

Date: 19 October 2012  
To: ScaleChem Clients  
From: Anthony J (A.J.) Gerbino, PhD  
Pat McKenzie  
Re: Case Studies in ScaleChem Standard and Studio ScaleChem  
PWG-12-Rel-002

## Summary

The purpose of this document is to directly compare ScaleChem Standard to Studio ScaleChem via a series of case studies. Comparisons are specific to the output of the calculations: do the calculations match each other identically? If not, where are the differences? In some cases the document explains why there are differences.

This document is part of our effort to make the transition from ScaleChem Standard to Studio ScaleChem as easy as possible, anticipating where there may be changes in results between the two programs. In this way, our clients can continue to work with either ScaleChem until they eventually transition to Studio ScaleChem. This document serves as evidence to whether the transition regarding a type of case is seamless (no differences between the two software), and if not, then what calculation differences are observed.

## Method

Thirty client/AQSim files were opened and tested. Of these, the first twenty-two cases are reported, ranging from very simple (brine only) to many calculation objects. Some of the cases are presented in this report and the accompanying Excel file. Others were excluded because they provided no new knowledge relative to the previously compared cases (i.e., cases with duplicate comparisons were ignored). The cases tested are archived at the following AQSim FTP location:

[www.aqsim.com/Downloads/ScaleChemComparisons.zip](http://www.aqsim.com/Downloads/ScaleChemComparisons.zip)

Finally, the data presented is complete for some files but not others, again based on the decision that duplication of observations would not provide new information.

This report does not provide conclusions or recommendations. Rather it is a blind study of previously saved files that were opened in both software and tested. This work began in February 2012 using the alpha-release of Studio ScaleChem. It was redone in September 2012 using the V9.0.1 release. During this time, differences observed were submitted to OLI for evaluation. In some cases changes were made to the new software. In other cases, the developers confirmed that the new software provide a more accurate representation of the fluid properties. Thus, this comparison work was also a beta testing tool for the new product.

We plan to produce a second comparison document, given the differences between the two software products that are presented in this document. In this planned document, the remaining files will be presented along with the files in this document that contained discrepancies.

## Cases not shown

The files selected were random and assigned case numbers. Several cases, when evaluated resulted in similar/same results as previous cases. Therefore they are not reported here. These files are available in the download link provided above. The cases are: 5, 10, 11, and 21.

### ***Differences observed***

The following differences were observed during the study. Please be aware of them as you plan to transfer your existing ScaleChem Standard files (SC) to Studio ScaleChem (SSC)

- 1) **Saturation**  
There are some cases where the precipitates selected in SC do not appear in SSC.
- 2) **Facilities** (*Case #20 and #22*)  
Solids are separated in the First Node in SSC, even though they were not selected as such in SC
- 3) **Facilities** (*Case #20 and #22*)  
There are some cases where the precipitates selected in SCStd does not appear in SSC
- 4) **Brine Analysis** (*Case #22*)  
The Na/Cl charge balance is not in StudioSC. Analyses that used this option were converted to Makeup ion in StudioSC. Be careful! This creates some calculation problems.
- 5) **Brine Analysis** (*Case#9, #13, and #20*).  
The computed alkalinity differ between 0 and 10%
- 6) **Brine Analysis** (*Case #6*).  
The computed amount of CO<sub>2</sub> added to the brine in a CO<sub>2</sub> fraction calculation differs. This is because of the way that the new software handles the headspace. This difference is an improvement.
- 7) **Oil Analysis** (*Case #20*)  
The H<sub>2</sub>O saturation was set to **none** in SSC.
- 8) **Plot**  
None of the plot variables selected in SC are transferred to SSC.
- 9) **Saturation/Scaling Results** (*Case #22*)  
There is a significant difference in the water:oil ratio computed in SSC vs. SC
- 10) **CaCO<sub>3</sub> Predictions** (*Case #9, Object "B\_ST2"*)  
There are differences up to 20% in the computed scale tendencies between SSC and SC
- 11) **Object Convergence** (*Case #9, object "B\_ST1"*)  
There are some calculation objects that do not converge in SSC

## Contents

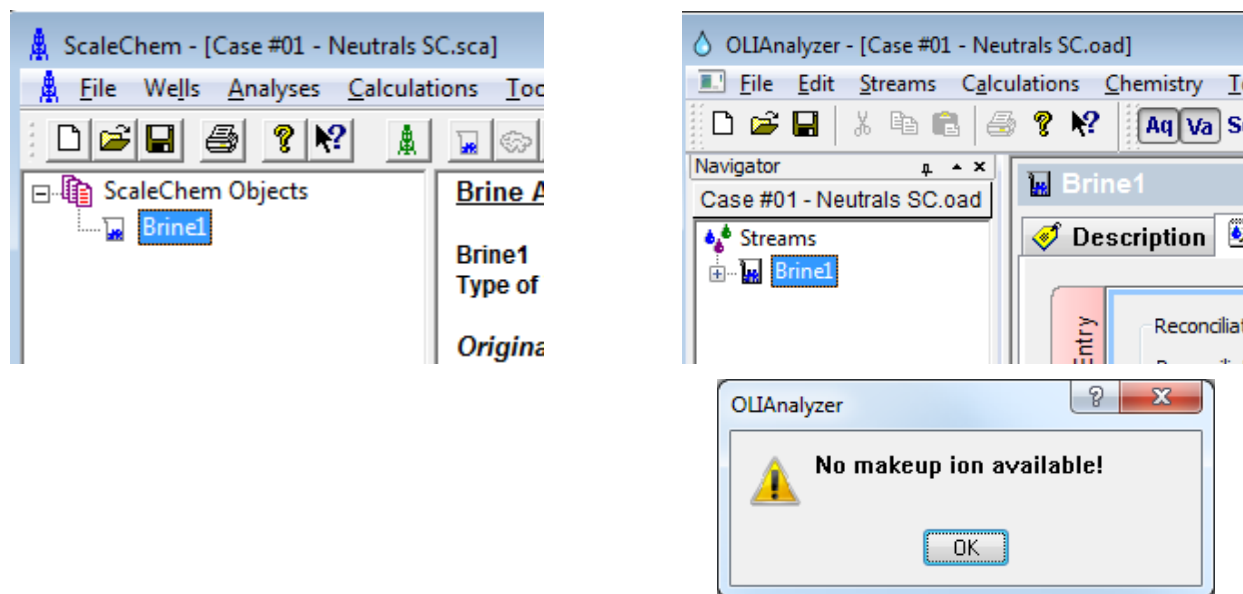
The following are the cases presented. They progress from simple to complex.

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## Case #1 -Neutrals SC

### Summary

This file contains a single Brine Analysis object. The object contains 1N HCl as a Neutrals inflow. There are no cations or anions in the analysis. The purpose of this case is to see whether the new software will accept molecular flows in the brine analysis. This is no longer a requirement of the ScaleChem software, since molecular flows can now be added into streams, and streams can be used in the ScaleChem objects. In summary, this calculation does not work in Studio ScaleChem.



There is a warning in Studio ScaleChem that No makeup ion is available. This is because the water analysis contains neutral inflows only.

## ScaleChem Std Screen – Brine Analysis

Settings – Non-Zero, Na/Cl balance, Equilibrium

Analysis View  
☒ Original ☐ Balanced ☐ Reconciled

Species Display  
☒ Formula ☐ Name

Species List  
☐ Standard ☐ Expanded ☒ Non Zero

Cations	mg/L	Anions	mg/L	Neutrals	mg/L
				HCl, aq	36453.000

Variable	Units	Measured	Calculated
Ambient Temperature	°F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	0.076
Alkalinity	as HCO <sub>3</sub> <sup>-</sup> , mg/L	0.000	
Density	g/cc	1.000	1.015
Total Dissolved Solids	mg/L	0.000	0.000
Electrical Conductivity	1/ohm-cm	0.000	0.334

Reconciliation Type  
 Equilibrium Calculation

☐ Update Brine with results

Units

Balance

Calculate

View Files

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	0.076	0.0756	
Alk	0		
Balance ion	0		
Balance Value	0		
Density	1.01481	1.01481	
Saturated	---		

## Studio ScaleChem Screen – Brine Analysis

Settings - Makeup Ion, Equilibrium

Brine1

Description Design Report

Data Entry Reconcile

Variable	Value	Balanced
Cations (mg/L)		
Anions (mg/L)		
Neutrals (mg/L)		
HCl	36453.0	

Entry Options  
 Units: mg/L  
 Display: Formula  
☐ Show Non-zero Only  
☒ Show Balanced Column

Template Manager  
 Last Applied: None  
 Expanded  
 Save as...

Balance Options  
 Type: Makeup Ion

Summary  
 Cations and Anions are required.

Brine1

Description Design Report

Data Entry Reconcile

Reconciliation Options  
 Reconciliation Type: ☒ Equilibrium Calculation  
☐ CO<sub>2</sub> Fraction in Gas  
☐ pH Alkalinity Reconcile  
☐ Allow solids to form

Calculate

Properties	Measured	Calculated
Temperature (°F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	
Alkalinity, Measured - Aqueous (mg HCO <sub>3</sub> /L)	0.0	
Density - Aqueous (g/cm <sup>3</sup> )	1.00000	
Elec Cond, specific - Aqueous (mho/m)	0.0	
Total Dissolved Solids (mg/L)	0.0	
Composition Adjustments		
Charge Balance Unknown		

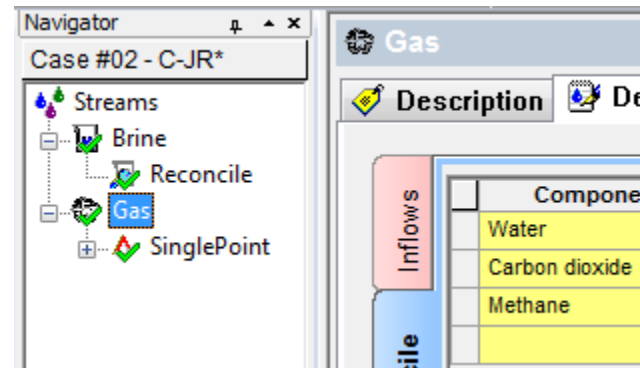
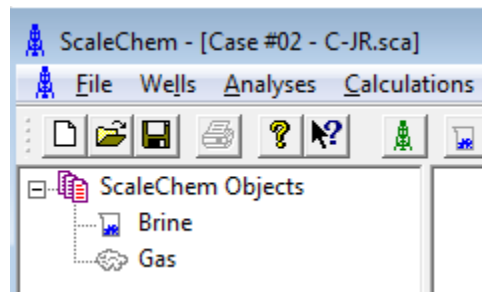
Summary  
 Cations and Anions are required.

**Notes** – No makeup ion warning, Brine Analysis does not handle Molecular flows. Streams now do this. Calculations not possible.

## Case #2 - CJ-R

### Summary

This case contains a water and gas analysis. Both are standard-type entries (nothing unique about the chemistry or conditions). The calculation results were the same except for Alkalinity, which varied by 5%. There was a difference in how the gas was handled. The Expanded gas template was on, and the water saturation calculation was active for the StudioScaleChem Gas.



## ScaleChem Std Screen - Brine Analysis

### Settings - Non-zero List, Na/Cl balance, Equilibrium

Description Species Summary

Analysis View: ☒ Original ☐ Balanced ☐ Reconciled

Species Display: ☒ Formula ☐ Name

Species List: ☐ Standard ☐ Expanded ☒ Non Zero

Cations	mg/L	Anions	mg/L	Neutrals	mg/L
Na+1	65280.000	Cl-1	114503.000		
K+1	330.900	SO4-2	24.000		
Ca+2	5435.000	HCO3-1	263.000		
Mg+2	914.600	Br-1	571.000		
Sr+2	299.200				
Ba+2	133.800				
Fe+2	26.400				
Zn+2	37.700				

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	7.160	6.944
Alkalinity	as HCO3-, mg/L	263.000	225.294
Density	g/cc	1.000	1.123
Total Dissolved Solids	mg/L	187818.600	187818.600
Electrical Conductivity	1/ohm-cm	0.000	0.199

Reconciliation Type:

☐ Update Brine with results

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	6.944	6.944	
Alk	225.3	214.9	~4.8%
Balance ion	Na/Cl	Na/Cl	
Balance Value	835.6	835.6	
Density	1.123	1.124	
Saturated	CaCO3, BaSO4, FeCO3	CaCO3, BaSO4, FeCO3	

## Studio ScaleChem Screen - Brine Analysis

### Settings - Expanded List, Makeup ion (Na+), Equilibrium

Brine1

Description Design Report

Data Entry Reconcile

Variable	Value	Balance
<b>Cations (mg/L)</b>		
Na+1	65280.0	66115.6
K+1	330.900	330.900
Ca+2	5435.000	5435.000
Mg+2	914.600	914.600
Sr+2	299.200	299.200
Ba+2	133.800	133.800
Fe+2	26.4000	26.4000
Zn+2	37.7000	37.7000
<b>Anions (mg/L)</b>		
Cl-1	1.14503	1.14503
SO4-2	24.0000	24.0000
HCO3-1	263.000	263.000
B(OH)4-1	0.0	0.0
HS-1	0.0	0.0
C2H3O2-1	0.0	0.0
Br-1	571.000	571.000
<b>Neutrals (mg/L)</b>		
CO2	0.0	
H2S	0.0	
SiO2	0.0	
B(OH)3	0.0	

Entry Options: Units: mg/L, Display: Formula, ☐ Show Non-zero Only, ☒ Show Balanced Column

Template Manager: Last Applied: None, Expanded, Save as...

Balance Options: Type: Makeup Ion

Summary:

Unit Set: Based on: Concentration

Automatic Chemistry Model: Aqueous (H+ ion) Databanks: Public

No Solid phase(s)

Stream amount: 1.00000 L

User Choice Charge Balance: Cation: Na+1

Cation Charge: 3.20532 eq/L

Anion Charge: -3.24167 eq/L

Imbalance: -0.0363482 eq/L

835.643 mg/L of Na+1 is needed to balance.

Isothermal Calculation: Calculation not done

25.0000°C

1.00000atm

Brine1

Description Design Report

Data Entry Reconcile

Reconciliation Options:

Reconciliation Type: ☒ Equilibrium Calculation ☐ CO2 Fraction in Gas ☐ pH Alkalinity Reconcile

☐ Allow solids to form

☒

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	7.16000	6.94474
Alkalinity, Measured - Aqueous (mg HCO3/L)	263.000	214.896
Density - Aqueous (g/cm3)	1.00000	1.12382
Elec Cond, specific - Aqueous (mho/m)	0.0	19.9398
Total Dissolved Solids (mg/L)	0.0	1.88654e5
<b>Composition Adjustments</b>		
Add Charge Balance (mg/L Na+1)		835.643

Summary:

Stream amount: 1.00000 L

User Choice Charge Balance: Cation: Na+1

Cation Charge: 3.20532 eq/L

Anion Charge: -3.24167 eq/L

Imbalance: -0.0363482 eq/L

835.643 mg/L of Na+1 is needed to balance.

Isothermal Calculation: Phase Amounts

Aqueous: 1123.82 g

Vapor: 0.0 g

Solid: 0.0 g

2nd Liquid: 0.0 g

Aqueous Phase Properties

pH: 6.94474

Ionic Strength: 0.0586584 mol/mol

Density: 1.12382 g/cm3

## ScaleChem Std Screen – Gas Analysis

**Settings** - Standard Gas, Methane balance, H2O Saturation inactive

☒ Description
 ☐ Composition
 ☐ Dew Point
 ☐ Summary

Gas	Mole / Vol %
Water	0.000
Nitrogen	0.000
Carbon dioxide	0.680
Hydrogen sulfide	0.000
Methane	99.320

Display  
☐ by Formula  
☒ by Name

Gases Display  
☒ Show standard gas list  
☐ Show expanded gas list  
☐ Show non-zero gases

Total Percent 100.00

☒ Calculate methane percent  
☐ Normalize to 100%

Methane percent is calculated as (100.0 - CO2 - H2S - H2O)

Gas Analysis Data - Gas

☒ Description
 ☐ Composition
 ☐ Dew Point
 ☐ Summary

Type of Calculation

☒ Saturated water content  
☐ Dew point temperature  
☐ Dew point pressure

Result

T, °F 77.0

P, psia 14.696

Water vapor, vol % 3.15342

Result

% water vapor: 3.153

The water vapor content can be changed for the calculation. It will not affect the stored gas compositions.

## Studio ScaleChem Screen – Gas Analysis

**Settings** - Expanded Gas, Methane balance, H2O saturation active

Gas1

☒ Description
 ☐ Design
 ☐ Definition
 ☐ Report

Inflows

Component	Value	Normalized
H2O	0.0	0.0
N2	0.0	0.0
CO2	0.680000	0.680000
H2S	0.0	0.0
CH4	99.3200	99.3200

Entry Options

Units mole %

Display Formula

☐ Show Non-zero Only  
☒ Show Normalized Column

Template Manager

Last Applied: None

Expanded

Save as...

Normalize Options

Type Makeup

Gas\_Gas\_

☒ Description
 ☐ Design
 ☐ Definition
 ☐ Report

Inflows

Component	Normalize	Reconciled
H2O	0.0	3.23935
N2	0.0	0.0
CO2	0.680000	0.657972
H2S	0.0	0.0
CH4	99.3200	96.1027

Calculate

Condition

Saturate With H2O

Conditions	Value
Temperature (°F)	77.00
Pressure (psia)	14.69

☐ Show Non-zero Only

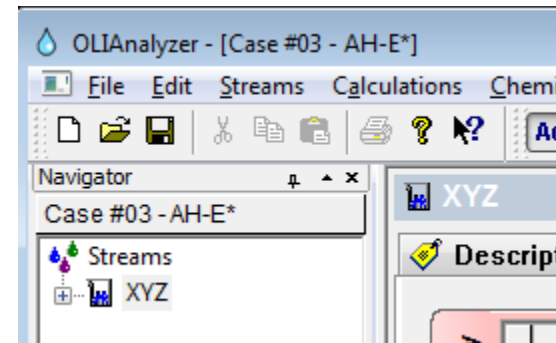
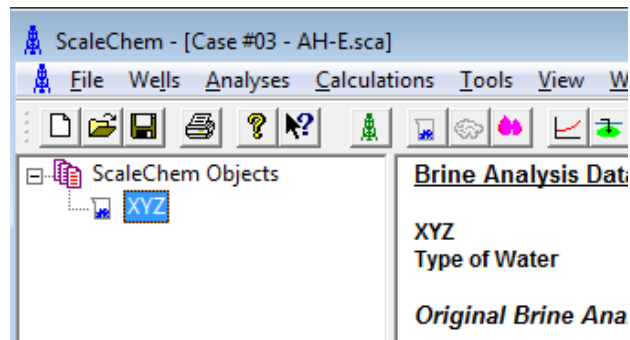
Saturated H2O Amount: 3.15345 mole



## Case #3 – AH-E

### Summary

This file contains a single Brine analysis with a complex composition, and using the pH/Alkalinity reconciliation. StudioScaleChem computes the results with no problems. However, the ScaeChem Std software no longer computes this – an Unable to Reconcile result is obtained. The ScaleChem std problem will be submitted to OLI.



## ScaleChem Std Screen – Brine Analysis

### Settings - Expanded List, Na/Cl Balance, pH&Alkalinity

Brine Analysis Data - XYZ

Description Species Summary

Analysis View: ☒ Original ☐ Balanced ☐ Reconciled

Species Display: ☒ Formula ☐ Name

Species List: ☐ Standard ☒ Expanded ☐ Non Zero

Cations	mg/L	Anions	mg/L	Neutrals	mg/L
Na+1	43860.000	Cl-1	151299.000	CO2, aq	0.000
K+1	3196.000	SO4-2	18.000	H2S, aq	0.000
Ca+2	40380.000	HCO3-1	13.000	SiO2, aq	31.000
Mg+2	3338.000	B(OH)4-1	0.000	B(OH)3, aq	0.000
Sr+2	536.000	HS-1	0.000	HCOOH, aq	0.000
Ba+2	53.000	OH-1	0.000	CH3COOH, aq	0.000
Fe+2	223.000	CHO2-1	0.000	C4H8O2, aq	0.000
H+1	0.000	C2H3O2-1	20.000	C3H6O2, aq	0.000
Cc+1	0.000	C3H5O2-1	0.000	CH3OH, aq	0.000

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	4.500	4.500
Alkalinity	as HCO3-, mg/L	13.000	13.009
Density	g/cc	1.160	1.170
Total Dissolved Solids	mg/L	242936.000	242936.000
Electrical Conductivity	1/ohm-cm	0.000	0.210
Alkalinity endpoint	pH units	4.300	
HCl added	mg/L		-17.001

Reconciliation Type: pH and Alkalinity

☒ Update Brine with results

Units: [ ]

Balance

Calculate

View Files

The brine no longer reconciles in the ScaleChem software. The screenshot above is from the original file, computed in an earlier version of ScaleChem std.

## Studio ScaleChem Screen – Brine Analysis

### Settings - Expanded List, Na/Cl Balance, pH&Alkalinity

XYZ

Description Design Report

Data Entry

Variable	Value	Balance
Cations (mg/L)		
Na+1	43860.0	43860.0
K+1	3196.00	3196.00
Ca+2	40380.0	40380.0
Mg+2	3338.00	3338.00
Sr+2	536.000	536.000
Ba+2	53.0000	53.0000
Fe+2	223.000	223.000
Anions (mg/L)		
Cl-1	151299e	1.52425e
SO4-2	18.0000	18.0000
HCO3-1	13.0000	13.0000
C2H3O2-1	20.0000	20.0000
Neutrals (mg/L)		
SiO2	31.0000	

Entry Options: Units: mg/L, Display: Formula

☒ Show Non-zero Only

☒ Show Balanced Column

Template Manager: Last Applied: None, Expanded

Save as...

Balance Options: Type: Makeup Ion

Summary:

Stream amount: 1.00000 L

User Choice Charge Balance

Anion: Cl-1

Cation Charge: 4.30027 eq/L

Anion Charge: -4.26852 eq/L

Imbalance: 0.0317502 eq/L

1125.638 mg/L of Cl-1 is needed to balance.

Alkalinity Calculation

Calculation not done

Measured Alkalinity: 13.0000 mg HCO3/L

Titration End Pt: 4.30000

Alkalinity Titrant: CO2

Alkalinity pH Titrant: H2SO4

pH Reconciliation: Measured pH: 4.50000, pH Titrant: HCl

XYZ

Description Design Report

Data Entry

Reconciliation Options

Reconciliation Type: ☐ Equilibrium Calculation, ☐ CO2 Fraction in Gas, ☒ pH Alkalinity Reconcile

☐ Allow solids to form

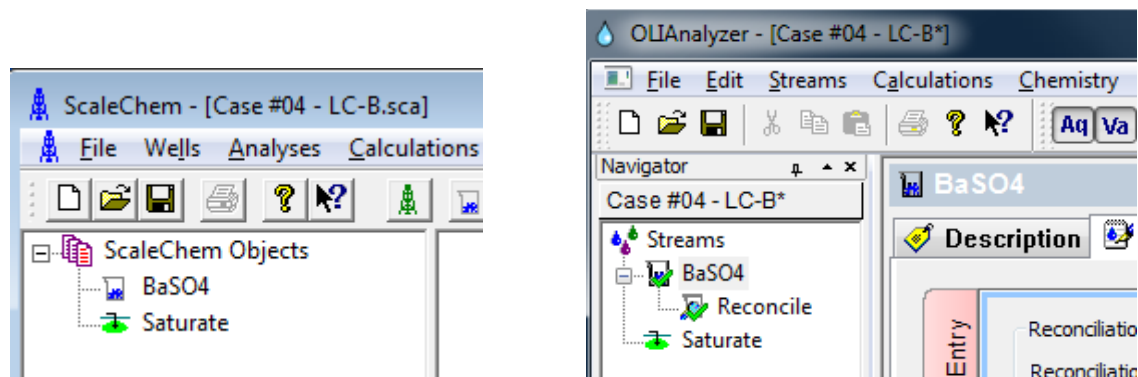
Calculate

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	4.50000	4.50000
Alkalinity, Measured - Aqueous (mg HCO3/L)	13.0000	12.9838
Alkalinity end point Alkalinity End Point pH	4.30000	
Density - Aqueous (g/cm3)	1.16000	1.17082
Elec Cond, specific - Aqueous (mho/m)	0.0	21.0098
Total Dissolved Solids (mg/L)	0.0	0.0
Composition Adjustments		
Added acidity (mg/L HCL)		-16.9341
Add carbonate (mg/L CO2)		85.1033
Add Charge Balance (mg/L Cl-1)		1125.64

## Case #4 – LC-B

### Summary

This file contains a single Brine Analysis and Saturation object. The brine analysis is basic, and the saturation calculation is being tested. Both software produced identical results. The amount of BaSO<sub>4</sub> added is not reported in the Studio ScaleChem Report. This has been submitted to the developers. Also, the Alkalinity calculation at every point did not occur Studio ScaleChem. The developers have not implemented this calculation. It has been submitted as a feature request. Lastly, the new way that Studio SC handles saturation is different, in that two selections need to be made, one for the allowing solids to form and the other to select which of these allowed solids will be saturated, and with what. This created additional flexibility, but is not initially obvious to the user.



