-analytical data between this newly an
previously analyzed sample.

Our computer record indicates that no analytical data on wa
collected from this well or field have been previously added to
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field, the technical personnel of Tretolite will contact you
immediately.

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are analyzed by utilizing some basic thermodynamic correlations.
These scale tendency considerations are different from the commonly
applied Stiff-Davis Diagrams and calculation methods because those
methods are not based on the critical thermodynamic conditions en-
countered in the field.

CaSO4

The calcium and sulfate ion concentration of the brine as
reported in this analysis does not seem to pose any danger of
calcium sulfate precipitation at 76 deg-F.

However, if the brine is heated to a temperature of 184.5 deg-F
or higher (at water saturation pressure), this brine would have a
tendency to precipitate calcium sulfate.

It has to be remembered that CaSO4 scale tendency decreases
with increasing pressure. This means, if the system pressure is
higher than the water vapor saturation pressure, calcium sulfate
scale would form at a temperature higher than reported.

BaSO4

Analysis No. 4000

The barium and sulfate ion concentrations of the brine as reported in this analysis indicate a definite potential for barium sulfate precipitation at 76 deg-F. This indicates that barium sulfate precipitation has already occurred somewhere in this system before the wellbore brine is brought to the ambient conditions.

However, the maximum amount of BaSO4 that can be precipitated is 2.209 Mg/liter of the brine.

SrSO4

The strontium and sulfate ion concentrations of the brine as reported in this analysis indicate that there is a potential for strontium sulfate precipitation at 76 deg-F. This suggests that as the brine is brought to the ambient conditions from higher temperatures and pressures strontium sulfate scaling has occurred.

CaCO3

At 76 deg-F, the stability index is (-): implies corrosive tendency.

The precise calcium carbonate scaling tendency of the brine cannot immediately be determined without the required information on temperature, pressure, pH and partial pressure of carbon dioxide above the brine. The Stiff-Davis Stability Index gives only a crude approximation of the CaCO3 scale tendencies. This stability index is given for the sake of completeness.

QUANTITATIVE INFORMATION ON ALL SCALE TENDENCIES

Quantitative information can be extracted on all scaling tendencies of this brine if the temperature and pressure conditions of the brine are available. The most complicated calculations have to be performed on the CaCO3 scale tendencies. The other scale tendencies are easier to determine.

(314) 561 3500 / TWX 910 760 1660 / Telex 44 2417

WATER ANALYSIS REPORT

COMPANY

Cabot Corporation

SOURCE

State "C" 1, Reed #2
Well Howard Fleet Comingled
Sample point:
Devonian

Submitted by: Brewer, M.
Sampled by: Brewer, M.
Distribution Center: Midland

Sample date: 10/31/80
Analysis Date: 11/ 7/80
Analysis No.: 5057

SAMPLE ANALYSIS

Appearance: Clear
Color: Colorless
Sp. Conductivity: 100000 micromhos/cm
Chem. Treatment: N/A
pH: 7.2
H2S (Qualitative): Pos.

constituent **	ppm	meq/l	method	comments
Sodium (Na+)	26400	1150	icp	
Potassium (K+)	635.	16.	icp	
Lithium (Li+)	9.	1.	icp	
Calcium (Ca++)	2770	138.	icp	
Magnesium (Mg++)	473.	38.9	icp	
Barium (Ba++)	3.5	0.05	icp	
Strontium (Sr++)	95.	2.	icp	
Aluminum (Al+++)	5.8	-	icp	
Silver (Ag+)	<0.2	-	icp	
Arsenic (As+++)	<5.	-	icp	
Chromium (Cr+++)	<0.6	-	icp	
Copper (Cu++)	1.1	0.03	icp	
Iron (Fe++)	2.4	0.08	icp	
Mercury (Hg++)	<2.	-	icp	
Lead (Pb++)	<3.	-	icp	
Antimony (Sb+++)	<20	-	icp	
Tin (Sn++)	<6.	-	icp	
Titanium (Ti++++)	<0.1	-	icp	
Zinc (Zn++)	0.82	0.0251	icp	
Boron (B) ***	7.1	2.0	icp	
Phosphate (PO4---)	<5.	-	icp	
Chloride (Cl-)	48400	1370	titr	
Sulfate (SO4--)	1430	29.8	turb	
Bicarbonate (HCO3-)	453.	7.4	titr	
Carbonate (CO3--)	<1.	-	titr	
Silica (SiO2)	56.	-	icp	

