AQSim
Aqueous Process Simulations

Solutions to water-based chemical processes

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973-998-0240

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

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 CO2 added to the brine in a CO2 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 H2O 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) **CaCO3 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

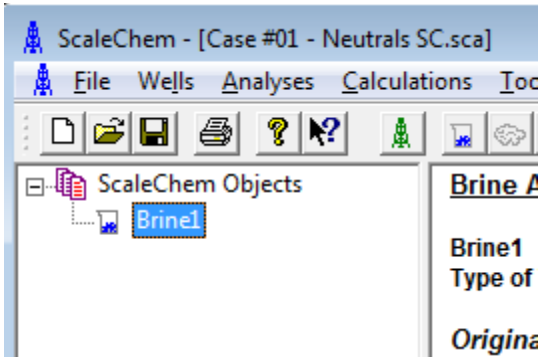
Contents

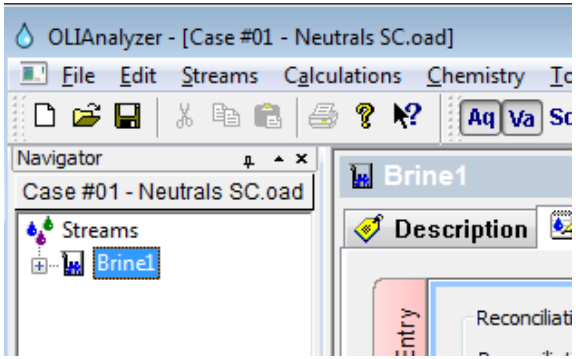
The following are the cases presented. They progress from simple to complex.

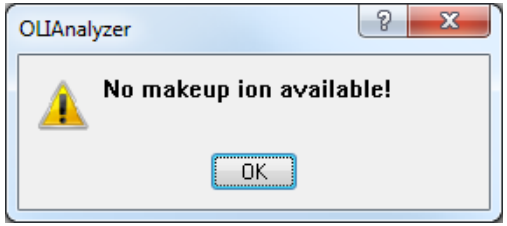
Case #1 –Neutrals SC

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.



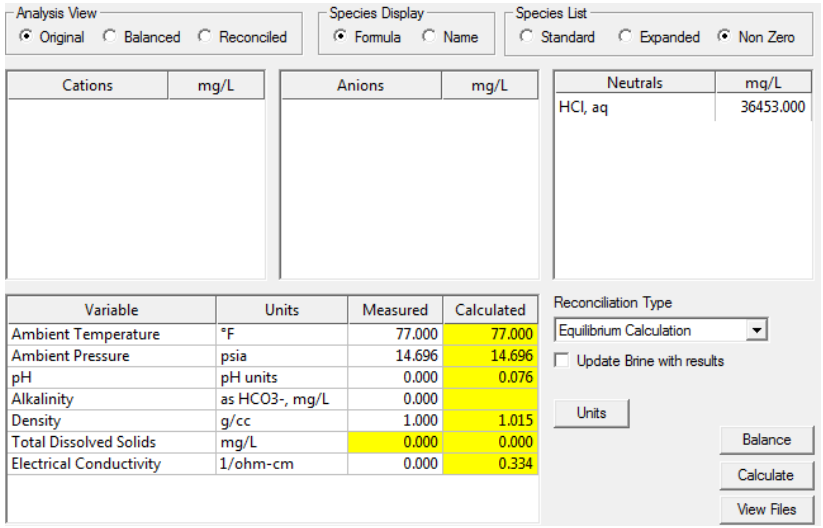




There is a warning in Studio ScaleChem that No makeup ion is available. This is because the water analysis contains neutral inflows only.