## ScaleChem Std Screen – Brine Analysis

**Settings** - Non-zero List, Na/Cl Balance, Equilibrium

Brine Analysis Data - BaSO4

Description Species Summary

Analysis View  
☒ Original ☐ Balanced ☐ Reconciled

Species Display  
☒ Formula ☐ Name

Species List  
☐ Standard ☐ Expanded ☒ Non Z

Cations		mg/L	Anions		mg/L	Neutrals		mg/L
Na+1		10000.000	Cl-1		15000.000			
Ba+2		28.000	SO4-2		28.000			

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	6.993
Alkalinity	as HCO3-, mg/L	0.000	2.505
Density	g/cc	1.000	1.015
Total Dissolved Solids	mg/L	25056.000	25056.000
Electrical Conductivity	1/ohm-cm	0.000	0.041

Reconciliation Type  
 Equilibrium Calculation

☐ Update Brine with results

Units

Balance

Calcul

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	6.993	6.993	
Alk	2.505	2.506	
Balance ion	Cl	Cl	
Balance Value	414.9	414.9	
Density	1.015	1.015	
Saturated	BaSO4	BaSO4	
Notes			

## Studio ScaleChem Screen – Brine Analysis

**Settings** - Expanded List, Makeup ion (Cl-), Equilibrium

BaSO4

Description Design Report

Data Entry

Variable	Value	Balance
Cations (mg/L)		
Na+1	10000.0	10000.0
Ba+2	28.0000	28.0000
Anions (mg/L)		
Cl-1	15000.0	15414.9
SO4-2	28.0000	28.0000
Neutrals (mg/L)		

Entry Options  
 Units: mg/L  
 Display: Formula  
☐ Show Non-zero Only  
☒ Show Balanced Column

Template Manager  
 Last Applied: None  
 Expanded  
 Save as...

Balance Options  
 Type: Makeup Ion

Summary

1.00000 L  
 User Choice Charge Balance  
 Anion: Cl-1  
 Cation Charge: 0.435380 eq/L  
 Anion Charge: -0.423678 eq/L  
 Imbalance: 0.0117018 eq/L  
 414.863 mg/L of Cl-1 is needed to balance.

Isothermal Calculation  
 Phase Amounts  
 Aqueous: 1014.60 g  
 Vapor: 0.0 g  
 Solid: 0.0 g  
 2nd Liquid: 0.0 g

Aqueous Phase Properties  
 pH: 6.99283  
 Ionic Strength: 7.80934e-3 mo  
 Density: 1.01460 g/cm3

Reconcile

Reconciliation Options  
 Reconciliation Type: ☒ Equilibrium Calculation  
☐ CO2 Fraction in Gas  
☐ pH Alkalinity Reconcile  
☐ Allow solids to form

Calculate

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	6.99283
Alkalinity, Measured - Aqueous (mg HCO3/L)	0.0	2.50598
Density - Aqueous (g/cm3)	1.00000	1.01460
Elec Cond, specific - Aqueous (mho/m)	0.0	4.14387
Total Dissolved Solids (mg/L)	0.0	25470.9
Composition Adjustments		
Add Charge Balance (mg/L Cl-1)		414.863

Notes –

## ScaleChem Std Screen – Saturation

Settings –One Brine, One Condition, no Scales

Saturation Study - Saturate

Description Components Conditions Saturation Calculate Results

Input

Type	Name	Amount	Units
Brine	BaSO4	1.000	bbt/day

Description Components Conditions Saturation Calculate Results

Temperature °F Pressure psia Description

200.000 2000.000 Example

Selected Conditions

1 200.000 2000.000 Example Add

Saturation Study - Saturate

Description Components Conditions Saturation Calculate Results

Available solids:

NaCl (Halite)  
BaSO4 (Barite)

Chosen solids: Solid [Inflow to Vary]

Add >>

- No solids were selected in the ScaleChem Saturate
- Alkalinity is turned off in the ScaleChem.

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	6.15	6.15	
Alk	2.65	---	
Solid	BaSO4	BaSO4	
pScaleTend	4.80	4.80	
Added/Removed	29.1	---	
Brine Flow	1.03	1.03	

## Studio ScaleChem Screen – Saturation

Settings - One Brine, One Condition, no Scales

Saturate

Description Design Report File Viewer

Inlets

Type	Name	Flow
Brine (bbt/day)	BaSO4	1.00000
<select>		

Calculate

Summary

Saturate

Description Design Report File Viewer

Solid Selection (check solids allowed to form)

Standard  
☒ BaSO4  
☐ NaCl  
 Expanded  
☒ All

Select Inflows To Vary

Solid	Inflow
BaSO4	BaSO4
<Select Solid>	

Scale Mineral	Max Scale	Pre-scaling	Pre-index
Barium sulfate	0.0	4.80425	0.681625
Sodium chloride	0.0	2.23602e-3	-2.65053

### Brine Totals

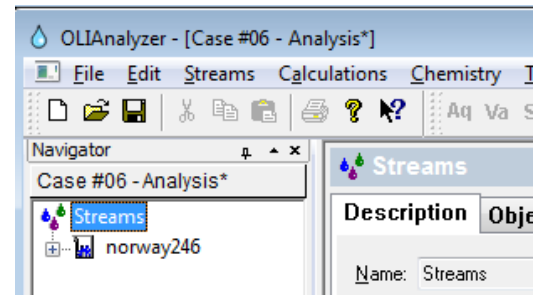
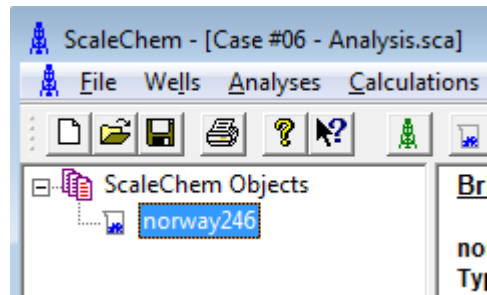
Cations	Value (mg/L)	Anions	Value (mg/L)	Neut
Na(+1)	9716.08	Cl(-1)	14977.2	
Ba(+2)	27.2050	SO4-2	27.2431	

- No Alkalinity calculation is available in StudioSC Saturate
- BaSO4 does not automatically precipitate in StudioSC Saturate unless it is checked

## Case #6 - Analysis

### Summary

This file contains a single Brine Analysis that uses the CO<sub>2</sub> Fraction in gas calculation. Studio SC and Sc Std produced similar results



## ScaleChem Std Screen – Brine Analysis

### Settings - Expanded List, Na/Cl Balance, CO2 in Gas

Brine Analysis Data - norway246

Description Species Summary

Analysis View  
☐ Original ☐ Balanced ☒ Reconciled

Species Display  
☐ Formula ☒ Name

Species List  
☐ Standard ☐ Expanded ☒ Non Zero

Cations	mg/L	Anions	mg/L	Neutrals	mg/L
Sodium (+1)	32090.800	Chloride (-1)	58823.100		
Potassium (+1)	238.969	Bicarbonate (-1)	14521.800		
Calcium (+2)	3795.928				
Magnesium (+2)	183.822				
Strontium (+2)	1268.373				
Barium (+2)	1948.515				
Hydrogen (+1)	235.185				

Variable	Units	Measured	Calculated
Ambient Temperature	°C	145.000	145.000
Ambient Pressure	psia	4200.000	4200.000
pH	pH units	0.000	5.169
Alkalinity	as HCO3-, mg/L	300.000	294.087
Density	g/cc	1.000	1.008
Total Dissolved Solids	mg/L	113106.492	113106.492
Electrical Conductivity	1/ohm-cm	0.000	0.493
fraction CO2 in Gas	mole fraction	0.042	0.042
Alkalinity endpoint	pH units	4.000	

Reconciliation Type  
CO2 Fraction in Gas

☒ Update Brine with results

Units

Balance

Calculate

View Files

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	5.17	5.14	
Alk	294.1	298.1	
Balance ion	Na+	Na+	
Balance Value	15..0	15.0	
Density	1.031	1.008	
Saturated	CaCO3, SrCO3	CaCO3, SrCO3	
Notes			

## Studio ScaleChem Screen – Brine Analysis

### Settings - Expanded List, Na/Cl Balance (Na+), CO2 in Gas

norway246

Description Design Report

Data Entry

Variable	Value	Balance
Na+1	34900.0	34915.0
K+1	260.000	260.000
Ca+2	4130.000	4130.000
Mg+2	200.000	200.000
Sr+2	1380.000	1380.000
Ba+2	2120.000	2120.000
Fe+2	0.0	0.0

Entry Options  
Units: mg/L  
Display: Formula  
☐ Show Non-zero Only  
☒ Show Balanced Column

Template Manager  
Last Applied: None  
Expanded  
Save as...

Balance Options  
Type: Makeup Ion

Summary

Unit Set  
Based on: Concentration

Automatic Chemistry Model  
Aqueous (H+ ion) Databanks:  
Public  
No Solid phase(s)

Stream amount:  
1.00000 L  
User Choice Charge Balance  
Cation: Na+1

Cation Charge: 1.80963 eq/L  
Anion Charge: -1.81029 eq/L  
Imbalance: -6.54370e-4 eq/L

15.044 mg/L of Na+1  
is needed to balance.

CO2 Fraction in Gas Calculation  
Calculation not done

norway246

Description Design Report

Data Entry

Reconciliation Options

Reconciliation Type  
☐ Equilibrium Calculation  
☒ CO2 Fraction in Gas  
☐ pH Alkalinity Reconcile

☐ Allow solids to form

Calculate

Reconcile

Properties	Measured	Calculated
Temperature (°C)	145.000	
Pressure (psia)	4200.00	
pH - Aqueous	0.0	5.13981
Alkalinity, Measured - Aqueous (mg HCO3/L)	300.000	298.065
Measured CO2 Gas Mole Fraction	0.0420000	
Density - Aqueous (g/cm3)	1.00000	1.00165
Elec Cond, specific - Aqueous (mho/m)	0.0	45.6391
Total Dissolved Solids (mg/L)	0.0	0.0

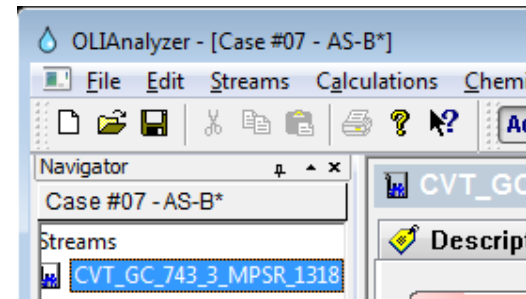
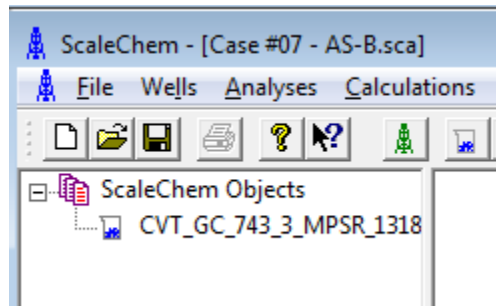
Composition Adjustments

Add carbonate (mg/L CO2)		6983.11
Add Charge Balance (mg/L Na+1)		15.0439

## Case #7 - AS-B

### Summary

This file contains a single Brine Analysis using the pH/Alkalinity calculation. This is a duplication of a previous case, but is still presented because when tested in a previous beta-version, the pH/Alkalinity option was not selected. Also, since the above pH/Alk calculation did not work on ScaleChem Std, a second comparison is provided. Both software produce similar results.





## ScaleChem Std Screen – Brine Analysis

### Settings - Non-zero List, Na/Cl Balance , pH&Alk Reconciliation

Brine Analysis Data - CVT\_GC\_743\_3\_MPSR\_1318

Description Species Summary

Analysis View: ☒ Original ☐ Balanced ☐ Reconciled

Species Display: ☐ Formula ☒ Name

Species List: ☐ Standard ☐ Expanded ☒ Non-zero

Cations	mg/L	Anions	mg/L	Neutrals	mg/L
Sodium (+1)	13281.500	Chloride (-1)	21587.000		
Potassium (+1)	75.400	Sulfate (-2)	26.700		
Calcium (+2)	301.500	Bicarbonate (-1)	747.700		
Magnesium (+2)	87.300	Boron tetrahydroxide...	278.000		
Strontium (+2)	43.400	Acetate (-1)	86.200		
Barium (+2)	28.200	Propanate (-1)	45.100		
Iron (+2)	2.700	Bromide (-1)	43.700		

Variable	Units	Measured	Calculated
Ambient Pressure	psia	14.696	14.696
pH	pH units	7.500	7.500
Alkalinity	as HCO <sub>3</sub> <sup>-</sup> , mg/L	747.000	745.710
Density	g/cc	1.030	1.023
Total Dissolved Solids	mg/L	36634.400	36634.400
Electrical Conductivity	1/ohm-cm	0.000	0.057
Alkalinity endpoint	pH units	4.500	
HCl added	mg/L	...	153.332
CO <sub>2</sub> added	mg/L	...	-31.089

Reconciliation Type: pH and Alkalinity

☒ Update Brine with results

Units

Balance

Calculate

View

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	7.5	7.5	
Alk	745.7	747	
Balance ion	Na+	Na+	
Balance Value	562.9	562.9	
Density	1.023	1.023	
Saturated	CaCO <sub>3</sub> , BaSO <sub>4</sub> , FeHCO <sub>3</sub>	CaCO <sub>3</sub> , BaSO <sub>4</sub> , FeCO <sub>3</sub> , SrCO <sub>3</sub>	
Notes			
HCl	153.3	152.8	0.3%
CO <sub>2</sub>	-31.1	-30.4	2.3%

## Studio ScaleChem Screen – Brine Analysis

### Settings - Expanded List, Makeup (Na+) BalancepH/Alkalinity

CVT\_GC\_743\_3\_MPSR\_1318

Description Design Report

Data Entry

Variable	Value	Balance
Cations (mg/L)		
Na+1	13281.5	13844.4
K+1	75.4000	75.4000
Ca+2	301.500	301.500
Mg+2	87.3000	87.3000
Fe+2	2.70000	2.70000
Ba+2	28.2000	28.2000
Sr+2	43.4000	43.4000
Anions (mg/L)		
Cl-1	21587.0	21587.0
SO4-2	26.7000	26.7000
HCO3-1	747.700	747.700
Br-1	43.7000	43.7000
B(OH)4-1	278.000	278.000
C2H3O2-1	86.2000	86.2000
C3H5O2-1	45.1000	45.1000

Entry Options

Units: mg/L

Display: Formula

☐ Show Non-zero Only

☒ Show Balanced Column

Template Manager

Last Applied: None

Expanded

Save as...

Balance Options

Type: Makeup Ion

Summary

User Choice Charge Balance

Cation: Na+1

Cation Charge: 0.603364 eq/L

Anion Charge: -0.627851 eq/L

Imbalance: -0.0244863 eq/L

562.939 mg/L of Na+1 is needed to balance.

Alkalinity Calculation

Phase Amounts

Aqueous: 1022.61 g

Vapor: 0.0 g

Solid: 0.0 g

2nd Liquid: 0.0 g

Aqueous Phase Properties

pH: 7.50000

Ionic Strength: 0.0113603 mol/mo

Density: 1.02261 g/cm<sup>3</sup>

CVT\_GC\_743\_3\_MPSR\_1318

Description Design Report

Data Entry

Reconciliation Options

Reconciliation Type: ☐ Equilibrium Calculation ☐ CO<sub>2</sub> Fraction in Gas ☒ pH Alkalinity Reconcile

☐ Allow solids to form

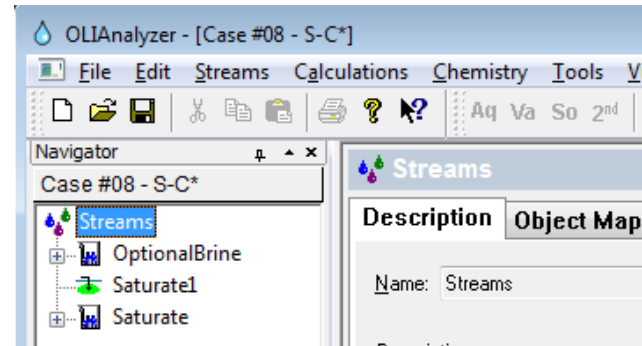
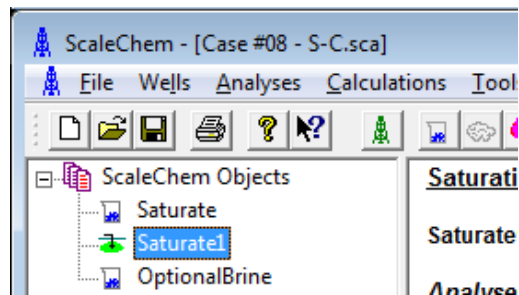
Calculate

Properties	Measured	Calculated
Temperature (°F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	7.50000	7.50000
Alkalinity, Measured - Aqueous (mg HCO <sub>3</sub> /L)	747.000	747.000
Alkalinity end point Alkalinity End Point pH	4.50000	
Density - Aqueous (g/cm <sup>3</sup> )	1.03000	1.02270
Elec Cond, specific - Aqueous (mho/m)	0.0	5.65961
Total Dissolved Solids (mg/L)	0.0	0.0
Composition Adjustments		
Added acidity (mg/L HCL)		152.775
Add carbonate (mg/L CO <sub>2</sub> )		-30.4105
Add Charge Balance (mg/L Na+1)		562.939

## Case #8 – S-C

### Summary

This case introduced the Optional Brine entry which is used in the ScaleScenario. The optional brine is no longer needed in StudioScaleChem. This file contains One Brine Analysis, one Saturation, one Optional Brine (computed from Saturate), and one scale scenario. Also, the Advanced button is used in the Saturate, to adjust  $\text{Na}_2\text{SO}_4$  and saturate  $\text{BaSO}_4$ . The ScaleChem std software had problems converging the optional brine in the scale scenario, so there is some automated problems with the original software. Lastly, the Saturate calculation in ScaleChem std would automatically precipitate any solid phase even if it did not get selected. The Studio SC object only allows solids to form that are selected. Therefore, the fluid properties are different. We believe that the Studio SC approach is the best, even though it requires an additional step of selecting solids that precipitate AND solids that are to be saturated.



## ScaleChem Std Screen – Brine Analysis

### Settings - Expanded List, Na/Cl Balance, Equilibrium Reconciliation

Brine Analysis Data - Saturate

Description Species Summary

Analysis View: ☒ Original ☐ Balanced ☐ Reconciled

Species Display: ☒ Formula ☐ Name

Species List: ☐ Standard ☐ Expanded ☒ Non Zero

Cations	mg/L	Anions	mg/L	Neutrals	mg/L
Na+1	96500.000	Cl-1	148200.000	SiO2, aq	65.000
K+1	1540.000	SO4-2	23.000	B(OH)3, aq	120.000
Ca+2	870.000	HCO3-1	44.000		
Mg+2	256.000	C2H3O2-1	54.000		
Sr+2	36.000				
Ba+2	39.000				
Fe+2	6.000				

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	6.120
Alkalinity	as HCO3-, mg/L	0.000	46.422
Density	g/cc	1.000	1.161
Total Dissolved Solids	mg/L	247568.000	247568.000
Electrical Conductivity	1/ohm-cm	0.000	0.236

Reconciliation Type: ☐ Equilibrium Calculation ☐ CO2 Fraction in Gas ☐ pH Alkalinity Reconcile

☐ Allow solids to form

Units

Balance

## Studio ScaleChem Screen – Brine Analysis

### Settings - Expanded List, Na/Cl Balance, Equilibrium Reconciliation

Saturate

Description Design Report

Reconciliation Options

Reconciliation Type: ☒ Equilibrium Calculation ☐ CO2 Fraction in Gas ☐ pH Alkalinity Reconcile

☐ Allow solids to form

Calculate

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	6.12041
Alkalinity, Measured - Aqueous (mg HCO3/L)	0.0	45.0346
Density - Aqueous (g/cm3)	1.00000	1.16130
Elec Cond, specific - Aqueous (mho/m)	0.0	23.5765
Total Dissolved Solids (mg/L)	0.0	0.0
Composition Adjustments		
Add Charge Balance (mg/L Cl-1)		4277.74

## ScaleChem Std Screen – Saturate

Settings – One Brine, One Condition, One Solid

Available solids: (NaCl (Halite))

Chosen solids: BaSO4 (Barite)

Add >>

Specify inflow to vary

Saturate Solid	by Varying
BaSO4 (Barite)	Na2SO4

### Scaling Tendencies and Solids - Point 1

Scale Mineral	Maximum Scale mg/L	lb/bbl	Scaling Ten pre-scaling
NaCl	0.0	0.0000	0.2413
CaCO3	12.9	0.0045	2.5265
CaSO4	0.0	0.0000	0.0309
SrSO4	0.0	0.0000	0.0027
BaSO4	0.1	0.0000	1.0000
Fe(OH)3	0.0	0.0000	0.2431
SiO2	0.0	0.0000	0.1309
KCl	0.0	0.0000	0.0030
Mg(OH)2	0.0	0.0000	1.3348
SrCO3	0.0	0.0000	0.0452
BaCO3	0.0	0.0000	0.0011
Fe(OH)2	0.0	0.0000	0.0517

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	6.13	6.32	
Alk	38.15	...	No Alk in SSC
Density	1.068	1.068	
Flow	108.8	108.8	
Sat Solid	BaSO4	BaSO4	
Value		...	
New Ba, SO4 Conc1	35.8,63.9	35.9,66.2	

## Studio ScaleChem Screen – Saturate

Settings - One Brine, One Condition, One Solid

Saturate1

Description Design Report File Viewer

Inlets

Solid

Solid Selection (check solids allowed to form)

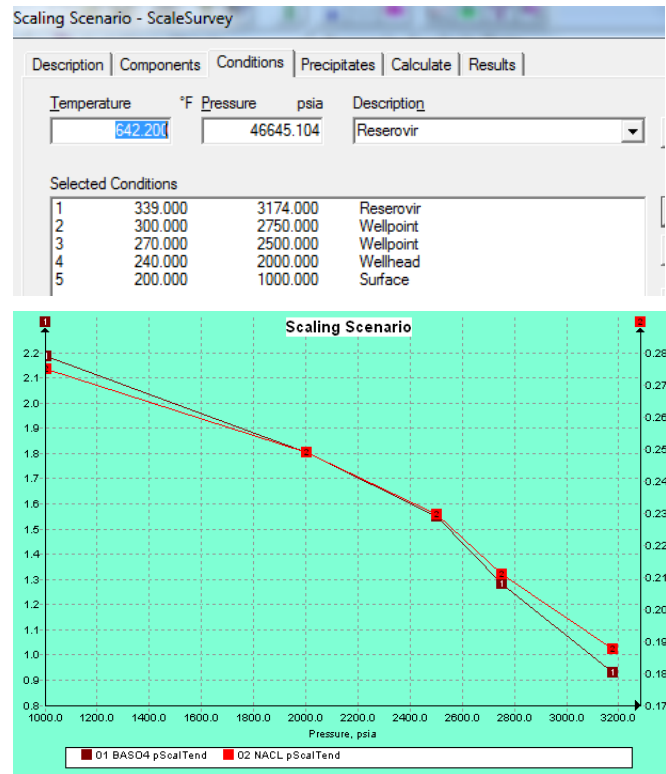
- ☒ Standard
  - ☒ BaSO4
  - ☐ CaCO3
  - ☐ CaSO4
  - ☐ CaSO4.2H2O
  - ☐ FeCO3
  - ☐ NaCl
  - ☐ SrSO4
- ☒ Expanded
- ☒ All

Select Inflows To Vary

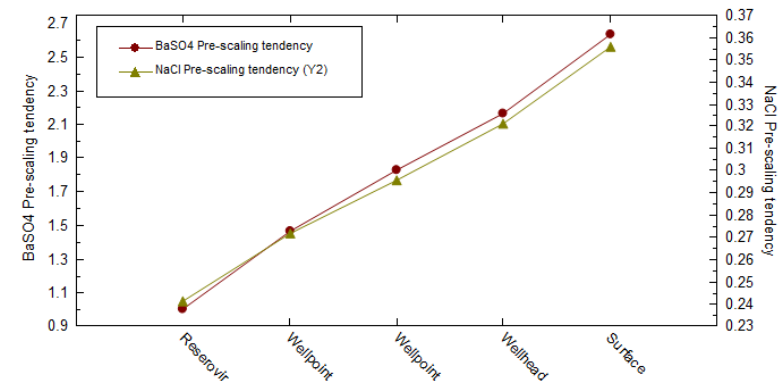
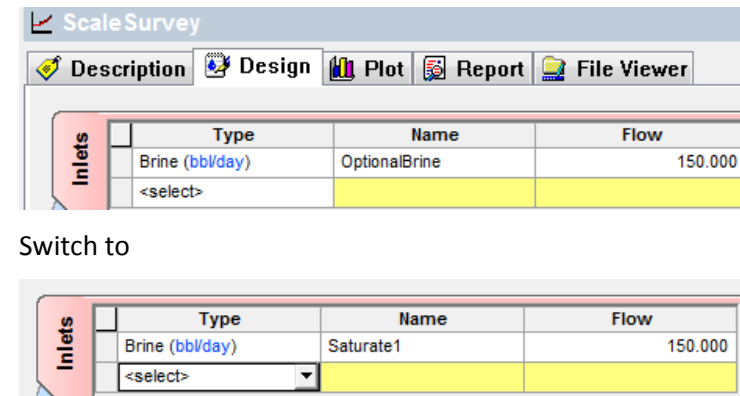
Solid	Inflow
BaSO4	Na2SO4

Scale Mineral	Max Scale	Pre-scaling
CaSO4.2H2O	0.0	1.13667e-3
FeCO3	0.0	0.261318
Fe(OH)2	0.0	0.0561120
SrSO4	0.0	2.70723e-3
SrCO3	0.0	0.0484794
BaSO4	3.23874e-4	1.00000
BaCO3	0.0	1.22582e-3
CaSO4	0.0	0.0308099
CaCO3	0.0	2.52624
Mg(OH)2	0.0	1.45111
SiO2	0.0	0.130858
NaCl	0.0	0.241320
KCl	0.0	3.03650e-3

## ScaleChem Std Screen – Scale Scenario



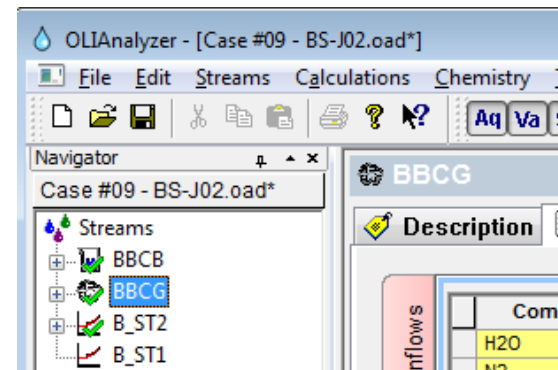
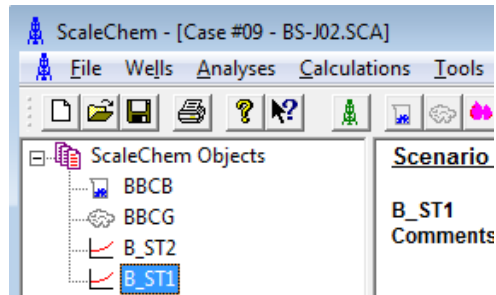
## Studio ScaleChem Screen – Scale Scenario



## Case #9 – BS-J02

This file contains One Brine Analysis, one Gas Analysis, and two Scale Scenarios. This was an older file that contained Hydrocarbon gas as an input. To make this work in both ScaleChem Std and Studio SC, hydrocarbon gas was switched manually to Methane. You will also notice that the water saturation values differ because of the way that the saturation is calculated in the new software. Lastly, the Sorting of scale calculation option in ScaleChem is not part of StudioScaleChem. Therefore, the plots are mirror images. The results in the calculations are also different, presumably because of the different water saturation. Lastly, the second liquid was not turned on in ScaleChem std, which resulted in the high pressure calculations failing.