Analysis No. 5057

NOTES TO ANALYSIS

	Ion Balance		
Sum of cations:	1350 meq/l	Standard deviation:	24.2 meq/l
Sum of anions:	1400 meq/l	Standard deviation:	27.3 meq/l
	*TDS Balance		
Measured:	84000 ppm	Standard deviation:	4210 ppm
Calculated:	80800 ppm	Standard deviation:	1120 ppm

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N/A= not available
meq/l= milliequivalents per liter
ppm and milligrams per liter used interchangeably
icp= inductively coupled plasma emission
titr= titration; turb= turbidimetric
TDS by gravimetric determination
Specific Conductivity by Wheatstone Bridge

* Total Dissolved Solids
** Valency given is arbitrarily chosen and is not necessarily the true valency unless indicated in the column for comments
*** TDS boron is given as ppm elemental boron, but for the purposes of an ion balance, boron is converted to BO3---

The various parameters in the above results can be usefully interpreted using the guidelines below:

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2) Specific conductivity: this gives an approximate indication of the total amount of inorganic dissolved solids in the water sample. A simple guideline is that 10,000 micromhos/cm is equivalent to 100 meq/l of dissolved solids. However, this relationship is valid only in solutions with specific conductivities less than approximately 50,000 micromhos/cm.

3) Concentration of various ionic species: the concentrations of various ionic species give information about a) thermodynamic characteristics of the brine, b) scaling tendency of the water, and c) enthalpy of the water.

Analysis No. 5057

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CaSO4

The calcium and sulfate ion concentration of the brine as reported in this analysis does not seem to pose any danger of calcium sulfate precipitation at 76 deg-F.

However, if the brine is heated to a temperature of 184.5 deg-F or higher (at water saturation pressure), this brine would have a tendency to precipitate calcium sulfate.

It has to be remembered that CaSO4 scale tendency decreases with increasing pressure. This means, if the system pressure is higher than the water vapor saturation pressure, calcium sulfate scale would form at a temperature higher than reported.

BaSO4

Analysis No. 5057

The barium and sulfate ion concentrations of the brine as reported in this analysis indicate a definite potential for barium sulfate precipitation at 76 deg-F. This indicates that barium sulfate precipitation has already occurred somewhere in this system before the wellbore brine is brought to the ambient conditions.

However, the maximum amount of BaSO4 that can be precipitated is 5.946 Mg/liter of the brine.

SrSO4

The strontium and sulfate ion concentrations of the brine as reported in this analysis indicate that there is a potential for strontium sulfate precipitation at 76 deg-F. This suggests that as the brine is brought to the ambient conditions from higher temperatures and pressures strontium sulfate scaling has occurred.

CaCO3

At 76 deg-F, the stability index is (+): implies scaling tendency.

The precise calcium carbonate scaling tendency of the brine cannot immediately be determined without the required information on temperature, pressure, pH and partial pressure of carbon dioxide above the brine. The Stiff-Davis Stability Index gives only a crude approximation of the CaCO3 scale tendencies. This stability index is given for the sake of completeness.

QUANTITATIVE INFORMATION ON ALL SCALE TENDENCIES

Quantitative information can be extracted on all scaling tendencies of this brine if the temperature and pressure conditions of the brine are available. The most complicated calculations have to be performed on the CaCO3 scale tendencies. The other scale tendencies are easier to determine.