The second scale scenario, B\_ST1 did not converge in Studio SC



## ScaleChem Std Screen – Brine Analysis

Settings – Standard List, Na/Cl Balance, Equilibrium

Brine Analysis Data - BBCB

Description Species Summary

Analysis View  
☐ Original ☐ Balanced ☒ Reconciled

Species Display  
☒ Formula ☐ Name

Species List  
☒ Standard ☐ Expanded

Cations	mg/L	Anions	mg/L	Neutrals
Na+1	10440.110	Cl-1	19903.010	CO2, aq
K+1	5140.003	SO4-2	500.000	H2S, aq
Ca+2	280.000	HCO3-1	1800.001	SiO2, aq
Mg+2	14.000	B(OH)4-1	0.000	B(OH)3, aq
Sr+2	2.100	HS-1	0.000	
Ba+2	0.810	C2H3O2-1	0.000	
Fe+2	15.000			

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	7.604
Alkalinity	as HCO3-, mg/L	0.000	1743.120
Density	g/cc	1.026	1.023
Total Dissolved Solids	mg/L	38095.034	38095.034
Electrical Conductivity	1/ohm-cm	0.000	0.057

Reconciliation Type  
☒ Equilibrium Calculation  
☐ CO2 Fraction in Gas  
☐ pH Alkalinity Reconcile

☐ Allow solids to form

☐ Update Brine with results

Variable	ScaleChem Std	Studio ScaleChem
pH	7.60	7.60
Alk	1743	1718
Density	1.023	1.0217
Saturated	CaCO3, BaSO4, FeCO3	CaCO3, BaSO4, FeCO3
Balance ion	Cl-	Cl-
Balance Value	902.8	902.8
Notes		

## Studio ScaleChem Screen – Brine Analysis

Settings - Expanded List, Na/Cl Balance, Equilibrium

BBCB

Description Design Report

Data Entry

Reconcile

Reconciliation Options  
Reconciliation Type  
☒ Equilibrium Calculation  
☐ CO2 Fraction in Gas  
☐ pH Alkalinity Reconcile

☐ Allow solids to form

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	7.60367
Alkalinity, Measured - Aqueous (mg HCO3/L)	0.0	1718.03
Density - Aqueous (g/cm3)	1.02600	1.02288
Elec Cond, specific - Aqueous (mho/m)	0.0	5.65399
Total Dissolved Solids (mg/L)	0.0	0.0
Composition Adjustments		
Add Charge Balance (mg/L Cl-1)		902.842

Notes – Na+ was removed instead of Cl- being added.

## ScaleChem Std Screen – Gas Analysis

Settings – Standard gas, H2O Sat (no conditions)

Gas	Mole / Vol %
Water	0.300
Nitrogen	0.000
Carbon dioxide	2.981
Hydrogen sulfide	0.000
Methane	0.000
hydrocarbon gas	96.720

Total Percent 100.00

☒ Calculate methane percent

Type of Calculation

☒ Saturated water content

☐ Dew point temperature

☐ Dew point pressure

Result

T, °F 175.0

P, psia 5000.0

Water vapor, vol % 0.285352

Calculate

View Files

Units

The water vapor content can be changed for the calculation. It will not affect the stored gas compositions.

Result

% water vapor: 0.285

- ScaleChem Std did not converge gas (undefined Chemistry model)
- Hydrocarbon Gas no longer exists. Methane is now used. The software does not automatically switch this over

## Studio ScaleChem Screen – Gas Analysis

Settings - Expanded List, H2O Sat (3e-13F, 0 psia).

Component	Normalize	Reconciled G
H2O	0.299579	8.56799e-3
CO2	2.98089	2.98959
CH4	96.7195	97.0018

Calculate

Condition

Saturate With H2O

Conditions	Value
Temperature (°F)	175.000
Pressure (psia)	5000.00

☒ Show Non-zero Only

Saturated H2O Amount: 8.56799e-3 mole %

Chemistry Tools View

Aq Va So 2nd Re

- this was turned on automatically. Calculation fails when turned off.
- OLI Analyzer does not recognize the Hydrocarbon Gas input. It needs to be changed manually



## ScaleChem Std Screen – Scale Scenario

**Settings** – one brine, one gas, six conditions, one scale

Description | Components | Conditions | Precipitates | Calculate | Results

Temperature °F Pressure psia Description  
  selected point

Selected Conditions

	Temperature °F	Pressure psia	Description
1	40.000	4999.693	selected point
2	40.000	4499.724	selected point
3	40.000	2999.816	selected point
4	40.000	999.939	selected point
5	40.000	349.979	selected point
6	40.000	149.991	selected point

Error: The gas stream(s) contain pseudocomponents but no oil streams are selected.

Scaling Scenario - B\_ST2

Description | Components | Conditions | Precipitates | Calculate | Results

DATA Case Number	CAC03 pScaITend	BAS04 pScaITend	FEIC03 pScaITend	pH aq phase
1.000	0.000	0.000	0.000	7609.700
2.000	0.000	0.000	0.000	7609.715
3.000	0.045	11.040	0.052	5.374
4.000	0.075	9.962	0.089	5.536
5.000	0.162	9.747	0.204	5.870
6.000	0.367	10.066	0.481	6.211

Pressure psia

4999.690  
4499.720  
2999.820  
999.939  
349.979  
149.991

DATA Case Number	CAC03 pScaITend	BAS04 pScaITend	FEIC03 pScaITend	pH aq phase
1.000	0.034	11.751	0.037	5.293
2.000	0.036	11.619	0.040	5.314
3.000	0.045	11.040	0.052	5.374
4.000	0.075	9.962	0.089	5.536
5.000	0.162	9.747	0.204	5.870
6.000	0.367	10.066	0.481	6.211

Pressure psia

H2O (v) molefrac

Dissolved H2O (oil)

4999.690 0.000 9.59e-005  
4499.720 0.000 9.87e-005  
2999.820 1.09e-004 0.000  
999.939 1.70e-004 0.000  
349.979 3.87e-004 0.000  
149.991 8.44e-004 0.000

## Studio ScaleChem Screen – Scale Scenario

**Settings** - one brine, one gas, six conditions, one scale

Description | Design | Plot | Report | File Viewer

Inlets

Location	Temperature (°F)	Pressure (psia)	Drop Solids
selected point	40.0000	4999.69	<input type="checkbox"/>
selected point	40.0000	4499.72	<input type="checkbox"/>
selected point	40.0000	2999.82	<input type="checkbox"/>
selected point	40.0000	999.939	<input type="checkbox"/>
selected point	40.0000	349.979	<input type="checkbox"/>
selected point	40.0000	149.991	<input type="checkbox"/>
<Enter Location Name>			

☒

Summary

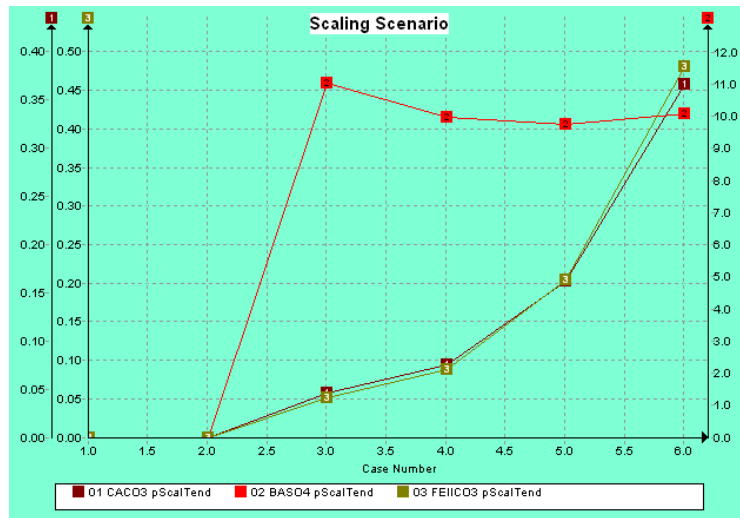
Unit Set  
Based on: Scale

B\_ST2

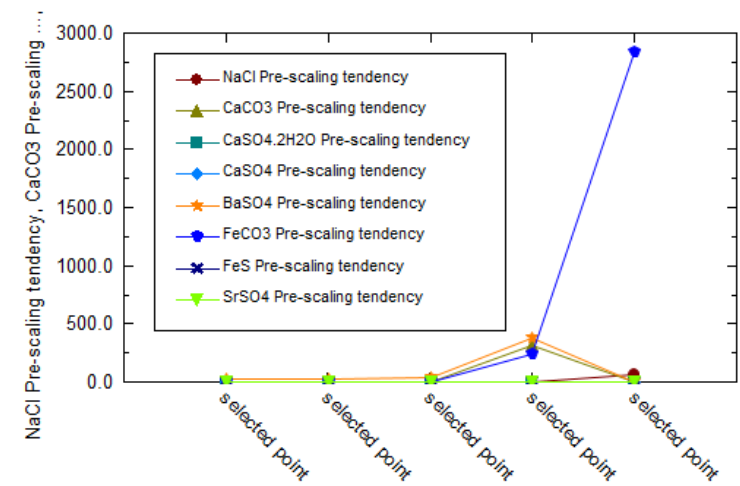
Description | Design | Plot | Report | File Viewer

View Plot Curves

	Locations	pH - Aqueous	Pressure psia	FeCO3 Pre-	CaCO3 Pre-	BaSO4 Pre-
1	1.00000	5.48280	4999.69	0.201487	0.158251	22.1753
2	2.00000	5.53517	4499.72	0.292763	0.222678	24.1525
3	3.00000	5.72079	2999.82	1.34714	0.906613	33.3832
4	4.00000	5.92132	999.939	235.359	311.973	379.394
5	5.00000	6.50555	349.979	2831.33	5.33748e-3	0.0392377
6	6.00000					



DATA				
Case #	CACO3	BASO4	FEIICO3	pH
	pScalTend	pScalTend	pScalTend	aq phase
1	0	0	0	7609.854
2	0	0	0	7609.869
3	0.045	11.04	0.052	5.374
4	0.075	9.963	0.089	5.536
5	0.162	9.747	0.204	5.87
6	0.367	10.067	0.481	6.211



Locations	pH - Aqueous	FeCO3 Pre-scaling tendency	CaCO3 Pre-scaling tendency	BaSO4 Pre-scaling tendency
1	5.4828	0.201487	0.158251	22.1753
2	5.53517	0.292763	0.222678	24.1525
3	5.72079	1.34714	0.906613	33.3832
4	5.92132	235.359	311.973	379.394
5	6.50555	2831.33	5.34E-03	0.0392377
6				

Cases are flipped, two conditions contained no water. One condition was not converged in Analyzer. Scale tendencies differ significantly. pH values are generally the same.

## ScaleChem Std Screen – Scale Scenario Settings -

Scaling Scenario - B\_ST1

Description Components Conditions Precipitates Calculate Results

Input

Type	Name	Amount	Units
Brine	BBCB	1.000	bbl/day
Gas	BBCG	1000.000	ksct/day

Description Components Conditions Precipitates Calculate Results

Temperature °F Pressure psia Description

175.000 4999.693 selected point Units

Selected Conditions

	Temperature	Pressure	Description
1	175.000	4999.693	selected point
2	175.000	4499.724	selected point
3	175.000	2999.816	selected point
4	175.000	999.939	selected point
5	175.000	349.979	selected point
6	175.000	149.991	selected point
7	145.000	4999.693	selected point
8	145.000	4499.724	selected point
9	145.000	2999.816	selected point
10	145.000	999.939	selected point
11	145.000	349.979	selected point
12	145.000	149.991	selected point
13	100.000	4999.693	selected point
14	100.000	4499.724	selected point
15	100.000	2999.816	selected point
16	100.000	999.939	selected point
17	100.000	349.979	selected point

Add Remove Auto Step

Note: this will or exactly 2 condit

Available precipitates: NaCl (Halite) CaSO4.2H2O (Gypsum) CaSO4 (Anhydrite)

Chosen precipitates: CaCO3 (Calcite)

Solids Selection Standard CaSO4.2H2O FeCO3 SrSO4 BaSO4 CaSO4 CaCO3 NaCl FeS

## Studio ScaleChem Screen – Scale Scenario Settings -

B\_ST1

Description Design Plot Report File Viewer

Inlets

Type	Name	Flow
Brine (bbl/day)	BBCB	1.00000
Gas (std Mft3/day)	BBCG	1000.00

Calculate Summary

B\_ST1

Description Design Plot Report File Viewer

Inlets

Location	Temperature (°)	Pressure (psia)	Drop Solids
selected point	175.000	4999.69	<input type="checkbox"/>
selected point	175.000	4499.72	<input type="checkbox"/>
selected point	175.000	2999.82	<input type="checkbox"/>
selected point	175.000	999.939	<input type="checkbox"/>
selected point	175.000	349.979	<input type="checkbox"/>
selected point	175.000	149.991	<input type="checkbox"/>
selected point	145.000	4999.69	<input type="checkbox"/>
selected point	145.000	4499.72	<input type="checkbox"/>
selected point	145.000	2999.82	<input type="checkbox"/>
selected point	145.000	999.939	<input type="checkbox"/>

Auto Step Steps: 5 Auto Step

B\_ST1

Description Design Plot Report File Viewer

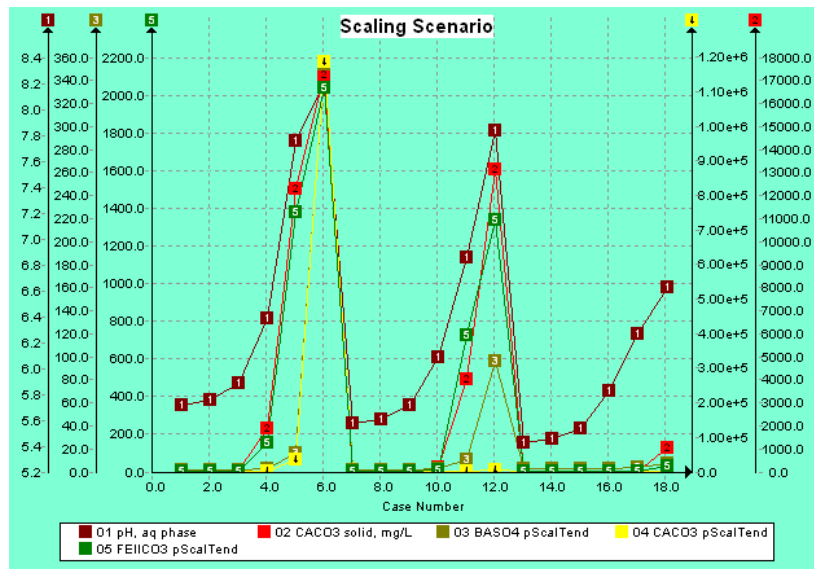
Inlets

Solids Selection

- ☒ Standard
- ☐ CaSO4.2H2O
- ☐ FeCO3
- ☐ SrSO4
- ☐ BaSO4
- ☐ CaSO4
- ☒ CaCO3
- ☐ NaCl
- ☐ FeS

Sym U S C

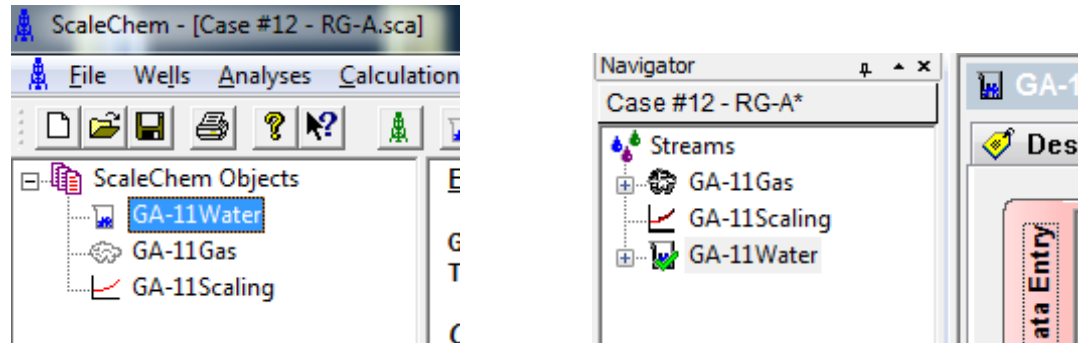
B\_ST1 did not converge in StudioSC



Notes –

## Case #12 – RG-A

This case contains a water analysis set for pH and Alkalinity and a sour gas analysis. The gas to water ratio is low, 0.004MMscf/bbl. This file contains sulfur and all the solids are selected in the scale tendency. Therefore, we are focusing on the scale scenario results. There is a table at the bottom of this case, which contains the results of the two scale scenarios and the difference between their values. The differences range from 0% to 80%. s



Brine Analysis Data - GA-11Water

Description Species Summary

Analysis View  
☒ Original ☐ Balanced ☐ Reconciled

Species Display  
☒ Formula ☐ Name

Species List  
☒ Standard ☐ Expanded ☐ Non Zero

Cations		Anions		Neutrals	
	mg/L		mg/L		mg/L
Na+1	91898.000	Cl-1	154000.000	CO2, aq	0.000
K+1	1291.000	SO4-2	53.000	H2S, aq	0.000
Ca+2	3847.000	HCO3-1	24.400	SiO2, aq	0.000
Mg+2	2054.000	B(OH)4-1	0.000	B(OH)3, aq	0.000
Sr+2	127.000	HS-1	0.000		
Ba+2	38.000	C2H3O2-1	40.000		
Fe+2	48.000				

Variable	Units	Measured	Calculated
Ambient Pressure	psia	14.696	14.696
pH	pH units	6.580	6.580
Alkalinity	as HCO3-, mg/L	65.070	65.081
Density	g/cc	1.000	1.165
Total Dissolved Solids	mg/L	253420.400	253420.400
Electrical Conductivity	1/ohm-cm	0.000	0.233
Alkalinity endpoint	pH units	4.500	
HCl added	mg/L	...	-38.576
CO2 added	mg/L	...	47.398

Reconciliation Type  
pH and Alkalinity

☒ Update Brine with results

Units

Balance

Calculate

View Files

GA-11Water

Description Design Report

Data Entry

Variable	Value	Balanced
Cations (mg/L)		
<input type="checkbox"/> Na+1	91898.0	91898.0
<input type="checkbox"/> K+1	1291.00	1291.00
<input type="checkbox"/> Ca+2	3847.00	3847.00
<input type="checkbox"/> Mg+2	2054.00	2054.00
<input type="checkbox"/> Sr+2	127.000	127.000
<input type="checkbox"/> Ba+2	38.0000	38.0000
<input type="checkbox"/> Fe+2	48.0000	48.0000
Anions (mg/L)		
<input checked="" type="checkbox"/> Cl-1	1.54000e	1.55792e
<input type="checkbox"/> SO4-2	53.0000	53.0000
<input type="checkbox"/> HCO3-1	24.4000	24.4000
<input type="checkbox"/> C2H3O2-1	40.0000	40.0000

Entry Options  
Units: mg/L  
Display: Formula  
☒ Show Non-zero Only  
☒ Show Balanced Column

Template Manager  
Last Applied: None  
Expanded  
Save as...

Balance Options  
Type: Makeup Ion

GA-11Water

Description Design Report

Data Entry

Reconciliation Options

Reconciliation Type  
☐ Equilibrium Calculation  
☐ CO2 Fraction in Gas  
☒ pH Alkalinity Reconcile

☐ Allow solids to form

Calculate

Properties	Measured	Calculated
Pressure (psia)	14.6960	
pH - Aqueous	6.58000	6.58000
Alkalinity, Measured - Aqueous (mg HCO3/L)	65.0700	65.0694
Alkalinity end point	4.50000	
Density - Aqueous (g/cm3)	1.00000	1.16522
Elec Cond, specific - Aqueous (mho/m)	0.0	23.2506
Total Dissolved Solids (mg/L)	0.0	2.55212e5
Composition Adjustments		
Added acidity (mg/L HCL)		-38.5472
Add carbonate (mg/L CO2)		47.3631
Add Charge Balance (mg/L Cl-1)		1791.57

Gas Analysis Data - GA-11Gas

Description Composition Dew Point Summary

Gas	Mole / Vol %
Water	0.670
Nitrogen	0.000
Carbon dioxide	0.500
Hydrogen sulfide	4.00e-003
Methane	98.826

Display  
☐ by Formula  
☒ by Name

Gases Display  
☒ Show standard gas list  
☐ Show expanded gas list  
☐ Show non-zero gases

Total Percent 100.00

Gas Analysis Data - GA-11Gas

Description Composition Dew Point Summary

Type of Calculation  
☒ Saturated water content  
☐ Dew point temperature  
☐ Dew point pressure

Result  
 T, °C 37.611  
 P, bar 10.0  
 Water vapor, vol % 0.674335

The water vapor content can be changed for the calculation. It will not affect the stored gas compositions.

Result  
 % water vapor: 0.674

GA-11Gas

Description Design Definition Report

Inflows

Component	Value	Normalized
H2O	0.670000	0.670000
N2	0.0	0.0
CO2	0.500000	0.500000
H2S	4.00000e-3	4.00000e-3
CH4	98.8260	98.8260

Reconcile

Entry Options  
 Units mole %  
 Display Formula  
☐ Show Non-zero Only  
☒ Show Normalized Column

Template Manager  
 Last Applied: None  
 Expanded

GA-11Gas

Description Design Definition Report

Inflows

Component	Normalize	Reconciled
H2O	0.670000	0.749697
N2	0.0	0.0
CO2	0.500000	0.499599
H2S	4.00000e-3	3.99679e-3
CH4	98.8260	98.7467

Reconcile

Calculate

Condition  
 Saturate With H2O

Conditions	Value
Temperature (°F)	99.6980
Pressure (psia)	145.038

☐ Show Non-zero Only

Saturated H2O Amount:  
 0.674337 mole %

Scaling Scenario - GA-11Scaling

Description Components Conditions Precipitates Calculate Results

Input

Type	Name	Amount
Brine	GA-11Water	1.000
Gas	GA-11Gas	4.000

Scaling Scenario - GA-11Scaling

Description Components Conditions Precipitates Calculate Results

Temperature °C Pressure bar Description

37.600 10.000 Wellhead?

Units

Selected Conditions

	Temperature	Pressure	Description
1	37.600	10.000	Wellhead?
2	100.000	100.000	Test Cond
3	100.000	200.000	Test Cond
4	100.000	300.000	Test Cond
5	125.000	100.000	Test Cond
6	150.000	100.000	Test Cond

Add Remove Auto Step

Scaling Scenario - GA-11Scaling

Description Components Conditions Precipitates Calculate Results

Available precipitates:

- KCl (Sylvite)
- Mg(OH)2 (Pyrochroite)
- CaCl2
- CaCl2.1H2O
- CaCl2.2H2O
- CaCl2.4H2O
- CaCl2.6H2O
- SrCO3 (Strontianite)
- BaCO3 (Witherite)
- Fe(OH)2 (amorphous)

Chosen precipitates:

- NaCl (Halite)
- CaCO3 (Calcite)
- CaSO4.2H2O (Gypsum)
- CaSO4 (Anhydrite)
- SrSO4 (Celestite)
- BaSO4 (Barite)
- FeCO3 (Siderite)
- FeS (Pyrrhotite)
- FeS (Mackinawite)

Add >> Add All >> << Remove

GA-11Scaling

Description Design Plot Report File

Inlets

Type	Name	Flow
Brine (bbl/day)	GA-11Water	1.00000
Gas (std Mft3/d)	GA-11Gas	4.00000
<select>		

GA-11Scaling

Description Design Plot Report File Viewer

Inlets

Location	Temperature (°F)	Pressure (psia)	Drop Sol
Wellhead?	99.6800	145.038	<input type="checkbox"/>
Test Cond	212.000	1450.38	<input type="checkbox"/>
Test Cond	212.000	2900.76	<input type="checkbox"/>
Test Cond	212.000	4351.15	<input type="checkbox"/>
Test Cond	257.000	1450.38	<input type="checkbox"/>
Test Cond	302.000	1450.38	<input type="checkbox"/>
<Enter Location Name>			

GA-11Scaling

Description Design Plot Report File

Inlets

Solids Selection

- ☒ Standard
  - ☒ CaSO4.2H2O
  - ☒ FeCO3
  - ☒ SrSO4
  - ☒ BaSO4
  - ☒ CaSO4
  - ☒ CaCO3
  - ☒ NaCl
  - ☒ FeS
- ☒ Expanded
- ☒ All

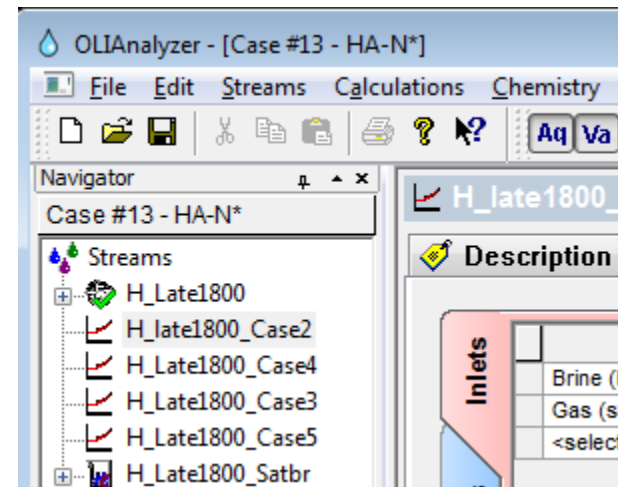
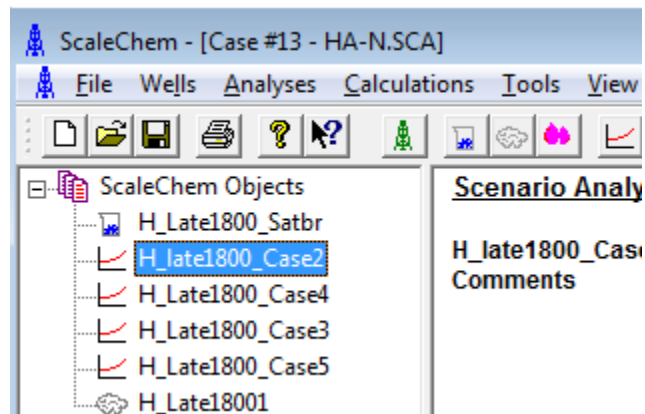


ScaleChem Std								
Pressure, bar		NaCl p	CaCO3 p	CaSO4.2H2O p	CaSO4 p	BaSO4 p	FeCO3 p	FeS p
bar		ScalTend	ScalTend	ScalTend	ScalTend	ScalTend	ScalTend	ScalTend
10	1	0.444	0.046	0.02	0.027	4.099	0.021	13.329
100	2	0.359	0.084	0.011	0.042	1.492	0.022	3.809
200	3	0.353	0.05	9.63E-03	0.038	1.578	0.014	2.27
300	4	0.348	0.038	8.78E-03	0.034	1.637	0.011	1.696
100	5	0.327	0.19	9.04E-03	0.064	1.258	0.016	1.653
100	6	0.301	0.423	0 (outside range)	0.1	1.043	5.65E-03	0.395
Studio SC								
	Locations	NaCl	CaCO3	CaSO4.2H2O	CaSO4	BaSO4	FeCO3	FeS
		Pre-scaling tendency	Pre-scaling tendency	Pre-scaling tendency	Pre-scaling tendency	Pre-scaling tendency	Pre-scaling tendency	Pre-scaling tendency
1	1	0.438	0.044	0.020	0.026	4.062	0.019	14.583
2	2	0.378	0.068	0.011	0.044	1.537	0.013	3.625
3	3	0.351	0.042	0.010	0.037	1.573	0.009	2.428
4	4	0.340	0.033	0.009	0.033	1.614	0.008	1.885
5	5	0.416	0.134	0.010	0.074	1.433	0.004	0.869
6	6	0.558	0.251	0.008	0.137	1.231	0.000	0.049
Difference [(StudioSC-SCStd)/SCStd]								
	1	-1%	-5%	-2%	-3%	-1%	-9%	9%
	2	5%	-19%	-1%	4%	3%	-41%	-5%
	3	-1%	-16%	0%	-1%	0%	-34%	7%
	4	-2%	-13%	-1%	-2%	-1%	-31%	11%
	5	27%	-29%	10%	15%	14%	-76%	-47%
	6	85%	-41%		37%	18%	-96%	-88%

### Case #13 – HA-N

This file contains one Brine, one gas and several scale scenario objects. This file was created in 2003, using a pre-V3 version of ScaleChem. The purpose of this study is to see how the Studio SC and ScaleChem Std (V4 and higher) software will handle old files. We observed that several of the scale scenarios were missing their flow rates. Also, a phase called Hydrocarbon gas is no longer used in the new software. Consequently, Hydrocarbon Gas had to be changed manually in the gas analysis to methane.

With regard to the Scale Scenario results, the computed values of Studio SC are different from ScaleChem Std.



## ScaleChem Std Screen – Brine Analysis

Settings – Standard List, Na/Cl Balance, Equilibrium

Brine Analysis Data - H\_Late1800\_Satbr

Description Species Summary

Analysis View  
☐ Original ☐ Balanced ☒ Reconciled

Species Display  
☒ Formula ☐ Name

Species List  
☐ Standard ☐ Expanded

Cations	mg/L	Anions	mg/L	Neutrals
Na+1	38249.130	Cl-1	65937.410	
Ca+2	2943.610	SO4-2	10.454	
Mg+2	511.742	HCO3-1	196.751	
Sr+2	253.901			
Ba+2	254.651			
Fe+2	9.743			
H+1	0.713			

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	6.120
Alkalinity	as HCO3-, mg/L	0.000	140.099
Density	g/cc	0.000	1.071
Total Dissolved Solids	mg/L	108368.105	108368.105
Electrical Conductivity	1/ohm-cm	0.000	0.138

Reconciliation Type  
☒ Equilibrium Calculation

☐ Update Brine with re

Units

## Studio ScaleChem Screen – Brine Analysis

Settings - Expanded List, Makeup (Cl-), Equilibrium, Display Name

H\_Late1800\_Satbr

Description Design Report

Data Entry

Variable	Value	Balance
<b>Cations (mg/L)</b>		
<input checked="" type="checkbox"/> Sodium ion(+1)	38248.3	38248.4
<input type="checkbox"/> Calcium ion(+2)	2943.55	2943.55
<input type="checkbox"/> Magnesium ion(+2)	511.741	511.741
<input type="checkbox"/> Strontium ion(+2)	253.902	253.902
<input type="checkbox"/> Barium ion(+2)	254.647	254.647
<input type="checkbox"/> Iron ion(+2)	9.74276	9.74276
<input type="checkbox"/> Hydrogen ion(+1)	0.71349	0.71349
<b>Anions (mg/L)</b>		
<input type="checkbox"/> Chloride ion(-1)	65936.1	65936.1
<input type="checkbox"/> Sulfate ion(-2)	10.4539	10.4539
<input type="checkbox"/> Bicarbonate ion(-1)	196.752	196.752
<b>Neutrals (mg/L)</b>		

Entry Options  
 Units: mg/L  
 Display: Display Name  
☒ Show Non-zero Only  
☒ Show Balanced Column

Template Manager  
 Last Applied: None  
 Expanded  
 Save as...

Balance Options  
 Type: Makeup Ion

Summary

Stream amount:  
 1.00000 L

User Choice Charge Balance  
 Cation: Sodium ion(+1)

Cation Charge: 1.86326 eq/L  
 Anion Charge: -1.86326 eq/L  
 Imbalance: -2.46604e-6 eq/L

0.057 mg/L of Sodium ion(+1)  
 is needed to balance.

Isothermal Calculation  
 Phase Amounts  
 Aqueous 1071.11 g  
 Vapor 0.0 g  
 Solid 0.0 g  
 2nd Liquid 0.0 g

Aqueous Phase Properties  
 pH 6.11983  
 Ionic Strength 0.0343342 mol  
 Density 1.07111 g/cm3

Notes –

Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	6.12	6.12	
Alk	141	136	
Density	1.071	1.071	
Balance ion	Na	Na+	
Balance Value	0.057	0.057	
Saturated	BaSO4	BaSO4	
Notes			

## ScaleChem Std Screen – Scale Scenario

Settings – One Brine, One Gas, gas, Five conditions, One Scale

Scaling Scenario - H\_Late1800\_Case2

Description Components Conditions Precipitates Calculate Results

Input

Type	Name	Amount	Units
Brine	H_Late1800_Satbr	1.000	bbl/day
Gas	H_Late1800	90.000	ksct/day

Description Components Conditions Precipitates Calculate Results

Temperature °F Pressure psia Description

92.000 1799.890 surface Units

Selected Conditions

	Temperature (°F)	Pressure (psia)	Description
1	92.000	1799.890	surface
2	106.000	2144.868	surface
3	128.000	3029.814	surface
4	135.000	3824.765	surface
5	207.000	7499.540	surface

Add Remove

Description Components Conditions Precipitates Calculate Results

Available precipitates:

NaCl (Halite)  
CaSO4.2H2O (Gypsum)  
CaSO4 (Anhydrite)

Chosen precipitates:

CaCO3 (Calcite)

## Studio ScaleChem Screen – Scale Scenario

Settings - Expanded List, H2O Sat (3e-13F, 0 psia).

H\_Late1800\_Case2

Description Design Plot Report File Viewer

Inlets

Type	Name	Flow
Brine (bbl/day)	H_Late1800_Satbr	1.00000
Gas (std Mft3/day)	H_Late1800	90.0000
<select>		

Inlets

Location	Temperature (°F)	Pressure (psia)	Drop Solids
surface	92.0000	1799.89	<input type="checkbox"/>
surface	106.000	2144.87	<input type="checkbox"/>
surface	128.000	3029.81	<input type="checkbox"/>
surface	135.000	3824.77	<input type="checkbox"/>
surface	207.000	7499.54	<input type="checkbox"/>

Conditions

Solids Selection

☒ Standard

- ☐ Calcium sulfate dihydrate
- ☐ Iron(II) carbonate
- ☐ Strontium sulfate
- ☐ Barium sulfate
- ☐ Calcium sulfate
- ☒ Calcium carbonate (calcite)
- ☐ Sodium chloride
- ☐ Iron(II) sulfide (hexagonal)

Sy

Notes – Scale Results are different

## H\_late1800\_Case2

ScaleChem Std								
Pressure		NACL	CACO3	CASO4.2H2O	CASO4	BASO4	FEIICO3	SRSO4
psia		pScalTend	pScalTend	pScalTend	pScalTend	pScalTend	pScalTend	pScalTend
1799.89		0.045	0.19	3.32E-03	3.14E-03	11.835	0.038	0.015
2144.87		0.045	0.235	3.36E-03	3.58E-03	10.345	0.055	0.015
3029.81		0.045	0.316	3.08E-03	3.97E-03	7.972	0.089	0.014
3824.76		0.044	0.317	2.89E-03	3.93E-03	7.421	0.092	0.014
7499.54		0.041	1.25	2.40E-03	6.56E-03	4.16	0.306	0.016
Studio SC								
	Locations	NaCl	CaCO3	CaSO4.2H2O	CaSO4	BaSO4	FeCO3	SrSO4
		pST	pST	pST	pST	pST	pST	pST
1	1	0.02076	0.085613	1.93E-03	1.74E-03	7.72586	0.016923	8.45E-03
2	2	0.020652	0.103436	2.01E-03	2.05E-03	6.80905	0.023974	9.02E-03
3	3	0.020323	0.134237	1.97E-03	2.42E-03	5.43662	0.037206	9.05E-03
4	4	0.020096	0.13288	1.88E-03	2.43E-03	5.09704	0.03834	8.80E-03
5	5	0.018454	0.474522	1.64E-03	4.25E-03	2.76761	0.121986	0.010475
Difference [(StudioSC-SCStd)/SCStd]								
Difference	1	-54%	-55%	-42%	-44%	-35%	-55%	-44%
	2	-54%	-56%	-40%	-43%	-34%	-56%	-40%
	3	-55%	-58%	-36%	-39%	-32%	-58%	-35%
	4	-54%	-58%	-35%	-38%	-31%	-58%	-37%
	5	-55%	-62%	-32%	-35%	-33%	-60%	-35%

## H\_late1800\_Case4

ScaleChem Std								
Pressure	CACO3 solid	CACO3	CASO4.2H2O	CASO4	FEIICO3	BASO4	NACL	SrSO4
psia	mg/L	pST	pST	pST	pST	pST	pST	pST
1799.89	0	0.074	2.32E-03	1.53E-03	7.72E-03	14.906	0.038	8.31E-03
2135.87	0	0.088	2.45E-03	1.84E-03	0.012	13.125	0.038	9.55E-03
2299.86	0	0.127	2.80E-03	2.51E-03	0.025	11.424	0.038	0.012
4526.72	0	0.131	2.57E-03	2.74E-03	0.033	9.617	0.037	0.012
7499.54	1.478	1.023	2.22E-03	5.99E-03	0.254	3.82	0.035	0.014
Studio SC								
	Locations	CaCO3 pST	CaSO4.2H2O pST	CaSO4 pST	FeCO3 pST	BaSO4 pST	NaCl pST	SrSO4 pST
1	1	0.040734	1.64E-03	1.05E-03	4.33E-03	12.0564	0.020594	5.91E-03
2	2	0.048138	1.66E-03	1.20E-03	6.71E-03	10.0064	0.020651	6.49E-03
3	3	0.067613	1.83E-03	1.59E-03	0.012828	8.19949	0.020666	7.81E-03
4	4	0.067662	1.73E-03	1.78E-03	0.01647	6.93876	0.020202	8.27E-03
5	5	0.474522	1.64E-03	4.25E-03	0.121986	2.76761	0.018454	0.010475
Difference [(StudioSC-SCStd)/SCStd]								
1		-45%	-29%	-32%	-44%	-19%	-46%	-29%
2		-45%	-32%	-35%	-44%	-24%	-46%	-32%
3		-47%	-35%	-37%	-49%	-28%	-46%	-35%
4		-48%	-33%	-35%	-50%	-28%	-45%	-31%
5		-54%	-26%	-29%	-52%	-28%	-47%	-25%

## H\_late1800\_Case3

ScaleChem Std								
Pressure	CACO3 solid	BASO4	CACO3	CASO4.2H2O	CASO4	FEIICO3	SRSO4	NACL
psia	mg/L	pST	pST	pST	pST	pST	pST	pST
1799.89	0	11.01	0.15	0.00	0.00	0.03	0.01	0.04
2118.87	0	9.71	0.19	0.00	0.00	0.04	0.01	0.04
2609.84	0	7.58	0.27	0.00	0.00	0.08	0.01	0.04
4135.75	0	6.67	0.27	0.00	0.00	0.08	0.01	0.04
7499.54	1.478	3.82	1.02	0.00	0.01	0.25	0.01	0.04
Studio SC								
	CACO3 solid	BaSO4	CaCO3	CaSO4.2H2O	CaSO4	FeCO3	SrSO4	NaCl
	mg/L	pST	pST	pST	pST	pST	pST	pST
1	0	7.87	0.08	0.00	0.00	0.02	0.01	0.02
2	0	6.95	0.10	0.00	0.00	0.02	0.01	0.02
3	0	5.56	0.14	0.00	0.00	0.04	0.01	0.02
4	0	4.95	0.13	0.00	0.00	0.04	0.01	0.02
5	0	2.77	0.47	0.00	0.00	0.12	0.01	0.02
Difference [(StudioSC-SCStd)/SCStd]								
1		-28%	-47%	-35%	-37%	-47%	-36%	-45%
2		-28%	-48%	-34%	-36%	-48%	-36%	-46%
3		-27%	-49%	-30%	-33%	-50%	-29%	-46%
4		-26%	-50%	-29%	-31%	-50%	-27%	-46%
5		-28%	-54%	-26%	-29%	-52%	-25%	-47%

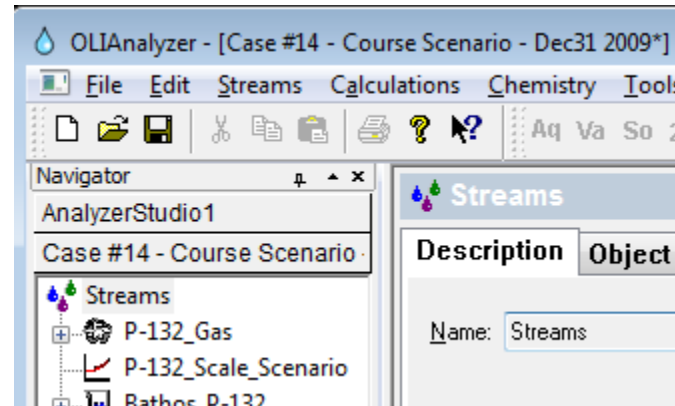
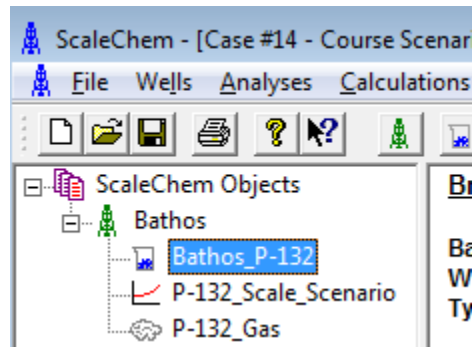
**H\_late1800\_Case5**

ScaleChem Std								
Pressure	CACO3	BASO4	CACO3	CASO4.2H2O	CASO4	FEIICO3	NACL	SRSO4
psia	mg/L	pST	pST	pST	pST	pST	pST	pST
1799.89	0	22.02	0.06	0.00	0.00	0.00	0.05	0.01
2305.86	0	17.16	0.07	0.00	0.00	0.01	0.05	0.01
2499.85	0	14.71	0.09	0.00	0.00	0.01	0.05	0.01
4469.73	0	13.69	0.09	0.00	0.00	0.02	0.04	0.01
7499.54	14.665	4.16	1.25	0.00	0.01	0.31	0.04	0.02
Studio SC								
	CACO3	BaSO4	CaCO3	CaSO4.2H2O	CaSO4	FeCO3	SrSO4	NaCl
	mg/L	pST	pST	pST	pST	pST	pST	pST
1	0	18.03	0.03	0.00	0.00	0.00	0.01	0.02
2	0	13.34	0.03	0.00	0.00	0.00	0.01	0.02
3	0	10.57	0.04	0.00	0.00	0.01	0.01	0.02
4	0	9.08	0.04	0.00	0.00	0.01	0.01	0.02
5	0	2.76761	0.474522	1.64E-03	4.25E-03	0.121986	0.010475	0.018454
Difference [(StudioSC-SCStd)/SCStd]								
1		-18%	-52%	-33%	-37%	-49%	-88%	150%
2		-22%	-53%	-35%	-38%	-52%	-88%	142%
3		-28%	-54%	-38%	-41%	-53%	-86%	106%
4		-34%	-55%	-41%	-44%	-56%	-84%	69%
5		-33%	-62%	-32%	-35%	-60%	-74%	15%



### Case #14 – Course Scenario-Dec31.2009

This file contains the output of chapters 2 and 3 of the ScaleChem Course Scenario. This scenario contains a high CO<sub>2</sub> content gas and a brine at moderate temperatures and pressures. The main comparison is the CaCO<sub>3</sub> scale tendency.



## ScaleChem Std Screen – Brine Analysis

Settings - Expanded List, Na/Cl Balance, Equilibrium

Brine Analysis Data - Bathos\_P-132

Description Species Summary

Analysis View  
☐ Original ☐ Balanced ☒ Reconciled

Species Display  
☒ Formula ☐ Name

Species List  
☐ Standard ☐

Cations	mg/L	Anions	mg/L
Na+1	1801.807	Cl-1	3200.054
Ca+2	250.001	SO4-2	16.000
Mg+2	35.000	HCO3-1	217.001
Sr+2	15.000		
Ba+2	0.300		
Fe+2	2.100		

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	7.642
Alkalinity	as HCO3-, mg/L	0.000	214.875
Density	g/cc	1.001	1.001
Total Dissolved Solids	mg/L	5537.263	5537.263
Electrical Conductivity	1/ohm-cm	0.000	9.86e-003

Reconciliation  
☐ Equilibrium C  
☐ Update B

Variable	ScaleChem Std	Studio ScaleChem
pH	7.642	7.64
Alk	214.9	214
Balance ion	Na+	Na+
Balance Value	301.8	301.8
Density	1.001	1.00089
Saturated	CaCO3, FeCO3, SrCO3	CaCO3, FeCO3, SrCO3

## Studio ScaleChem Screen – Brine Analysis

Settings - Expanded List, Na/Cl Balance, Equilibrium Reconciliation

Bathos\_P-132

Description Design Report

Data Entry Reconcile

Variable	Value	Balanced
<b>Cations (mg/L)</b>		
Sodium ion(+1)	1500.00	1801.77
Calcium ion(+2)	250.000	250.000
Magnesium ion(+2)	35.0000	35.0000
Strontium ion(+2)	15.0000	15.0000
Barium ion(+2)	0.300000	0.300000
Iron ion(+2)	2.10000	2.10000
<b>Anions (mg/L)</b>		
Chloride ion(-1)	3200.00	3200.00
Sulfate ion(-2)	16.0000	16.0000
Bicarbonate ion(-1)	217.000	217.000
<b>Neutrals (mg/L)</b>		

Entry Options  
Units: mg/L  
Display: Display Name  
☒ Show Non-zero Only  
☒ Show Balanced Column

Template Manager  
Last Applied: None  
Expanded

Balance Options  
Type: Makeup Ion

Reconciliation Options  
Reconciliation Type: ☒ Equilibrium Calculation  
☐ CO2 Fraction in Gas  
☐ pH Alkalinity Reconcile  
☐ Allow solids to form

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	7.64188
Alkalinity, Measured - Aqueous (mg HCO3/L)	0.0	214.018
Density - Aqueous (g/cm3)	1.00100	1.00089
Elec Cond, specific - Aqueous (mho/m)	0.0	0.985482
Total Dissolved Solids (mg/L)	0.0	5537.17
<b>Composition Adjustments</b>		
Add Charge Balance (mg/L Sodium ion(+1))		301.773

Summary

User Choice Charge Balance  
Cation: Sodium ion(+1)  
Cation Charge: 0.0810235 eq/L  
Anion Charge: -0.0941498 eq/L  
Imbalance: -0.0131263 eq/L  
301.773 mg/L of Sodium ion(+1) is needed to balance.