(314) 961 3500 / TWX 910 760 1660 / Telex 44 7417

WATER ANALYSIS REPORT

COMPANY

Cabot Corporation

SOURCE

State "C"
Well 2
Sample point:
Wolf Camp Formation

Submitted by: Brewer, M.
Sampled by: Brewer, M.
Distribution Center: Midland

Sample date: 10/31/80
Analysis Date: 11/ 7/80
Analysis No.: 5058

SAMPLE ANALYSIS

Appearance: Clear
Sp. Conductivity: 110000 micromhos/cm
pH: 6.4

Color: Colorless
Chem. Treatment: N/A
H2S (Qualitative): Pos.

constituent **	ppm	meq/l	method	comments
Sodium (Na+)	29800	1300	icp	
Potassium (K+)	715.	18.	icp	
Lithium (Li+)	10	2.	icp	
Calcium (Ca++)	3090	154.	icp	
Magnesium (Mg++)	540.	44.4	icp	
Barium (Ba++)	8.1	0.1	icp	
Strontium (Sr++)	100	2.	icp	
Aluminum (Al+++)	36.	-	icp	
Silver (Ag+)	<0.2	-	icp	
Arsenic (As+++)	<5.	-	icp	
Chromium (Cr+++)	<0.6	-	icp	
Copper (Cu++)	1.2	0.04	icp	
Iron (Fe++)	10.2	0.4	icp	
Mercury (Hg++)	<2.	-	icp	
Lead (Pb++)	<3.	-	icp	
Antimony (Sb+++)	<20	-	icp	
Tin (Sn++)	<6.	-	icp	
Titanium (Ti++++)	<0.1	-	icp	
Zinc (Zn++)	1.75	0.0537	icp	
Boron (B) ***	14.2	3.9	icp	
Phosphate (PO4---)	<5.	-	icp	
Chloride (Cl-)	53200	1500	titr	
Sulfate (SO4--)	1520	31.5	turb	
Bicarbonate (HCO3-)	462.	7.6	titr	
Carbonate (CO3--)	<1.	-	titr	
Silica (SiO2)	130	-	icp	

Analysis No. 5058

NOTES TO ANALYSIS

Ion Balance

Sum of cations:	1520 meq/l	Standard deviation:	27.1 meq/l
Sum of anions:	1540 meq/l	Standard deviation:	30.0 meq/l

*TDS Balance

Measured:	93000 ppm	Standard deviation:	4670 ppm
Calculated:	89700 ppm	Standard deviation:	1230 ppm

# indicates that the amount of this component has changed in a statistically significant way since the last analysis
N/A= not available
meq/l= milliequivalents per liter
ppm and milligrams per liter used interchangeably
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* Total Dissolved Solids
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CaSO4

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However, if the brine is heated to a temperature of 184.5 deg-F or higher (at water saturation pressure), this brine would have a tendency to precipitate calcium sulfate.

It has to be remembered that CaSO4 scale tendency decreases with increasing pressure. This means, if the system pressure is higher than the water vapor saturation pressure, calcium sulfate scale would form at a temperature higher than reported.

BaSO4

Analysis No. 5058

The barium and sulfate ion concentrations of the brine as reported in this analysis indicate a definite potential for barium sulfate precipitation at 76 deg-F. This indicates that barium sulfate precipitation has already occurred somewhere in this system before the wellbore brine is brought to the ambient conditions.

However, the maximum amount of BaSO4 that can be precipitated is 13.762 Mg/liter of the brine.

SrSO4

The strontium and sulfate ion concentrations of the brine as reported in this analysis indicate that there is a potential for strontium sulfate precipitation at 76 deg-F. This suggests that as the brine is brought to the ambient conditions from higher temperatures and pressures strontium sulfate scaling has occurred.

CaCO3

At 76 deg-F, the stability index is (-): implies corrosive tendency.

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