Isothermal Calculation  
Phase Amounts  
Aqueous 1000.89 g  
Vapor 0.0 g  
Solid 0.0 g  
2nd Liquid 0.0 g

Aqueous Phase Properties  
pH 7.64188  
Ionic Strength 1.82885e-3 mol/mol  
Density 1.00089 g/cm3

## ScaleChem Std Screen – Scale Scenario

Settings – One Brine, One Gas, five conditions, three scales

Scaling Scenario - P-132\_Scale\_Scenario

Description Components Conditions Precipitates Calculate Results

Input

Type	Name	Amount
Brine	Bathos_P-132	1000.000
Gas	P-132_Gas	400.000

Description Components Conditions Precipitates Calculate Results

Temperature °F Pressure psia Description

160.000 1000.000 wellhead Units

Selected Conditions

	Temperature	Pressure	Description
1	160.000	1000.000	Wellhead
2	160.000	1800.000	Midwell
3	180.000	2700.000	Midwell
4	190.000	3200.000	FBHP
5	210.000	3700.000	Reservoir

Add Remove

Description Components Conditions Precipitates Calculate Results

Available precipitates:

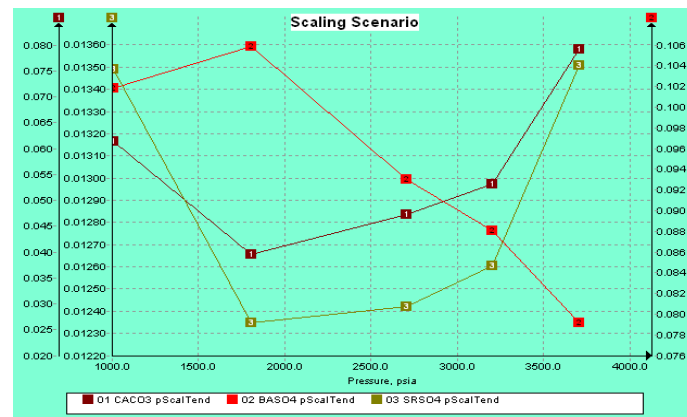
NaCl (Halite)  
CaSO4.2H2O (Gypsum)  
CaSO4 (Anhydrite)  
FeCO3 (Siderite)  
Mg(OH)2 (Pyrochroite)  
CaF2

Chosen precipitates:

CaCO3 (Calcite)  
SrSO4 (Celestite)  
BaSO4 (Barite)

Solids Selection

Standard Expanded



## Studio ScaleChem Screen – Scale Scenario

Settings – One brine, one gas, five conditions, three scales

P-132\_Scale\_Scenario

Description Design Plot Report File Viewer

Inlets

Type	Name	Flow
Brine (bbl/day)	Bathos_P-132	1000.00
Gas (std Mft3/day)	P-132_Gas	400.000

Description Design Plot Report File Viewer

Inlets

Location	Temperature (°F)	Pressure (psia)	Drop Solids
Wellhead	160.000	1000.00	<input type="checkbox"/>
Midwell	160.000	1800.00	<input type="checkbox"/>
Midwell	180.000	2700.00	<input type="checkbox"/>
FBHP	190.000	3200.00	<input type="checkbox"/>
Reservoir	210.000	3700.00	<input type="checkbox"/>

Summary

Unit Set Based

Description Design Plot Report File Viewer

Inlets

Solids Selection

☒ Standard

☐ Sodium chloride

☐ Calcium sulfate dihydrate

☐ Iron(II) carbonate

☒ Strontium sulfate

☒ Barium sulfate

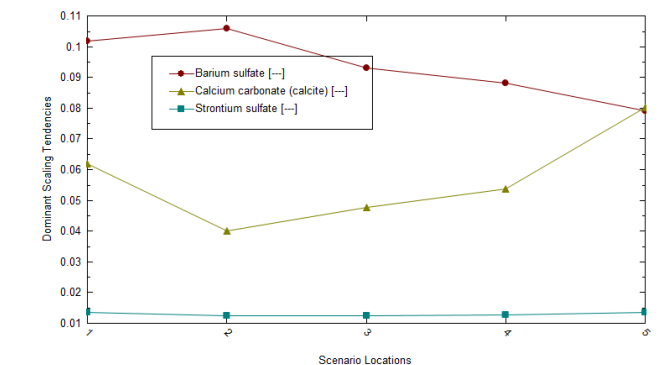
☐ Calcium sulfate

☒ Calcium carbonate (calcite)

Summary

Unit Set Based

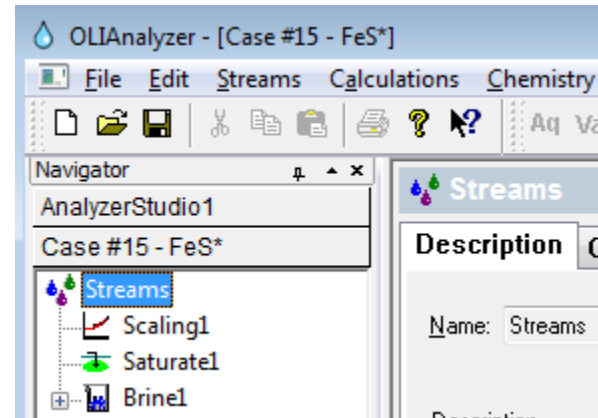
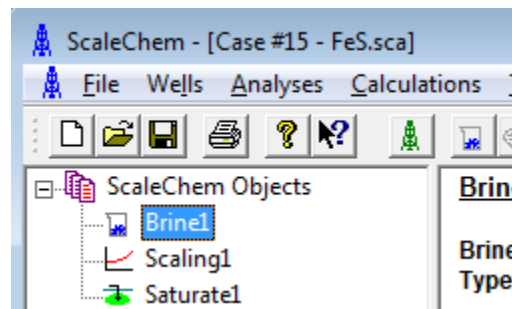
Scale S Calculat



ScaleChem Std								
Pressure	BASO4	CACO3	SRSO4	CASO4.2H2O	CASO4	FEIICO3	NACL	
psia	pST	pST	pST	pST	pST	pST	pST	
1000	0.10	0.06	0.01	0.00	0.01	0.05	0.00	
1800	0.11	0.04	0.01	0.00	0.01	0.03	0.00	
2700	0.09	0.05	0.01	0.00	0.01	0.04	0.00	
3200	0.09	0.05	0.01	0.00	0.01	0.05	0.00	
3700	0.08	0.08	0.01	0.00	0.01	0.07	0.00	
Studio SC								
	BaSO4	CaCO3	SrSO4	CaSO4.2H2O	CaSO4	FeCO3	NaCl	
	pST	pST	pST	pST	pST	pST	pST	
1	0.10	0.05	0.01	0.00	0.01	0.04	0.00	
2	0.11	0.03	0.01	0.00	0.01	0.03	0.00	
3	0.09	0.04	0.01	0.00	0.01	0.03	0.00	
4	0.09	0.04	0.01	0.00	0.01	0.04	0.00	
5	0.08	0.06	0.01	0.00	0.01	0.05	0.00	
Difference [(StudioSC-SCStd)/SCStd]								
1	0%	-14%	4%	0%	0%	-15%	0%	
2	0%	-21%	3%	0%	0%	-22%	0%	
3	0%	-22%	4%	0%	0%	-23%	1%	
4	0%	-23%	-3%	0%	0%	-25%	0%	
5	1%	-24%	-3%	0%	-3%	-24%	0%	

## Case #15 – FeS

This file contains one Brine Analysis, one Saturation, and one Scaling for a fluid saturated with FeS and CaCO<sub>3</sub> in a gas containing relatively high concentrations of CO<sub>2</sub> and H<sub>2</sub>S. This is a high TDS brine with high concentrations of organic acids and borates. The saturation calculation appears to work properly in ScaleChem Std. the Saturation calculation failed to converge in Studio SC.



## ScaleChem Std Screen – Brine/Gas Analysis

### Settings – Non-zero List, Na/Cl Balance, Equilibrium

Brine Analysis Data - Brine1

Description Species Summary

Analysis View: ☒ Original ☐ Balanced ☐ Reconciled

Species Display: ☒ Formula ☐ Name

Species List: ☒ Standard ☐ Expanded ☐ Non Zero

Cations	mg/L	Anions	mg/L	Neutrals	mg/L
Na+1	36541.000	Cl-1	78140.000	CO2, aq	0.000
K+1	1414.000	SO4-2	236.000	H2S, aq	0.000
Ca+2	942.000	HCO3-1	360.000	SiO2, aq	0.000
Mg+2	253.000	B(OH)4-1	231.000	B(OH)3, aq	0.000
Sr+2	26.000	HS-1	5.000		
Ba+2	1.000	C2H3O2-1	640.000		
Fe+2	10.000				

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	8.613
Alkalinity	as HCO3-, mg/L	0.000	729.290
Density	g/cc	1.000	1.085
Total Dissolved Solids	mg/L	118799.000	118799.000
Electrical Conductivity	1/ohm-cm	0.000	0.160

Reconciliation Type:

☐ Update Brine with results

Units:

Balance

### Settings – Standard gas, no water saturation

Gas Analysis Data - Gas

Description Composition Dew Point Summary

Gas	Mole / Vol %
Water	0.250
Nitrogen	0.000
Carbon dioxide	0.800
Hydrogen sulfide	0.010
Methane	98.940

Display: ☐ by Formula ☒ by Name

Gases Display: ☒ Show ☐ Show ☐ Show

Total Percent 100.00

## Studio ScaleChem Screen – Brine/Gas Analysis

### Settings - Expanded List, Na/Cl Balance, Equilibrium

Brine1

Description Design Report

Data Entry

Reconciliation Options

Reconciliation Type: ☒ Equilibrium Calculation ☐ CO2 Fraction in Gas ☐ pH Alkalinity Reconcile

☒

☐ Allow solids to form

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	8.61255
Alkalinity, Measured - Aqueous (mg HCO3/L)	0.0	704.293
Density - Aqueous (g/cm3)	1.00000	1.08461
Elec Cond, specific - Aqueous (mho/m)	0.0	15.9666
Total Dissolved Solids (mg/L)	0.0	0.0

Composition Adjustments

Properties	Measured	Calculated
Add Charge Balance (mg/L Na+1)		12285.6

### Settings – Expanded gas, water saturation ON and USED

Gas

Description Design Definition Report

Inflows

Component	Normalized
H2O	0.250000
Group1: 100.000 (mole %)	
CO2	0.800000
H2S	0.0100000
CH4	98.9400

Condition

Saturate With:

Conditions	Value
Temperature (*F)	77.0000
Pressure (psia)	14.6960

☒ Show Non-zero Only

## ScaleChem Std Screen – Saturate

Saturation Study - Saturate1

Description | Components | Conditions | Saturation | Calculate | Results

Input

Type	Name	Amount	Units
Brine	Brine1	24.000	bbbl/day
Gas	Gas	1600.000	kscf/day

Saturation Study - Saturate1

Description | Components | Conditions | Saturation | Calculate | Results

Temperature °F Pressure psia Description

339.080 61135.360 surface

Selected Conditions

	Temperature	Pressure	Description
1	170.600	4160.000	surface

Add

Saturation Study - Saturate1

Description | Components | Conditions | Saturation | Calculate | Results

Available solids:

NaCl (Halite)
CaSO4.2H2O (Gypsum)

Chosen solids: Solid [Inflow to 1]

FeS (Pyrrhotite) [FEIICL2]
CaCO3 (Calcite) [automatic]

Specify inflow to vary

Saturate Solid	by Varying
FeS (Pyrrhotite)	FEIICL2
CaCO3 (Calcite)	

## Studio ScaleChem Screen – Saturate

Saturate1

Description | Design | Report | File Viewer

Inlets

Type	Name	Flow
Brine (bbbl/day)	Brine1	24.0000
Gas (Mft3/day)	Gas	1600.00
<select>		

Solid

Conditions	Value
Temperature (°F)	170.600
Pressure (psia)	4160.00

Saturate1

Description | Design | Report | File Viewer

Inlets

Solid Selection (check solids allowed to form)

- ☒ Standard
  - ☐ BaSO4
  - ☒ CaCO3
  - ☐ CaSO4
  - ☐ CaSO4.2H2O
  - ☐ FeCO3
  - ☒ FeS
  - ☐ NaCl

Select Inflows To Vary

Solid	Inflow
FeS	FeCl2
CaCO3	CaCO3

## ScaleChem Std Screen – Scale Scenario

Settings –Gas+Brine, five conditions, all standard scales

Scaling Scenario - Scaling1

Description Components Conditions Precipitates Calculate Results

Input

Type	Name	Amount	Units
Brine	SatBrine	24,000	bbl/day
Gas	Gas	1600.000	kscf/day

Scaling Scenario - Scaling1

Description Components Conditions Precipitates Calculate Results

Temperature °F Pressure psia Description

284.000 8817.600 Separator

Selected Conditions

	Temperature °F	Pressure psia	Description
1	130.000	1700.000	wellhead
2	140.000	600.000	Separator
3	157.000	3100.000	Midwell
4	165.000	3800.000	Bottomhole
5	170.600	4160.000	reservoir

Available precipitates:

- KCl (Sylvite)
- Mg(OH)2 (Pyrochroite)
- CaCl2
- CaCl2.1H2O
- CaCl2.2H2O
- CaCl2.4H2O
- CaCl2.6H2O
- Ca3(BO3)2
- SrCO3 (Strontianite)

Chosen precipitates:

- NaCl (Halite)
- CaCO3 (Calcite)
- CaSO4.2H2O (Gypsum)
- CaSO4 (Anhydrite)
- SrSO4 (Celestite)
- BaSO4 (Barite)
- FeCO3 (Siderite)
- FeS (Pyrrhotite)
- FeS (Mackinawite)

Add >> Add All >> << Remove

Description Components Conditions Precipitates Calculate Results

## Studio ScaleChem Screen – Scale Scenario

Settings – Conversion is the same

Scaling1

Description Design Plot Report

Inlets

Type	Name	Flow
Brine (bbl/day)	Brine1	24.0000
Gas (Mft3/day)	Gas	1600.00
<select>		

Scaling1

Description Design Plot Report

Inlets

Location	Temperature	Pressure	Description
Separator	140.000	600.000	
wellhead	130.000	1700.00	
Midwell	157.000	3100.00	
Bottomhole	165.000	3800.00	
reservoir	170.600	4160.00	
<Enter Location Name			

Conditions

Solids Selection

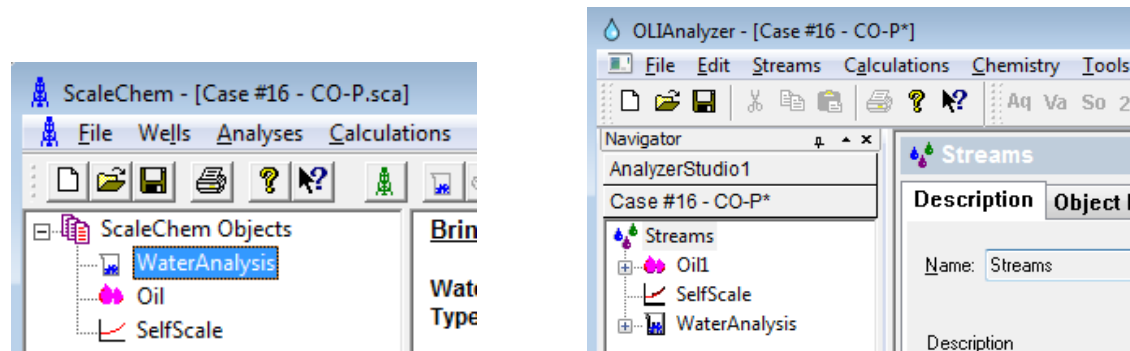
- ☒ Standard
  - ☒ BaSO4
  - ☒ CaCO3
  - ☒ CaSO4
  - ☒ CaSO4.2H2O
  - ☒ FeCO3
  - ☒ FeS
  - ☒ NaCl
  - ☒ SrSO4



ScaleChem Std											
Pressure	FEIIS pST	FEIICO3 pST	pH	CACO3 mg/l	CACO3 pST	FeS pST	CO2 aq (mg/l)	H2S, aq (mg/l)	Hac, vap (molfx)	Water rate l/hr	Gas rate l/hr
1700	1.16	1.57E-03	5.91	0	0.67		291.448	8.886	2.48E-08	159	17799
600	3.34	4.62E-03	6.16	204	2.29		129.616	4.232	1.87E-08	154	54311
3100	1.11	2.01E-03	5.89	0	0.88		341.655	10.222	5.46E-08	159	10621
3800	1.03	2.04E-03	5.88	0	0.93		362.38	10.651	6.85E-08	159	9090
4160	1.00	2.10E-03	5.88	1	1.00		370.518	10.79	7.51E-08	159	8558
StudioSC											
1	0.84	1.16E-03	5.84	0	0.37	0	3.18E+02	9.52E+00	2.45E-08	200	15848
2	2.50	3.54E-03	6.21	41	1.20	0.04035 3	1.42E+02	4.53E+00	1.40E-08	196	48364
3	0.83	1.54E-03	5.81	0	0.46	0	3.71E+02	1.08E+01	5.50E-08	200	9457
4	0.78	1.59E-03	5.80	0	0.49	0	3.93E+02	1.12E+01	6.94E-08	200	8093
5	0.78	1.66E-03	5.80	0	0.52	0	4.01E+02	1.14E+01	7.62E-08	200	7620
Rel Difference											
1	27%	26%	1%		45%		-9%	-7%	1%	-26%	11%
2	25%	23%	-1%	80%	47%		-9%	-7%	25%	-27%	11%
3	25%	23%	1%		47%		-8%	-6%	-1%	-26%	11%
4	24%	22%	1%		47%		-8%	-6%	-1%	-26%	11%
5	23%	21%	1%	100%	48%		-8%	-5%	-2%	-26%	11%

## Case #16 – C-OP1

This file contains one brine, one oil and one scale scenario. The oil phase includes pure components up to C40 (the maximum in ScaleChem). In addition, the starting pressure is 11000 psia (758bar). The oil phase density differed between the two calculations. Also the PVT curve calculator and plot needs to be created manually. This is not a problem since it does not affect the scale calculations.



## ScaleChem Std Screen – Brine Analysis

### Settings –Standard, Na/Cl balance Equilibrium

Brine Analysis Data - WaterAnalysis

Description Species Summary

Analysis View: ☒ Original ☐ Balanced ☐ Reconciled

Species Display: ☒ Formula ☐ Name

Species List: ☐ Standard ☐ Expanded

Cations	mg/L	Anions	mg/L	Neutrals
Na+1	17292.000	Cl-1	28591.000	
K+1	135.200	SO4-2	29.900	
Ca+2	717.500	HCO3-1	485.200	
Mg+2	240.500	B(OH)4-1	339.610	
Sr+2	53.100	C2H3O2-1	196.200	
Ba+2	18.600	C3H5O2-1	22.700	
Fe+2	1.400			

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	8.736
Alkalinity	as HCO3-, mg/L	0.000	829.062
Density	g/cc	1.000	1.030
Total Dissolved Solids	mg/L	48122.910	48122.910
Electrical Conductivity	1/ohm-cm	0.000	0.071

Reconciliation Type: ☒ Equilibrium Calculation ☐ Update Brine with results

Units

Variable	ScaleChem Std	Studio ScaleChem
pH	8.74	8.74
Alk	829.1	815.5
Density	1.03	1.03
Balance ion	Na+	Na+
Balance Value	235	235
Saturated	CaCO3, BaSO4, FeCO3, SrCO3	CaCO3, BaSO4, FeCO3, SrCO3
Notes		

## Studio ScaleChem Screen – Brine Analysis

### Settings – Expanded List, Makeup(Na=), Equilibrium

WaterAnalysis

Description Design Report

Data Entry Reconcile

Variable	Value	Balanced
Cations (mg/L)		
Na+1	17292.0	17527.0
K+1	135.200	135.200
Ca+2	717.500	717.500
Mg+2	240.500	240.500
Sr+2	53.1000	53.1000
Ba+2	18.6000	18.6000
Fe+2	1.40000	1.40000
Anions (mg/L)		
Cl-1	28591.0	28591.0
SO4-2	29.9000	29.9000
HCO3-1	485.200	485.200
B(OH)4-1	339.610	339.610
C2H3O2-1	196.200	196.200
C3H5O2-1	22.7000	22.7000
Neutrals (mg/L)		

Entry Options: Units: mg/L, Display: Formula, ☐ Show Non-zero Only, ☒ Show Balanced Column

Template Manager: Last Applied: None, Expanded, Save as...

Balance Options: Type: Makeup Ion

Summary:

User Choice Charge Balance: Cation: Na+1

Cation Charge: 0.812740 eq/L  
Anion Charge: -0.822964 eq/L  
Imbalance: -0.0102230 eq/L

235.027 mg/L of Na+1 is needed to balance.

Isothermal Calculation Phase Amounts: Aqueous: 1030.40 g, Vapor: 0.0 g, Solid: 0.0 g, 2nd Liquid: 0.0 g

Aqueous Phase Properties: pH: 8.73590, Ionic Strength: 0.0150072 mol/m, Density: 1.03040 g/cm3

Calc. elapsed time: 2.273 sec

Calculation complete

25.0000°C  
1.00000atm  
Calculated Alkalinity: 815.483483

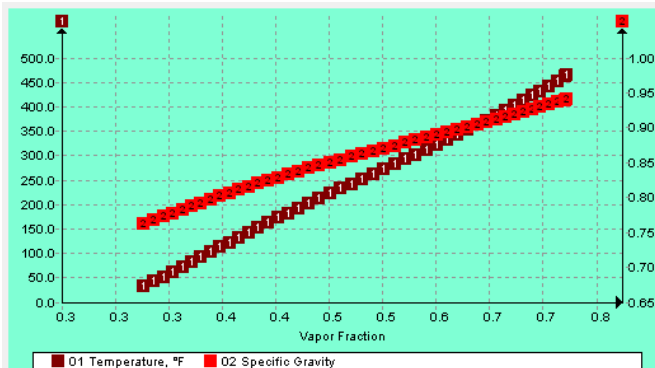
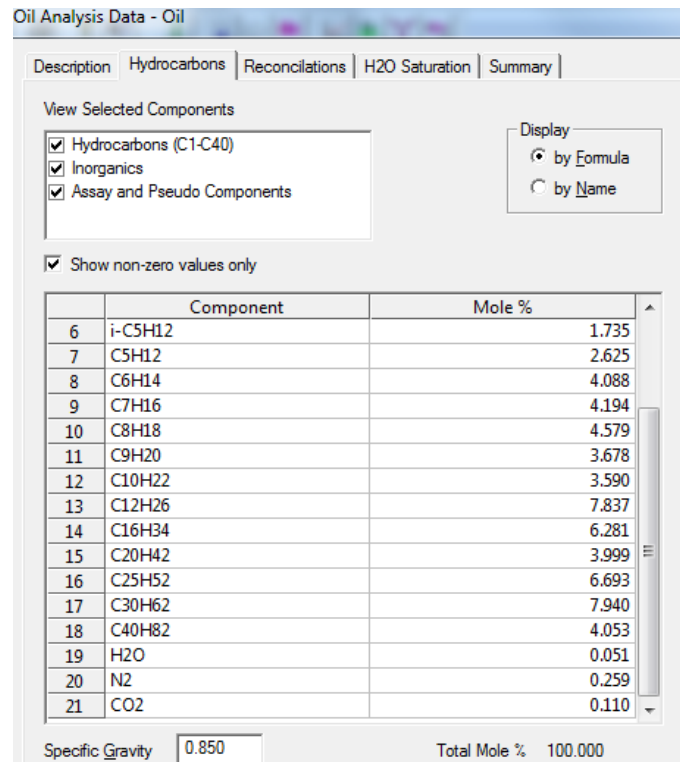
Reconciliation Options: Reconciliation Type: ☒ Equilibrium Calculation ☐ CO2 Fraction in Gas ☐ pH Alkalinity Reconcile, ☐ Allow solids to form, Calculate

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	8.73590
Alkalinity, Measured - Aqueous (mg HCO3/L)	0.0	815.483
Density - Aqueous (g/cm3)	1.00000	1.03040
Elec Cond, specific - Aqueous (mho/m)	0.0	7.13971
Total Dissolved Solids (mg/L)	0.0	48357.9
Composition Adjustments		
Add Charge Balance (mg/L Na+1)		235.027

Notes –

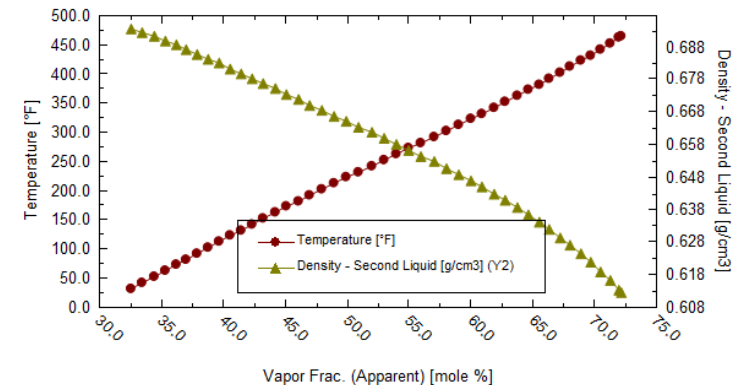
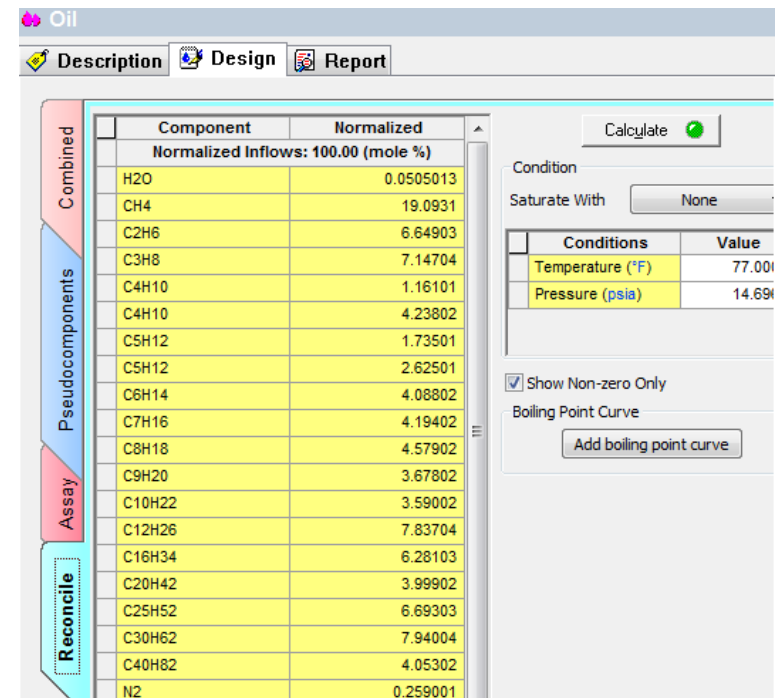
## ScaleChem Std Screen – Oil Analysis

**Settings** – All components on, water sat on, SG=0.85



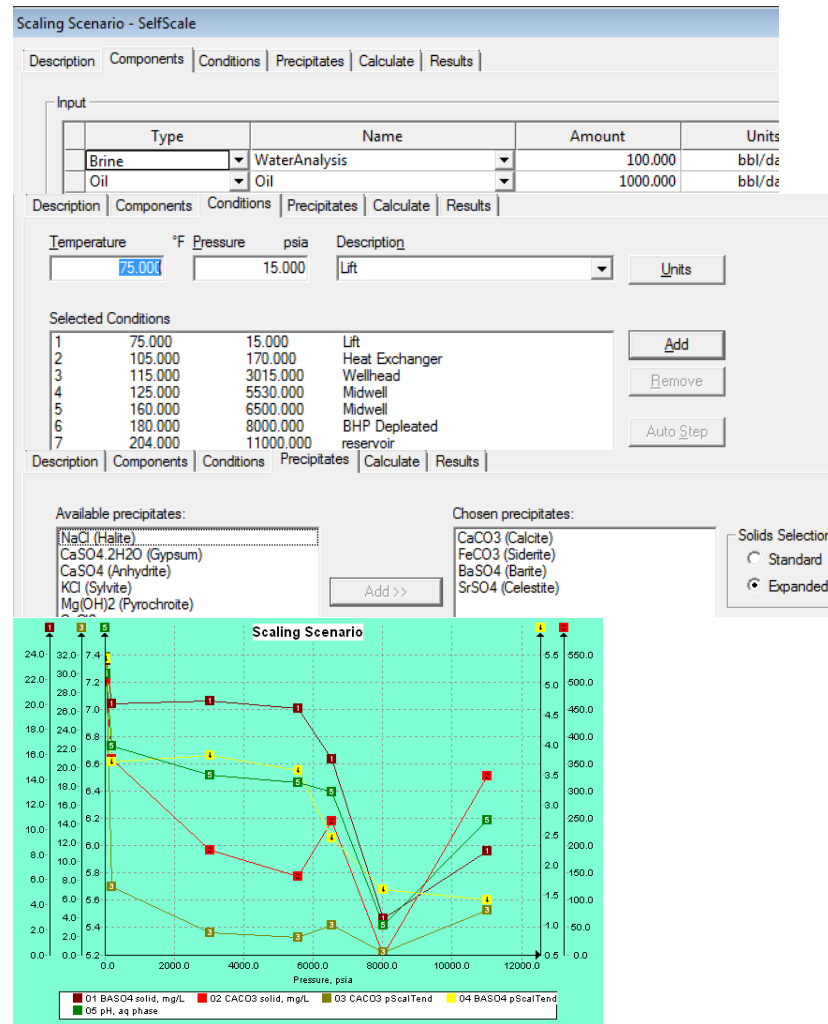
## Studio ScaleChem Screen – Oil Analysis

**Settings** – H2O Sat Off. Boiling point curve is manually created



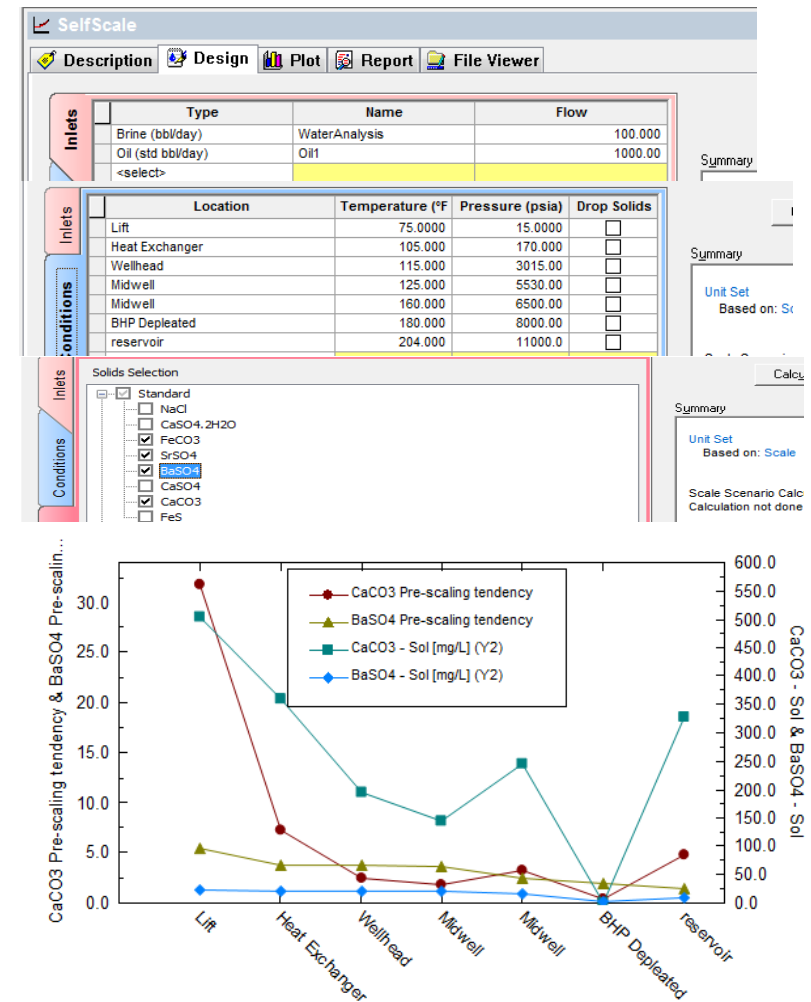
## ScaleChem Std Screen – Scale Scenario

Settings – One water, one oil, seven conditions, seven solids



## Studio ScaleChem Screen – Scale Scenario

Settings - One water, one oil, seven conditions, seven solids



Notes – Plots will be different because we are no longer showing mg/l

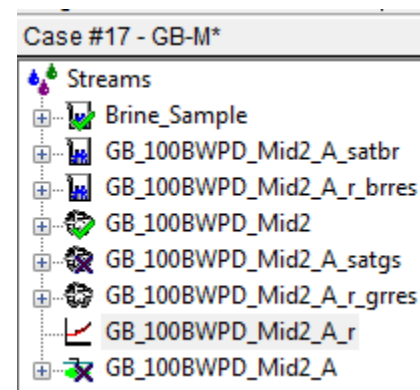
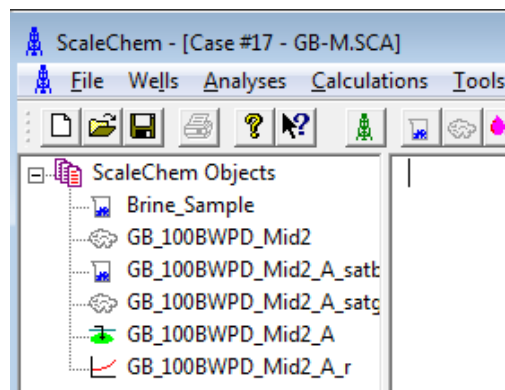
ScaleChem Std						
Pressure	BASO4 mg/l	CACO3 mg/l	CACO3 pST	BASO4 pST	pH	H2O (org), molfx
15	24	504	32	5	7.3	4.65E-04
170	20	358	7	4	6.7	1.01E-03
3015	20	192	2	4	6.5	9.93E-04
5530	20	143	2	4	6.5	1.03E-03
6500	16	244	3	2	6.4	2.02E-03
8000	3		0.3	2	5.4	
11000	8	327	5	1	6.2	3.42E-03
StudioSC						
15	23	503	32	5	7.3	4.65E-04
170	20	358	7	4	6.7	1.01E-03
3015	20	194	2	4	6.5	9.93E-04
5530	20	145	2	4	6.5	1.03E-03
6500	16	246	3	2	6.4	2.02E-03
8000	3		0.3	2	5.5	
11000	8	327	5	1	6.2	3.42E-03
Rel Difference						
15	0.2%	0.2%	-0.3%	0.2%	0.0%	0.1%
170	0.0%	-0.1%	-0.3%	-0.3%	0.0%	-0.1%
3015	0.0%	-0.9%	-1.4%	0.1%	0.0%	0.0%
5530	0.0%	-1.5%	-1.4%	0.1%	0.0%	-0.2%
6500	0.0%	-0.5%	-1.3%	0.1%	0.0%	0.2%
8000	-10.9%		-26.8%	-21.6%	-0.9%	
11000	0.1%	-0.2%	-0.9%	0.0%	0.0%	0.1%

### Case #17 – GB-M-

This file contains one brine, one gas, one saturate, one scale object and two optional brines and gases. The brines contains several of the expanded elements, Pb, Zn, Ni, Cu, and Fe(III). It also contains the anions, nitrate, fluoride, nitrite, and sulfite. Lastly, it contains dissolved silica. The saturation calculation did not converge to the same initial endpoint between the two software initially. The ScaleChem Std. software did not have 2<sup>nd</sup> Liquid on automatically because it had just been installed. Consequently, the gas phase was forced into the Aqueous phase. The 2<sup>nd</sup> Liquid needed to be turned on manually, and the calculation worked as expected thereafter. This calculation also uses the Advanced button, in which CaCO<sub>3</sub> is saturated by adding Na<sub>2</sub>CO<sub>3</sub>. We noticed that the Advanced button no longer included the alternative inflows for fluoride. This was reported to OLI.

The Saturation calculation failed in StudioSC. If CaF<sub>2</sub> is removed from the saturation set, then the calculation converges. This was done in order to continue with the work. The water saturated gas did not converge in Studio SC. This appeared to be the result of importing a file that was saved in ScaleChem V2, since the T/P values in the water saturation appeared to be multiplied by the metric to English units conversion, even though the initial data was in English units. Once this was fixed, the calculation could be computed, although since the hydrocarbon was a dense phase, there was no water saturation to compute and the saturation option was converted to none.

There are two additional streams that are computed from the last scale calculation. They represent the reservoir gas and brine. These are transferred to Studio SC, but are not needed since the optional brine/gas/oil has been eliminated. The inputs to the Scale scenario in Studio SC were therefore changed to include the output of the saturation calculation.



## ScaleChem Std Screen – Saturate

Settings – CaCO<sub>3</sub>, CaF<sub>2</sub> sat,

Selected Conditions  
1 276.000 7999.000 bottomhole

Saturation Study - GB\_100BWPD\_Mid2\_A

Description Components Conditions Saturation Calculate Results

Available solids:  
NaCl (Halite)  
CaSO<sub>4</sub>.2H<sub>2</sub>O (Gypsum)  
CaSO<sub>4</sub> (Anhydrite)

Chosen solids: Solid [Inflow to Vary]  
CaCO<sub>3</sub> (Calcite) [Na<sub>2</sub>CO<sub>3</sub>]  
CaF<sub>2</sub> (Fluorite) [automatic]

View Calculations

Brine Flow: 150.74 bbl/day

Scale Mineral	Maximum Scale mg/L	lb/bbl	Scaling Temp pre-scaling
NaCl	0.0	0.0000	0.0833
CaCO <sub>3</sub>	0.1	0.0000	1.0000
CaSO <sub>4</sub> .2H <sub>2</sub> O	0.0	0.0000	0.0019
CaSO <sub>4</sub>	0.0	0.0000	0.0053
SrSO <sub>4</sub>	0.0	0.0000	0.0033
BaSO <sub>4</sub>	0.0	0.0000	0.8368
CaF <sub>2</sub>	0.0	0.0000	1.0000
KCl	0.0	0.0000	0.0004
MgOH <sub>2</sub>	0.0	0.0000	0.0007
SrCO <sub>3</sub>	0.0	0.0000	0.0348
BaCO <sub>3</sub>	0.0	0.0000	0.0003
NiOH <sub>2</sub>	0.0	0.0000	0.0004
ZnCO <sub>3</sub>	0.0	0.0000	0.0006
CUOH <sub>2</sub>	0.0	0.0000	0.0017
CUCO <sub>3</sub>	0.0	0.0000	0.0004

Saturation Results:

Inflow Varied	Amount added mg/L	Final Value mg/L
Na <sub>2</sub> CO <sub>3</sub>	89.041	344.45
CaF <sub>2</sub>	-64.774	8.8638

## Studio ScaleChem Screen – Saturate

Settings – The Saturated solids did not transfer

GB\_100BWPD\_Mid2\_A

Description Design Report File Viewer

Inlets

Solid Selection (check solids allowed to form)

- ☒ Standard
  - ☐ BaSO<sub>4</sub>
  - ☒ CaCO<sub>3</sub>
  - ☐ CaSO<sub>4</sub>
  - ☐ CaSO<sub>4</sub>.2H<sub>2</sub>O
  - ☐ NaCl
  - ☐ SrSO<sub>4</sub>
- ☒ Expanded
- ☒ All

Select Inflows To Vary

Solid	Inflow
CaCO <sub>3</sub>	Na <sub>2</sub> CO <sub>3</sub>



## ScaleChem Std Screen – Scale Scenario

**Settings** – Six conditions, most solids, no special conditions

Scaling Scenario - GB\_100BWP\_Mid2\_A\_r

Description Components Conditions Precipitates Calculate Results

Input

Type	Name	Amount
Brine	GB_100BWP_Mid2_A_satbr	146.000
Gas	GB_100BWP_Mid2_A_satgs	14130.000

Description Components Conditions Precipitates Calculate Results

Temperature °F Pressure psia Description Units

170.600 215.972 ambient conditions

Selected Conditions

	Temperature	Pressure	Description
1	48.000	1799.890	surface
2	63.000	2060.873	riser base
3	77.000	14.696	ambient conditions
4	148.400	2091.872	wellheadafterchoke
5	217.100	5331.673	wellheadbeforechoke
6	276.000	7999.509	bottomhole

Description Components Conditions Precipitates Calculate Results

Available precipitates:

- BaSO4 (Barite)
- NaBr.2H2O
- CaCl2.1H2O
- CaCl2.2H2O
- CaCl2.4H2O
- CaCl2.6H2O
- CaBr2.4H2O
- CaBr2.6H2O
- SrCO3 (Strontianite)
- BaCO3 (Witherite)
- Zn(OH)2 (Sweetite)
- ZnCl2.H2O
- ZnCl2.3H2O
- ZnBr2.2H2O
- CuCO3 (Malachite)

Chosen precipitates:

- CaSO4 (Anhydrite)
- CaCO3 (Calcite)
- CaBr2
- CaCl2
- SrSO4 (Celestite)
- Cu(OH)2 (Speritine)
- CaSO4.2H2O (Gypsum)
- NaCl (Halite)
- Mg(OH)2 (Pyrochroite)
- Ni(OH)2 (Theophrastite)
- KBr
- KCl (Sylvite)
- NaBr
- ZnBr2
- ZnCO3 (Smithsonite)
- 7nCl2

Solids Sele

☐ Stand

☒ Expan

## Studio ScaleChem Screen – Scale Scenario

**Settings** – The scaling solids did not transfer

GB\_100BWP\_Mid2\_A\_r

Description Design Plot Report File Viewer

Inlets

Type	Name	Flow
Brine (bbl/day)	GB_100BWP_Mid2_A	146.000
Gas (Mft3/day)	GB_100BWP_Mid2_A	14130.0

Inlets

Location	Temperature (°F)	Pressure (psia)	Drop Solids
surface	48.0000	1799.89	<input type="checkbox"/>
riser base	63.0000	2060.87	<input type="checkbox"/>
ambient conditions	77.0000	14.6961	<input type="checkbox"/>
wellheadafterchoke	148.400	2091.87	<input type="checkbox"/>
wellheadbeforechoke	217.100	5331.67	<input type="checkbox"/>
bottomhole	276.000	7999.51	<input type="checkbox"/>

Conditions

GB\_100BWP\_Mid2\_A\_r

Description Design Plot Report File View

Inlets

Solids Selection

- ☒ Standard
  - ☒ BaSO4
  - ☒ CaCO3
  - ☒ CaSO4
  - ☒ CaSO4.2H2O
  - ☒ NaCl
  - ☒ SrSO4
- ☒ Expanded
- ☒ All

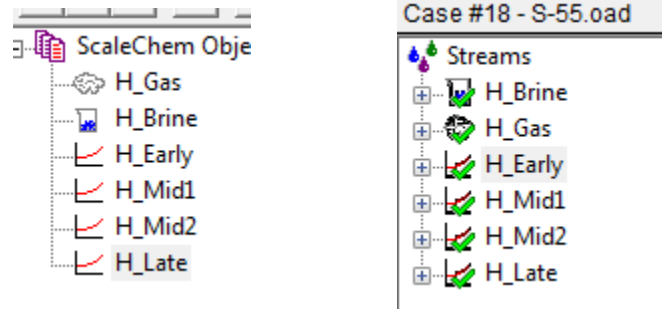
ScaleChem Std							
Pressure	pH	CAF2-pST	CACO3-pST	BASO4-pST	CACO3 mg/l	BASO4 mg/l	CAF2 mg/l
1799.89	5.5	22.3	0.1	3.4	0.0	13.9	6.9
2060.87	5.6	15.3	0.1	3.2	0.0	13.3	6.5
14.696	6.7	83.2	15.6	5.6	133.4	25.3	12.1
2091.87	5.6	11.0	0.1	3.0	0.0	13.0	6.1
5331.67	5.6	3.9	0.2	2.1	0.0	9.9	4.3
7999.51	5.8	1.0	1.0	0.8	0.0	0.0	0.0
StudioSC							
Locations	pH - Aq	CaF2 Pre-ST	CaCO3 Pre-ST	BaSO4 Pre-ST	CACO3 mg/l	BaSO4 - Sol	CAF2 mg/l
1799.89	5.8	27.1	0.2	3.6		14.9	
2060.87	5.8	18.0	0.2	3.4		14.4	
14.696	5.8	16.9	0.2	2.9		13.2	
2091.87	5.8	12.7	0.2	3.2		14.1	
5331.67	5.8	4.3	0.2	2.2		10.8	
7999.51	5.8	1.0	1.0	0.8		0.0	
Relative Difference							
1		22%	78%	5%		8%	
2		18%	61%	6%		8%	
3		80%	98%	49%		48%	
4		15%	42%	7%		8%	
5		12%	39%	5%		9%	
6		0%	0%	1%			

## Case #18 – S-55

This file contains two brines, one gas and four scale scenario. This is a straightforward case, and was selected for review because the brine contained high concentrations of organic acids and silica and the gas contained all the hydrocarbons plus ammonia. The scale scenarios are for different well phases, from early life to late life. No solids were selected in the scale calculations.

The ScaleChem Std default had second liquid off. This created an initial difference in the results between the two software. The 2<sup>nd</sup> liquid was turned on, and these are the results that are presented below.

The scale tendency results are consistent between the two software, with the exception of one scenario, Mid2, which shows significant difference for FeCO<sub>3</sub> and CaSO<sub>4</sub>. However, these solid phases are well below saturation, so this difference is due to the difference of small numbers, and it does not affect overall decisions about scaling.



## Brine Analyses (two)

Brine Analysis Data - H\_Brine

Description Species Summary

Analysis View  
☒ Original ☐ Balanced ☐ Reconciled

Species Display  
☒ Formula ☐ Name

Species List  
☐ Standard ☐ Expanded ☒

Cations	mg/L	Anions	mg/L	Neutrals
Na+1	38248.300	Cl-1	65936.100	SiO <sub>2</sub> , aq
Ca+2	2943.550	SO <sub>4</sub> -2	10.454	
Mg+2	511.741	HCO <sub>3</sub> -1	196.752	
Sr+2	253.902	CH <sub>3</sub> O2-1	36.000	
Ba+2	254.647	C <sub>2</sub> H <sub>3</sub> O2-1	264.000	
Fe+2	9.743	C <sub>3</sub> H <sub>5</sub> O2-1	143.000	
		C <sub>4</sub> H <sub>7</sub> O2-1	23.000	
		C <sub>5</sub> H <sub>9</sub> O2-1	15.000	

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	0.000	7.006
Alkalinity	as HCO <sub>3</sub> -, mg/L	0.000	327.105
Density	g/cc	0.000	1.071
Total Dissolved Solids	mg/L	108846.189	108846.189
Electrical Conductivity	1/ohm-cm	0.000	0.139

Reconciliation Type  
☒ Equilibrium Calculation  
☐ Update Brine with results

Units

H\_Brine

Description Design Report

Data Entry Reconcile

Variable	Value	Balanced
<b>Cations (mg/L)</b>		
<input checked="" type="checkbox"/> Na+1	38248.3	38440.3
<input type="checkbox"/> Ca+2	2943.55	2943.55
<input type="checkbox"/> Mg+2	511.741	511.741
<input type="checkbox"/> Fe+2	9.74276	9.74276
<input type="checkbox"/> Ba+2	254.647	254.647
<input type="checkbox"/> Sr+2	253.902	253.902
<b>Anions (mg/L)</b>		
<input type="checkbox"/> Cl-1	65936.1	65936.1
<input type="checkbox"/> SO <sub>4</sub> -2	10.4539	10.4539
<input type="checkbox"/> HCO <sub>3</sub> -1	196.752	196.752
<input type="checkbox"/> CH <sub>3</sub> O2-1	36.0000	36.0000
<input type="checkbox"/> C <sub>2</sub> H <sub>3</sub> O2-1	264.000	264.000
<input type="checkbox"/> C <sub>3</sub> H <sub>5</sub> O2-1	143.000	143.000
<input type="checkbox"/> C <sub>4</sub> H <sub>7</sub> O2-1	23.0000	23.0000
<input type="checkbox"/> C <sub>5</sub> H <sub>9</sub> O2-1	15.0000	15.0000
<b>Neutrals (mg/L)</b>		
SiO <sub>2</sub>	27.0000	

Data Entry Reconcile

Reconciliation Options

Reconciliation Type  
☒ Equilibrium Calculation  
☐ CO<sub>2</sub> Fraction in Gas  
☐ pH Alkalinity Reconcile

☐ Allow solids to form

Calculate

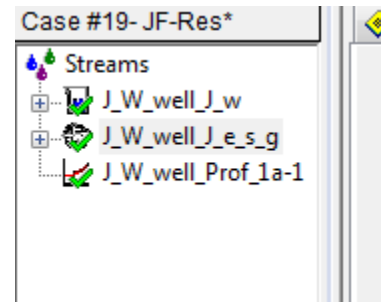
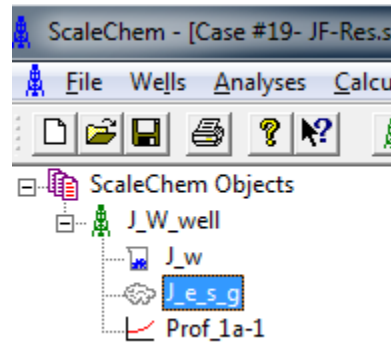
Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	0.0	7.00641
Alkalinity, Measured - Aqueous (mg HCO <sub>3</sub> /L)	0.0	319.004
Density - Aqueous (g/ml)	0.0	1.07139
Elec Cond, specific - Aqueous (mho/m)	0.0	13.8537
Total Dissolved Solids (mg/L)	0.0	0.0
<b>Composition Adjustments</b>		
Add Charge Balance (mg/L Na+1)		191.979

	Early – Scale Tendencies					Mid1 – Scale Tendencies					Mid2-Scale Tendencies					Late-Scale Tendencies				
Pressure	pH	BASO4	CACO3	CASO4	FEIICO3	pH	BASO4	CACO3	CASO4	FEIICO3	pH	BASO4	CACO3	CASO4	FEIICO3	pH	BASO4	CACO3	CASO4	FEIICO3
1800	5.9	7.6	4.6	0.002	0.9	5.3	11.2	0.1	0.003	0.03	5.1	15.2	0.0	0.002	0.00	5.0	17.2	0.0	0.001	0.00
2145	5.8	6.9	5.9	0.002	1.4	5.4	9.8	0.2	0.003	0.04	5.1	13.5	0.0	0.002	0.01	5.1	13.4	0.0	0.002	0.01
3030	5.8	5.8	8.8	0.003	2.4	5.4	7.6	0.2	0.004	0.07	5.2	10.9	0.1	0.003	0.02	5.3	7.1	0.1	0.004	0.04
3825	5.8	5.4	9.1	0.003	2.6	5.4	6.7	0.2	0.004	0.07	5.2	7.5	0.1	0.004	0.03	5.3	5.2	0.2	0.005	0.06
7500	5.4	4.8	57.0	0.012	12.1	5.5	3.7	1.0	0.006	0.25	5.4	3.7	0.5	0.007	0.14	5.4	3.7	0.5	0.007	0.15
Locations	pH	BASO4	CACO3	CASO4	FEIICO3	PH	BASO4	CACO3	CASO4	FEIICO3	pH	BASO4	CACO3	CASO4	FEIICO3	pH	BASO4	CACO3	CASO4	FEIICO3
1	6.2	7.6	4.7	0.002	0.9	5.3	11.2	0.1	0.003	0.03	5.1	15.2	0.0	0.002	0.00	5.0	17.2	0.0	0.001	0.00
2	6.2	6.9	6.1	0.002	1.4	5.4	9.8	0.2	0.003	0.04	5.1	13.5	0.0	0.002	0.01	5.1	13.4	0.0	0.002	0.01
3	6.2	5.7	9.1	0.003	2.5	5.4	7.6	0.2	0.004	0.07	5.2	10.9	0.1	0.003	0.02	5.3	7.1	0.1	0.004	0.04
4	6.2	5.4	9.4	0.003	2.7	5.4	6.7	0.3	0.004	0.07	5.2	7.5	0.1	0.003	0.03	5.3	5.2	0.2	0.005	0.06
5	6.2	4.9	59.7	0.012	12.5	5.5	3.7	1.0	0.006	0.25	5.4	3.7	0.5	0.007	0.14	5.4	3.7	0.5	0.007	0.15
	5%	1%	3%	1%	3%	0%	0%	2%	0%	1%	0%	0%	1%	63%	183%	0%	0%	0%	0%	6%
	6%	1%	4%	1%	3%	0%	0%	2%	0%	1%	0%	0%	1%	71%	252%	0%	0%	1%	0%	2%
	7%	1%	4%	1%	3%	0%	0%	2%	0%	2%	0%	0%	1%	81%	429%	0%	0%	0%	0%	0%
	8%	1%	4%	1%	3%	0%	0%	2%	0%	0%	0%	0%	1%	88%	755%	0%	0%	0%	0%	1%
	15%	2%	5%	2%	3%	0%	0%	2%	0%	1%	0%	0%	1%	95%	1928%	0%	0%	0%	0%	0%

## Case #19 – JF-Res

This file contains One brine, two gases, and two scale scenarios. The Brine analyses are similar, with no difference in the amount of HCl/CO<sub>2</sub> required to set the pH and Alkalinity. The gas analysis however differs. The H<sub>2</sub>O saturation is not automatically included in SCStd. As a result, the H<sub>2</sub>O saturation sent to the scale scenario is 0.528. By comparison, the H<sub>2</sub>O in the StudioSC is 0.53. This is a small value but it is a reflection of the different way that the two software handles the saturated water calculation – one is manual adjustment and one is automatic.

There is significant difference in the scaling results between the two software. This is the most severe of the cases observed. It appears to be due to calculations in water volume. StudioSC computes a water volume that is between 4 and 100 times larger than ScaleChem STd. This data is presented in the table below.



## ScaleChem Std Screen – Brine Analysis

Settings –Expanded, Na/Cl, pH&Alk

Brine Analysis Data - J\_w

Description Species Summary

Analysis View: ☐ Original ☐ Balanced ☒ Reconciled

Species Display: ☒ Formula ☐ Name

Species List: ☐ Standard ☐ Expanded

Cations	mg/L	Anions	mg/L	Neutrals
Na+1	59604.380	Cl-1	131972.400	
K+1	1379.983	SO4-2	409.995	
Ca+2	17599.790	HCO3-1	190.244	
Mg+2	2499.970			
Sr+2	733.991			
Ba+2	3.800			
Fe+2	142.998			
H+1	0.273			

Variable	Units	Measured	Calculated
Ambient Temperature	*F	77.000	77.000
Ambient Pressure	psia	14.696	14.696
pH	pH units	6.000	6.000
Alkalinity	as HCO3-, mg/L	129.000	128.984
Density	g/cc	1.140	1.145
Total Dissolved Solids	mg/L	214537.824	214537.824

Reconciliation Type: ☒ pH and Alkalinity

☒ Update Brine with results

Units

Variable	ScaleChem Std	Studio ScaleChem
pH	6.0	6
Alk	128	128.7
Density	1.145	1.145
Balance ion	Na+	Na+
Balance Value	705	705
Saturated	CaCO3, BaSO4, SrSO4	CaCO3, BaSO4, SrSO4
Notes		

## Studio ScaleChem Screen – Brine Analysis

Settings – Expanded, Makeup (Na+), pH&Alk

J\_w

Description Design Report

Data Entry

Variable	Value	Balanced
Cations (mg/L)		
Na+1	58900.0	59605.1
K+1	1380.00	1380.00
Ca+2	17600.0	17600.0
Mg+2	2500.00	2500.00
Sr+2	734.000	734.000
Ba+2	3.80000	3.80000
Fe+2	143.000	143.000
Anions (mg/L)		
Cl-1	1.32000e	1.32000e
SO4-2	410.000	410.000
HCO3-1	129.000	129.000
Neutrals (mg/L)		

Entry Options: Units: mg/L, Display: Formula, ☒ Show Non-zero Only, ☒ Show Balanced Column

Template Manager: Last Applied: None, Expanded, Save as...

Balance Options: Type: Makeup Ion

Reconciliation Options: Reconciliation Type: ☐ Equilibrium Calculation, ☐ CO2 Fraction in Gas, ☒ pH Alkalinity Reconcile, ☐ Allow solids to form, Calculate

Properties	Measured	Calculated
Temperature (*F)	77.0000	
Pressure (psia)	14.6960	
pH - Aqueous	6.00000	6.00000
Alkalinity, Measured - Aqueous (mg HCO3/L)	129.000	128.787
Alkalinity end point	4.50000	
Density - Aqueous (g/cm3)	1.14000	1.14510
Elec Cond, specific - Aqueous (mho/m)	4.80000	20.5989
Total Dissolved Solids (mg/L)	0.0	2.14505e5
Composition Adjustments		
Added acidity (mg/L HCL)		-26.6070
Add carbonate (mg/L CO2)		43.9790
Add Charge Balance (mg/L Na+1)		705.101

Summary: Cation: Na+1, Cation Charge: 3.70322 eq/L, Anion Charge: -3.73389 eq/L, Imbalance: -0.0306699 eq/L, 705.101 mg/L of Na+1 is needed to balance. Alkalinity Calculation Phase Amounts: Aqueous 1145.10 g, Vapor 0.0 g, Solid 0.0 g, 2nd Liquid 0.0 g. Aqueous Phase Properties: pH 6.00000, Ionic Strength 0.0731344 mol/mol, Density 1.14510 g/cm3. Summary: Cation: Na+1, Cation Charge: 3.70322 eq/L, Anion Charge: -3.73389 eq/L, Imbalance: -0.0306699 eq/L, 705.101 mg/L of Na+1 is needed to balance. Alkalinity Calculation Phase Amounts: Aqueous 1145.10 g, Vapor 0.0 g, Solid 0.0 g, 2nd Liquid 0.0 g. Aqueous Phase Properties: pH 6.00000, Ionic Strength 0.0731344 mol/mol, Density 1.14510 g/cm3. Calc. elapsed time: 3.532 sec. Calculation complete.

Notes – The results are the same. Nothing new observed

## ScaleChem Std Screen – Gas Analysis

Settings – Expanded, H2O Sat On

Gas Analysis Data - J\_e\_s\_g

Description Composition Dew Point Summary

Gas	Mole / Vol %
Water	0.528
Nitrogen	1.962
Carbon dioxide	0.707
Hydrogen sulfide	0.000
Methane	89.435
Ethane	4.381
Propane	1.213
i-Butane	0.203
n-Butane	0.312

Display  
☐ by Formula  
☒ by Name

Gases Display  
☐ Show standard gas list  
☒ Show expanded gas list  
☐ Show non-zero gases

Gas Analysis Data - J\_e\_s\_g

Description Composition Dew Point Summary

Type of Calculation  
☒ Saturated water content  
☐ Dew point temperature  
☐ Dew point pressure

Conditions  
 T, °F: 202.0  
 P, psia: 4150.0  
 Water vapor, vol %: 0.52785

Calculate  
View Files  
Units

## Studio ScaleChem Screen – Gas Analysis

Settings – Expanded gas, H2O sat on for both

J\_W\_well\_J\_e\_s\_g

Description Design Definition Report

Inflows

Reconcile

Component	Normalize	Reconciled G
H2O	0.527852	0.530660
N2	1.96241	1.96236
CO2	0.707183	0.707027
CH4	89.4354	89.4329
C2H6	4.38132	4.38125
C3H8	1.21341	1.21339
C4H10	0.202901	0.202900
C4H10	0.312311	0.312309
C5H12	0.118361	0.118360
C5H12	0.108410	0.108410
C6H14	0.133281	0.133280
C7H16	0.253631	0.253630
C8H18	0.172071	0.172070
C9H20	0.0865324	0.0865319
C10H22	0.384922	0.384920

Calculate

Condition  
 Saturate With: H2O

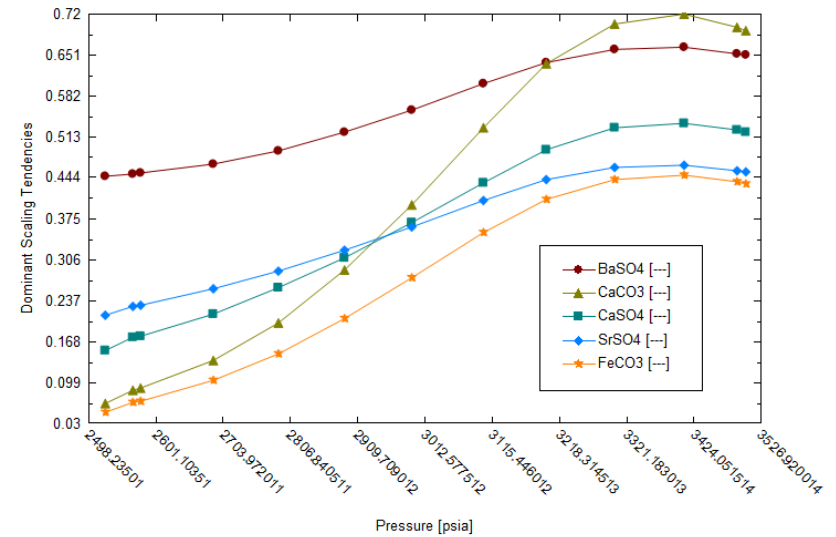
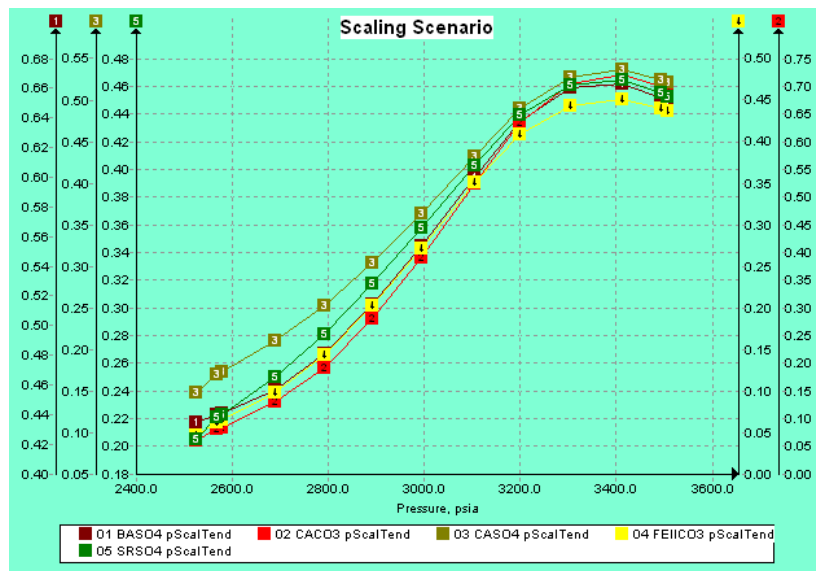
Conditions	Value
Temperature (°F)	202.000
Pressure (psia)	4150.00

☒ Show Non-zero Only

Saturated H2O Amount:  
 0.530660 mole %

Notes –. Results are the same





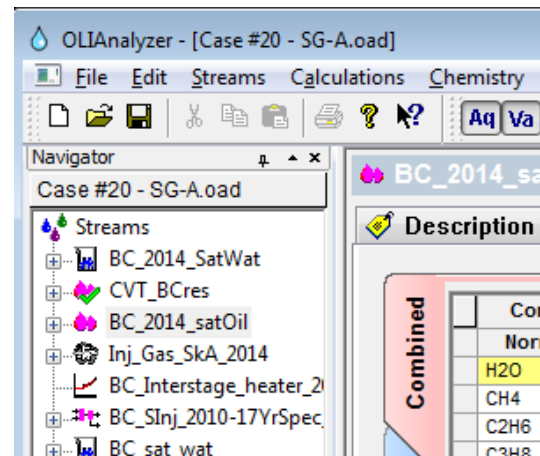
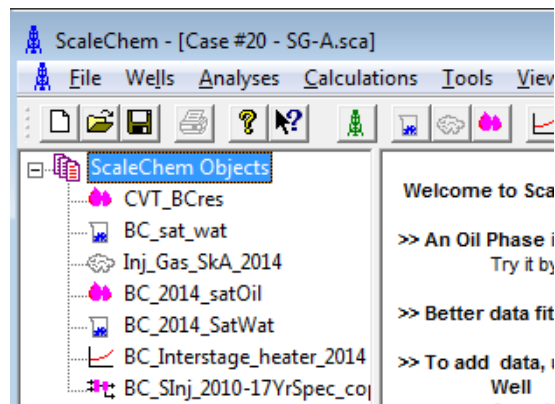
ScaleChem Std									
Pressure	KgMoles (Aq)	Water Vol (bbl/day)	pH	BASO4	CACO3	CASO4	FEIICO3	NACL	SRSO4
3503	119	13	5.2	0.65	0.68	0.52	0.432	0.085	0.45
3490	119	13	5.2	0.65	0.69	0.52	0.435	0.086	0.45
3409	117	13	5.3	0.66	0.71	0.53	0.446	0.089	0.46
3302	118	13	5.3	0.65	0.70	0.52	0.439	0.088	0.46
3198	122	14	5.2	0.63	0.63	0.49	0.405	0.08	0.44
3102	130	15	5.2	0.60	0.52	0.43	0.346	0.069	0.40
2992	142	16	5.2	0.55	0.38	0.36	0.268	0.055	0.36
2890	155	17	5.2	0.51	0.28	0.302	0.199	0.044	0.32
2789	172	19	5.1	0.48	0.19	0.25	0.141	0.035	0.28
2688	189	21	5.1	0.45	0.13	0.208	0.097	0.028	0.25
2577	210	24	5.0	0.44	0.08	0.171	0.064	0.022	0.22
2566	212	24	5.0	0.44	0.08	0.168	0.061	0.022	0.22
2523	226	26	5.0	0.43	0.06	0.147	0.045	0.019	0.20
Studio SC	0								
Pressure	KgMoles (Aq)	Water Vol (bbl/day)	pH	BASO4	CACO3	CASO4	FEIICO3	NACL	SRSO4
3503	513	60	4.8	0.13	0.020	0.086	0.016	3.22E-03	0.08

3490	481	56	4.8	0.14	0.024	0.092	0.018	3.64E-03	0.09
3409	383	45	4.9	0.18	0.041	0.119	0.031	5.66E-03	0.11
3302	425	50	4.9	0.16	0.032	0.105	0.024	4.63E-03	0.10
3198	887	103	4.6	0.08	0.006	0.044	0.005	1.16E-03	0.04
3102	2674	311	4.4	0.02	0.001	0.011	0.001	1.55E-04	0.012
2992	5907	687	4.2	0.010	0.000	0.004	0.000	3.66E-05	0.005
2890	9533	1106	4.2	0.006	0.000	0.002	0.000	1.52E-05	0.003
2789	13633	1580	4.2	0.004	0.0001	0.0012	0.0001	7.86E-06	0.002
2688	17990	2081	4.2	0.003	0.0001	0.0007	0.0001	4.69E-06	0.001
2577	22817	2633	4.2	0.002	0.0000	0.0005	0.0000	3.01E-06	0.001
2566	23278	2686	4.2	0.002	0.0000	0.0004	0.0000	2.90E-06	0.001
2523	26665	3072	4.1	0.002	0.0000	0.0003	0.0000	2.24E-06	0.001
Difference									
3503	330%	347%	9%	80%	97%	83%	96%	96%	82%
3490	305%	320%	8%	78%	97%	82%	96%	96%	81%
3409	227%	240%	7%	73%	94%	78%	93%	94%	76%
3302	260%	274%	7%	75%	95%	80%	94%	95%	78%
3198	626%	654%	12%	88%	99%	91%	99%	99%	90%
3102	1961%	2037%	17%	96%	100%	97%	100%	100%	97%
2992	4072%	4214%	18%	98%	100%	99%	100%	100%	99%
2890	6037%	6229%	19%	99%	100%	99%	100%	100%	99%
2789	7849%	8076%	18%	99%	100%	100%	100%	100%	99%
2688	9400%	9648%	18%	99%	100%	100%	100%	100%	100%
2577	10778%	11037%	17%	100%	100%	100%	100%	100%	100%
2566	10894%	11154%	17%	100%	100%	100%	100%	100%	100%
2523	11680%	11941%	17%	100%	100%	100%	100%	100%	100%

## Case #20 – SG-A

This file contains two brines, one gas, two oils, one scale tendency, and one facility. The scale scenario and Facilities results were similar with one exception. The StudioSC Facilities dropped the solids from block 1 to 2, which was not the case in the ScaleChem STd object. However, if you look at the ScaleChem Std facility, you will notice that the user selected drop solids for the Oil phase and not for the water.

When the Solids removal button is deselected in StudioSC, then the results are still different. It appears that this facility object in StudioSC continues to remove the solid phase. However, the results do not indicate that the solids were removed in any way. This has been submitted to OLI.



The brines and gas analyses are similar between ScaleChem Std and Studio SC. Their results are not presented.

## ScaleChem Std Screen – Oil Analysis

**Settings** –Pure/Pseudo Comp, Water saturation, density not set

Oil Analysis Data - CVT\_BCres

Description | Hydrocarbons | Reconciliations | H2O Saturation | Summary |

View Selected Components

☒ Hydrocarbons (C1-C40)  
☒ Inorganics  
☒ Assay and Pseudo Components

Display  
☐ by Formula  
☒ by Name

☒ Show non-zero values only

	Component	Mole %
3	Propane	4.216
4	i-Butane	0.667
5	n-Butane	1.797
6	i-Pentane	0.657
7	n-Pentane	0.920
8	Water	0.047
9	Nitrogen	0.307
10	Carbon dioxide	1.816
11	C6	1.309
12	C7	2.440
13	C8	2.947
14	C9	0.855
15	C1015	21.098
16	C1620	0.000
17	C2127	0.000
18	C2837	0.000

Specific Gravity: 1.000      Total Mole %: 100.000

Description | Hydrocarbons | Reconciliations | H2O Saturation | Summary |

Saturate with H2O, at Conditions

T, °F: 77.0  
P, psia: 14.696  
Saturated Value: 0.046906 Mole %

Enter conditions, an optional output name, and press Calculate.

## Studio ScaleChem Screen – Oil Analysis

**Settings** – Pure/Pseudo Comp., no Water Sat

CVT\_BCres

Description | Design | Definition | Report

Component Value Normalized

Normalized Inflows: 71.35 (mole %)

H2O	0.0468	0.0468459
CH4	54.242	54.2418
C2H6	6.6835	6.68348
C3H8	4.2162	4.21619
C4H10	0.6667	0.666728
C4H10	1.7965	1.79649
C5H12	0.6566	0.656638
C5H12	0.9199	0.919907
N2	0.3066	0.306639
CO2	1.8156	1.81559

Normalized Pseudocomponents: 28.65 (mole %)

C1015	21.098	21.0979
C6	1.3093	1.30930
C7	2.4400	2.43999
C8	2.9473	2.94729
C9	0.8553	0.855347

Component Value

C1015	21.0980
C1620	0.0
C2127	0.0
C2837	0.0
C3880	0.0
C6	1.30930
C7	2.44000
C8	2.94730
C9	0.855350
Thermo Method	API-5
Normal Boiling Point (°F)	32.0000
Specific Gravity	0.785000
Molecular Weight	118.100

Entry Options  
Units: mole %  
Display: Formula  
☒ Show Non-zero Only  
☒ Show Normalized Column

Template Manager  
Last Applied: None  
AJ-PC  
Save as...

Normalize Options  
Type: Prorate

Entry Options  
Units: mole %  
Display: Formula  
☐ Show Non-zero Only

CVT\_BCres

Description | Design | Report

Component Normalized Reconciled O

Normalized Inflows: 71.35 (mole %)

H2O	0.0468459	0.0469056
CH4	54.2418	0.360491
C2H6	6.68348	0.274622
C3H8	4.21619	0.623575
C4H10	0.666728	0.230956
C4H10	1.79649	0.880203
C5H12	0.656638	0.679571
C5H12	0.919907	1.16177
N2	0.306639	6.53910e-4
CO2	1.81559	0.0583328

Normalized Pseudocomponents: 28.65 (mole %)

C1015	21.0979	74.5240
C6	1.30930	2.56643
C7	2.43999	6.38710

Calculate

Condition  
Saturate With: H2O

Conditions	Value
Temperature (°F)	77.0000
Pressure (psia)	14.6960

☒ Show Non-zero Only

Boiling Point Curve  
Add boiling point curve

Saturated H2O Amount:  
0.0469056 mole %

## Scale Scenario – BC-Interstage Heater

One brine, one gas, one condition, no precipitates,

Scaling Scenario - BC\_Interstage\_heater\_2014

Description Components Conditions Precipitates Calculate Results				
Input				
Type	Name	Amount	Units	
Brine	BC_2014_satWat	1077.900	bbl/day	Add
Oil	BC_2014_satOil	230910.000	bbl/day	Remove

## Scale Scenario – BC-Interstage Heater

One brine, one gas, one condition, no precipitates,

BC\_Interstage\_heater\_2014

Description Design Plot Report File View			
Inlets	Type	Name	Flow
	Brine (bbl/day)	BC_2014_satW	1077.90
	Oil (bbl/day)	BC_2014_satOil	2.30910e5
	<select>		
Inlets	Location	Temperat	Pressure
	surface	293.000	386.000
	<Enter Location Name		

Notes – The results are the same there is little difference between the two cases

pH:	5.2	5.205
Ionic Strength:	2.0487	0.0344
Brine Density:	1.013	1.01275 g/cc
Oil Density:	0.197	0.197 g/cc
Brine Flow:	1077.9	1077.9 bbl/day
Gas Flow:	0	0 kscf/day
Oil Flow:	2.31E+05	2.31E+05 bbl/day
Components	Oil Mole %	Components %
H2O	1.92052	H2O 1.92%
C2H6	6.10161	C2H6 6.10%
C3H8	3.15661	C3H8 3.16%
C4H10	1.10239	C4H10 1.10%
C5H12	0.480691	C5H12 0.48%
C6H14	0.329681	C6H14 0.33%
C6	0.254029	C6 0.25%
C7	0.473408	C7 0.47%
C8	0.571828	C8 0.57%
C9	0.16596	C9 0.17%
CH4	78.1562	CH4 78.16%
CO2	2.336	CO2 2.34%
C1015	4.0934	C1015 4.09%
HCL	1.54E-08	HCL 0.00%
IPENTAN	0.357691	IPENTAN 0.36%
ISOBUTANE	0.440461	ISOBUTANE 4.40E-03
N2	5.96E-02	N2 0.06%
Scale Mineral	Maximum Scale	
	pre-scaling	pre-scaling
NACL	0.0211	NaCl 0.021139
CACO3	1.0002	CaCO3 0.999901
KCL	0.014	KCl 0.014019
MGOH2	0.0006	Mg(OH)2 5.98E-04
SRCO3	0.0965	SrCO3 0.097
BACO3	0.0036	BaCO3 3.64E-03

## Facilities – BC\_Sinj\_2010-17yrSpec\_Copy

Two nodes, one brine, and one gas

**Nodes**

#	Node Name	Description	T, °F	P, bar	Ready
1	Node1		293.0	386.0	<input checked="" type="checkbox"/>
2	Node2		293.0	386.0	<input checked="" type="checkbox"/>

**Node1 Inlets**

Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	Units
Brine	BC_sat_wat	1701.000	bbl/day
Gas	Inj_Gas_SkA_2014	169884.000	kscf/day
Oil	CVT_BCres	19418.000	bbl/day

**Node2 Inlets**

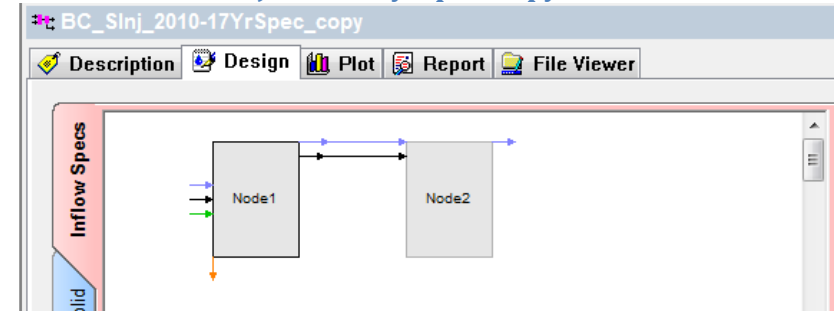
Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	Units
Brine from ...	Node1	Calculated	Carry solids
Oil from ...	Node1	Calculated	Drop solids

Case	CACO3 mg/l	CACO3-pST	pH
1	280.781	8.54	5.205
2	280.781	8.54	5.205

Notes – the drop solids is turned on automatically in the Node 1. There is a drop solids in Oil from node, but this should not have affected the results. There are differences in the scale tendencies and scale mass.

## Facilities – BC\_Sinj\_2010-17yrSpec\_Copy



Conditions	Value
Temperature (°F)	293.0
Pressure (bar)	386.0

Type	Name	Flow
Brine (bbl/day)	BC_sat_wat	1701.00
Gas (Mft3/day)	Inj_Gas_SkA_2014	1.69884e5
Oil (bbl/day)	CVT_BCres	19418.0

Conditions	Value
Temperature (°F)	293.0
Pressure (bar)	386.0

Type	Name	Flow
Brine from (bbl/day)	Node1	Calculated
Oil from (bbl/day)	Node1	Calculated
<select>		

NODE	CACO3 mg/l	CACO3-pST	pH
1	271.5	8.19	5.21
2		8.19	5.21

## Case #22 – SW

This file contains a number of objects, and too many to discuss in detail. Instead, the saturation results will be presented in its own section (and table) and a select number of random facilities calculations will also be presented.

**Saturation Objects** - The saturating solids were not automatically selected in any of the eight saturation calculations. Also, several of the saturation calculations differed. The first saturation calculation differed significantly. This is the case in which gas, oil, brine were added. The remaining saturation calculations were brine only.

**Facilities Objects** – None of the facilities objects had solids selected. The solids selected in ScaleChem Std were not transferred during the importing step. Most of the calculations were similar. These calculations were either brine only and one was brine-oil. There were several calculations that differed significantly between the software. These calculations contained brine, gas, and oil inflows. They also had low brine flow rates.

ScaleChem - [Case #22]
File Wells Analyse
ScaleChem Objects
SW01
SW01
SW04
SW05
SW04
SW01\_sat
SW01\_sat
SW04\_sat
SW04\_sat\_oil
SW04\_sat\_gas
SW05
SW05\_sat
SW05\_satPA
SW06
SW05\_satPC
SW05\_satPC
SW06\_sat
SW07\_sat
SW06\_satb
SW06\_sat
SW05\_satPA\_oil
SW05\_satPC\_oil
SW07\_sat\_oil
SW06
SW06\_sat\_oil
SW08\_sat
SW08\_sat
SW08\_sat\_oil
SW01\_2001
SW01\_2003
SW01\_2005
SW01\_2007
SW01\_2008
SW01\_2009
SW01\_2010
SW01\_2011
SW01\_2012
SW01\_2013
SW01\_2001
SW01\_2003
SW01\_2005
SW01\_2007
SW01\_2008
SW01\_2009
SW01\_2010
SW01\_2011
SW01\_2012
SW01\_2013
SW01\_2014
SW04\_2003
SW04\_2004
SW04\_2005
SW04\_2006
SW05\_2010
SW05\_2011
SW05\_2012
SW05\_2013
SW05\_2014
SW05\_2015
SW06\_2004
SW06\_2005
SW06\_2008
SW06\_2009
SW07\_2002
SW07\_2004
SW07\_2006
SW07\_2008
SW07\_2010
SW07\_2012
SW07\_2014
SW07\_2016
SW07\_2018
SW08\_2002
SW08\_2004
SW08\_2010
SW08\_2012
SW08\_2014
SW08\_2016
SW08\_2018
SW01\_sat\_oil
SW01\_sat\_brine

Case #22 - SW\*
SW01\_2003
SW01\_2005
SW01\_2007
SW01\_2008
SW01\_2009
SW01\_2010
SW01\_2011
SW01\_2012
SW01\_2013
SW01\_2014
SW04\_2003
SW04\_2004
SW04\_2005
SW04\_2006
SW05\_2010
SW05\_2011
SW05\_2012
SW05\_2013
SW05\_2014
SW05\_2015
SW06\_2004
SW06\_2005
SW06\_2008
SW06\_2009
SW07\_2002
SW07\_2004
SW07\_2006
SW07\_2008
SW07\_2010
SW07\_2012
SW07\_2014
SW07\_2016
SW07\_2018
SW08\_2002
SW08\_2004
SW08\_2010
SW08\_2012
SW08\_2014
SW08\_2016
SW08\_2018
SW04

Case #22 - SW\*
Streams
SW01\_sat
SW04\_sat
SW05
SW05\_satPA
SW06
SW05\_satPC
SW07\_sat
SW06\_sat
SW08\_sat
SW01\_sat\_brine
SW01
SW041
SW04\_sat\_oil
SW05\_satPA\_oil
SW05\_satPC\_oil
SW07\_sat\_oil
SW061
SW06\_sat\_oil
SW08\_sat\_oil
SW01\_sat\_oil
SW011
SW051
SW04\_sat\_gas
SW01\_sat1
SW04\_sat1
SW05\_sat
SW05\_satPC1
SW06\_sat1
SW07\_sat1
SW06\_satb
SW08\_sat1



## Saturation calculation

There are eight saturation calculations. All inputs except for the saturating solids were converted properly. The results for the first saturation SW01, had significant difference because of hydrocarbon flow rate. This was forwarded to OLI for review. The remaining saturation calculations were similar.

Sat Object		Brine Vol	Oil Vol	Total Moles/hr	Na+1 (total)	Ca+2 (total)	HCO3-1	H2O in Oil	pH	CaCO3 added
SW01_sat	SC Std	54133	1.7e5	2.36e7	61682	17617	3.01	2.45	4.54	-292
	StudioSC	18887	1.57e7	9.40e8	176764	50888	n.r.	1.3	4.34	
SW04_sat	SC Std	1057	...	3.66e5	63181	18018	454.2	...	5.0	-366
	StudioSC	1057		3.66e5	63167	18021	463.6	...	5.0	
SW05_sat	SC Std	1054.8	...	3.66e5	58531	21457	641	...	4.82	-421
	StudioSC	1054.8	...	3.66e5	58660	21514	665.5		4.78	
SW06_sat	SC Std	1075.6	...	3.66e5	62084	17704	445	...	4.92	-362
	StudioSC	1075.7	...	3.66e5	62076	17849	454.4	...	4.8	
SW07_sat	SC Std	1093	...	3.66e5	61088	17420	437	...	4.87	-357
	StudioSC	1093.2	...	3.66e5	61077	17563	446.6	...	4.87	
SW08_sat	SC Std	1087	...	3.66e5	61431	17518	440	...	4.88	-357
	StudioSC	1087	...	3.66e5	61420	17661	450.2	...	4.87	

## Facilities Calculation

There are fifty facility calculations in the ScaleChem file and the first fifteen facilities were computed. There was little difference for most of the facility objects. However, several of them produced significant differences;

- 1) Some of the ScaleChem Std facilities did not converge
- 2) Some of the ScaleChem Std facilities predicted NaCl solids.
- 3) Several of the downstream nodes in the same facility were missing the CaCO<sub>3</sub> scale mass. This is similar to what was observed in Case #20.

Secondly, none of the scales selected for precipitation in the ScaleChem facilities objects were imported to the StudioSC objects. Therefore, users would need to check to be sure that these scales are selected before running the calculation.

c

## ScaleChem Std Screen – Facilities

Facilities Scaling - SW01\_2001

Description | Node Manager | Precipitates | Calculate | Results

Nodes

#	Node Name	Description	T, °C	P, psia	Ready
1	Node1	Reservoir	180.0	14976	<input checked="" type="checkbox"/>
2	Node2	Tubing Head	144.0	9106.0	<input checked="" type="checkbox"/>
3	Node3	Flowline	142.0	1305.0	<input checked="" type="checkbox"/>

Add Remove Units

Node1 Inlets

Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	
Brine	SW01_sat	5.000	bbl/day

Add Remove

Node2 Inlets

Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	
Brine from ...	Node1	Calculated	Carry soli...
Gas from ...	Node1	Calculated	Carry solids
Oil from ...	Node1	Calculated	Carry solids

Add Remove Units

Node3 Inlets

Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	
Brine from ...	Node2	Calculated	Carry soli...
Gas from ...	Node2	Calculated	Carry solids
Oil from ...	Node2	Calculated	Carry solids

Add Remove Units

## Studio ScaleChem Screen – Facilities

SW01\_2001

Description | Design | Plot | Report | File Viewer

Inflow Specs

Node Input

Node Name: Node1

☒ Separate Gas  
☒ Separate Oil  
☐ Drop Solids

Add Node Remove Node Rename Node

Conditions	Value
Temperature (°C)	180.0
Pressure (psia)	14976.3

Type	Name	Flow
Brine (bbl/day)	SW01_sat	5.00000
<select>		

Node Input

Node Name: Node2

☒ Separate Gas  
☒ Separate Oil  
☐ Drop Solids

Add Node Remove Node Rename Node

Conditions	Value
Temperature (°C)	144.0
Pressure (psia)	9106.0

Type	Name	Flow
Brine from (bbl/day)	Node1	Calculated
Gas from (Mft3/day)	Node1	Calculated
Oil from (bbl/day)	Node1	Calculated

Node Input

Node Name: Node3

☐ Separate Gas  
☐ Separate Oil  
☐ Drop Solids

Add Node Remove Node Rename Node

Conditions	Value
Temperature (°C)	142.0
Pressure (psia)	1305.0

Type	Name	Flow
Brine from (bbl/day)	Node2	Calculated
Gas from (Mft3/day)	Node2	Calculated
Oil from (bbl/day)	Node2	Calculated

Notes –

Description | Node Manager | Precipitates | Calculate | Results

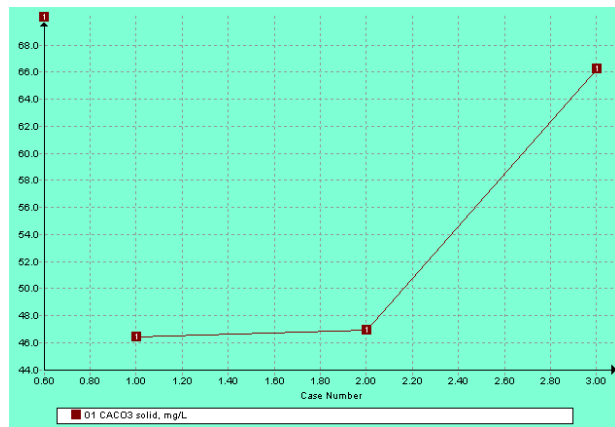
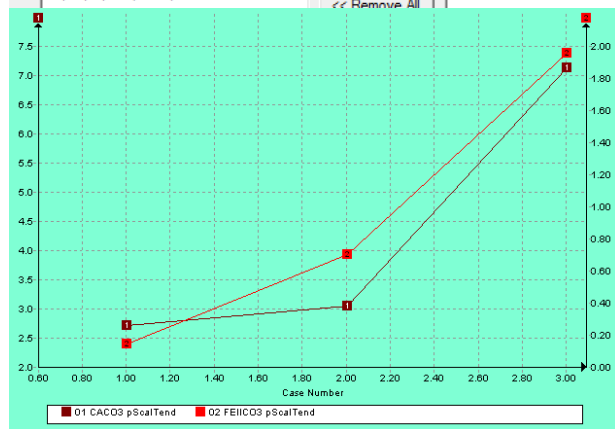
Available precipitates:
 

- FeS (Mackinawite)
- KCl (Sylvite)
- Mg(OH)2 (Pyrochroite)
- CaCl2
- CaCl2.1H2O
- CaCl2.2H2O
- CaCl2.4H2O
- CaCl2.6H2O
- SrCO3 (Strontianite)
- BaCO3 (Witherite)
- Fe(OH)2 (amorphous)

Chosen precipitates:
 

- CaCO3 (Calcite)
- NaCl (Halite)
- FeS (Pyrrhotite)
- FeCO3 (Siderite)

Add >>  
 Add All >>  
 << Remove  
 << Remove All



SW01\_2001

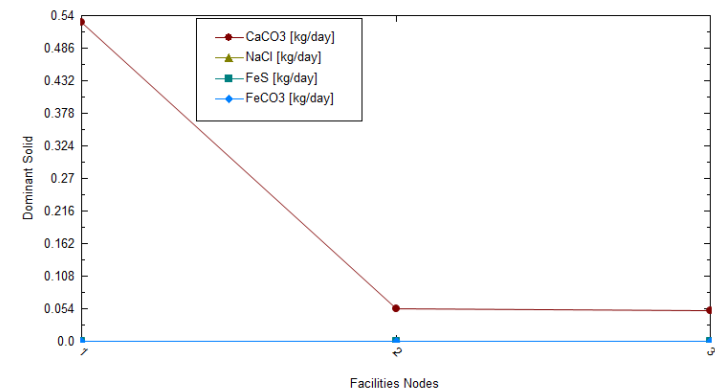
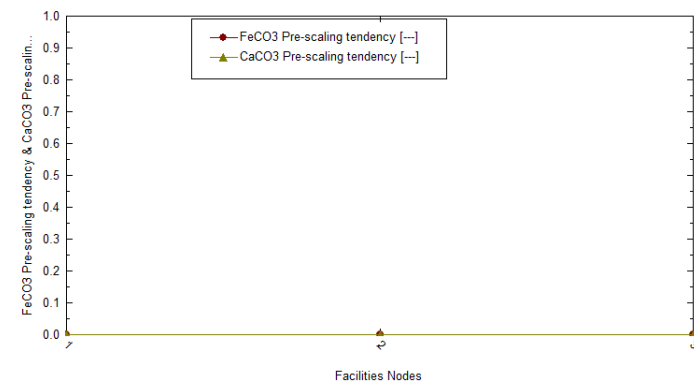
Description | Design | Plot | Report | File Viewer

Inflow Specs

Solid

Solids Selection
 

- ☒ Standard
  - ☐ CaSO4.2H2O
  - ☒ FeCO3
  - ☐ SrSO4
  - ☐ BaSO4
  - ☒ CaSO4
  - ☒ CaCO3
  - ☒ NaCl
  - ☒ FeS



Facilities Scaling - SW01\_2003

Description Node Manager Precipitates Calculate Results

Nodes

#	Node Name	Description	T, °C	P, psia	Ready
1	Node1	Reservoir	175.0	9259.3	<input checked="" type="checkbox"/>
2	Node2	Tubing Head	175.0	9259.3	<input checked="" type="checkbox"/>
3	Node3	Flowline	134.89	1305.0	<input checked="" type="checkbox"/>

Add Remove Units

Node1 Inlets

Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	
Brine	SW01_sat_brine	500.000	bbl/day
Oil	SW04_sat_oil	20000.000	bbl/day

Add Remove

Node2 Inlets

Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	
Brine from...	Node1	Calculated	Drop solids
Gas from ...	Node1	Calculated	Drop solids
Oil from ...	Node1	Calculated	Drop solids

Add Remove Units

Node3 Inlets

Select one or more brines, oils or gases as input(s) to this node.

Type	Name	Amount	
Brine from...	Node2	Calculated	Carry soli...
Gas from ...	Node2	Calculated	Carry solids
Oil from ...	Node2	Calculated	Carry solids

Add Remove Units More...

SW01\_2003

Description Design Plot Report File Viewer

Inflow Specs

Node Input

Node Name Node1

☒ Separate Gas  
☒ Separate Oil  
☒ Drop Solids

Add Node Remove Node Rename Node

Conditions	Value
Temperature (°C)	175.0
Pressure (psia)	9259.29

Type	Name	Flow
Brine (bbl/day)	SW01_sat_brine	500.000
Oil (std bbl/day)	SW04_sat_oil	20000.0

Node Input

Node Name Node2

☒ Separate Gas  
☒ Separate Oil  
☐ Drop Solids

Add Node Remove Node Rename Node

Conditions	Value
Temperature (°C)	175.0
Pressure (psia)	9259.29

Type	Name	Flow
Brine from (bbl/day)	Node1	Calculated
Gas from (Mft3/day)	Node1	Calculated
Oil from (bbl/day)	Node1	Calculated

Node Input

Node Name Node3

☐ Separate Gas  
☐ Separate Oil  
☐ Drop Solids

Add Node Remove Node Rename Node

Conditions	Value
Temperature (°C)	134.89
Pressure (psia)	1305.0

Type	Name	Flow
Brine from (bbl/day)	Node2	Calculated
Gas from (Mft3/day)	Node2	Calculated
Oil from (bbl/day)	Node2	Calculated

Description | Node Manager | Precipitates | Calculate | Results

Available precipitates:
 

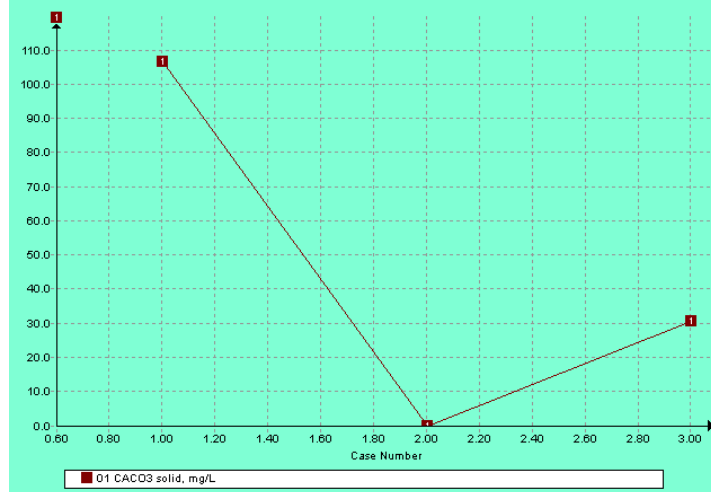
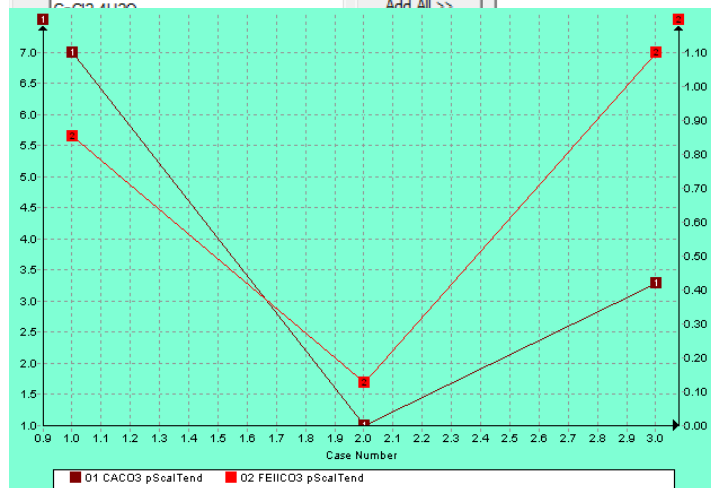
- FeS (Mackinawite)
- KCl (Sylvite)
- Mg(OH)2 (Pyrochroite)
- CaCl2
- CaCl2.1H2O
- CaCl2.2H2O
- CaCl2.4H2O

Chosen precipitates:
 

- CaCO3 (Calcite)
- NaCl (Halite)
- FeS (Pyrrhotite)
- FeCO3 (Siderite)

Add >>

Add All >>



Description | Design | Plot | Report | File Viewer

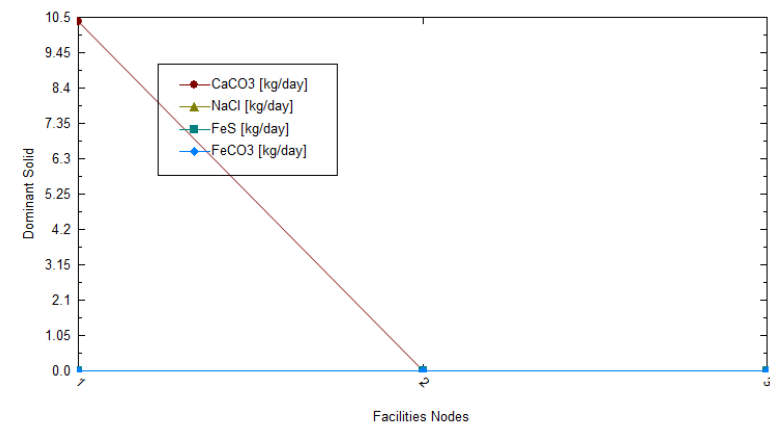
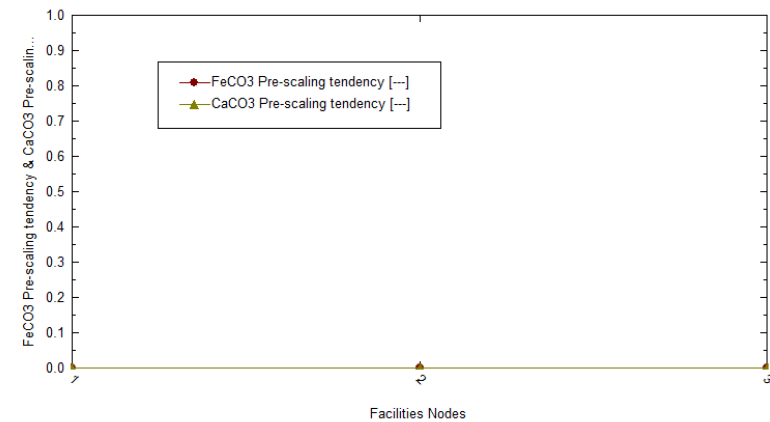
Inflow Specs

Solids Selection
 

- ☒ Standard
  - ☐ CaSO4.2H2O
  - ☒ FeCO3
  - ☐ SrSO4
  - ☐ BaSO4
  - ☐ CaSO4
  - ☒ CaCO3
  - ☒ NaCl
  - ☒ FeS

Summary
 

- Unit Se
- Base
- Facilitie
- Node S
- Calcula



### Results for the first ten facilities objects

		SCStd	SSC	
Facility object	Case	CACO3 (s), mg/l	CACO3(s), mg/l	Rel Diff
SW01_2001	1	46.379	46.3818	0%
	2	46.94	0	0%
	3	66.242	19.5	0%
SW01_2003	1	43.838	41.77	-192%
	2	0	0	0%
	3	35.01	33.74	1%
SW01_2005	1	56.043	56.0	0%
	2	62.52	5.1	0%
	3	61.538	0	0%
SW01_2007	1	59.111	59.1	0%
	2	61.004	0.25	0%
	3	60.332	0	0%
SW01_2008	1	60.1	60.1	0%
	2	61.004	0	0%
	3	60.332	0	0%
SW01_2009	1	60.852	60.8	0%
	2	52.502	0	0%
	3	50.499	0	0%
SW01_2010	1	61.435	61.4	0%
	2	52.502	0	0%
	3	50.499	0	0%
SW01_2011	1	61.841	61.8	0%
	2	52.502	0	0%
	3	50.499	0	0%
SW01_2012	1	61.804	61.8	0%
	2	52.502	0	0%
	3	50.499	0	0%
SW01_2013	1	62.067	62.1	0%
	2	42.16	0	0%
	3	39.404		0%
SW01_2014	1	61.698	61.7	0%
	2	42.16	0	0%
	3	39.404	0	0%

		SCStd	SSC	
Facility object	Case	NaCl (s) mg/l	NaCl (s), mg/l	Rel Diff
SW04_2003	1	0		
	2	0		
	3	35540		
SW04_2004	1	0	Did not	
	2	0	Converge	
	3	251508		
SW04_2005	1	0	Did not	
	2	43833	Converge	
	3	252591		
SW04_2006	1	0	Did not	
	2	31858	converge	
	3	221149		
SW05_2010	1	0	0	
	2	52.4, 94690 (NaCl)	130.9	150%
	3	0	0	
	4	0	0	
SW05_2011	1	0	13.6	
	2	68.9	137.5	
	3	0	0	
	4	0	0	
SW05_2012	1	Did Not	18.7	
	2	Converge	139.7	
	3		0	
	4		0	
SW05_2013	1	Did not	19.9	
	2	Converge	140.4	
	3		0	
	4		0	
SW05_2014	1	Did Not	20.1	
	2	Converge	140.7	
	3		0	
	4		0	
SW05_2015	1	0, (870805 nacl)	19.6	
	2	0, (1570000 nacl)	140.6	
	3	79.5, (595683 nacl)	0	
		74.9, (534528 NaCl)	0	