ScaleChem Std Screen – Brine Analysis

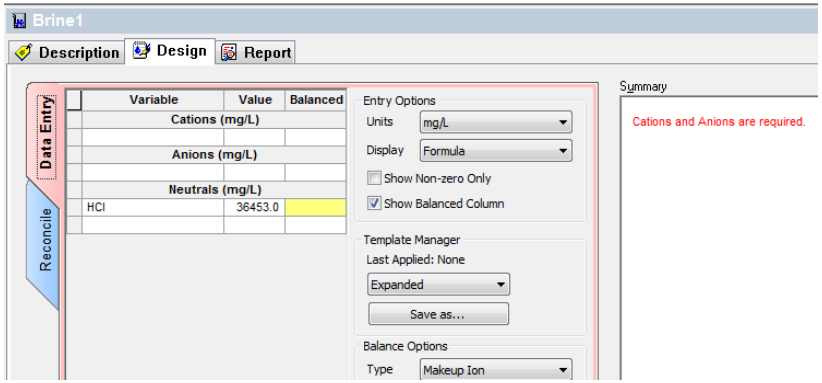
Settings – Non-Zero, Na/Cl balance, Equilibrium

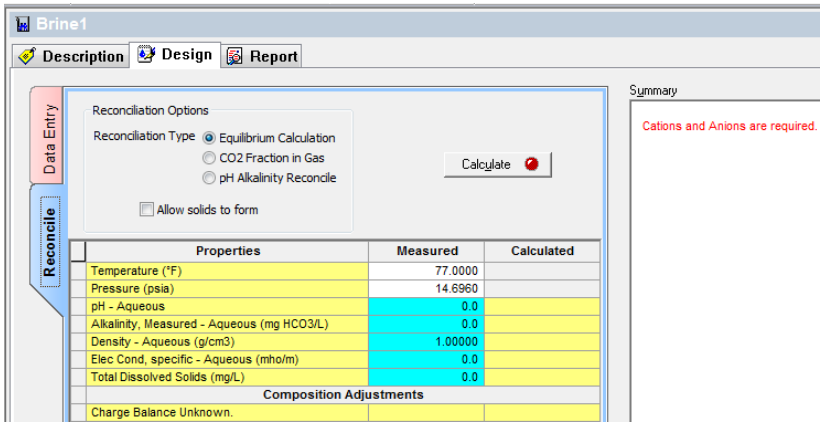


Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	0.076	0.0756	
Alk	0		
Balance ion	0		
Balance Value	0		
Density	1.01481	1.01481	
Saturated	---		

Studio ScaleChem Screen – Brine Analysis

Settings - Makeup Ion, Equilibrium



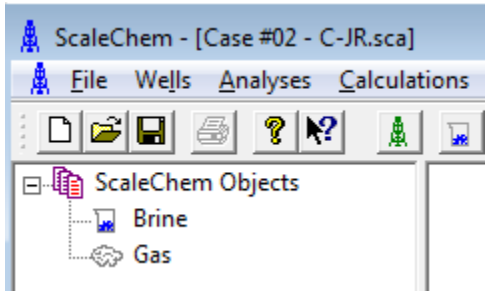


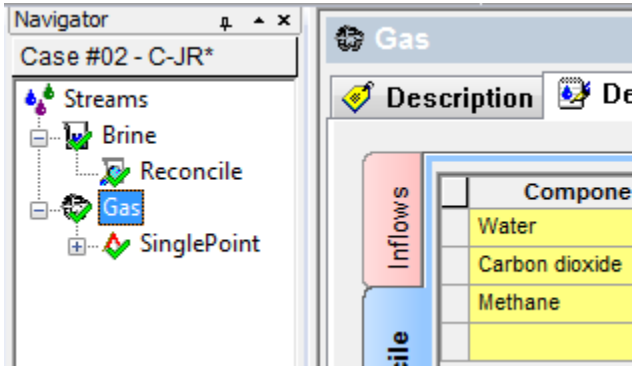
Notes – No makeup ion warning, Brine Analysis does not handle Molecular flows. Streams now do this. Calculations not possible.

Case #2 – CJ-R

Summary

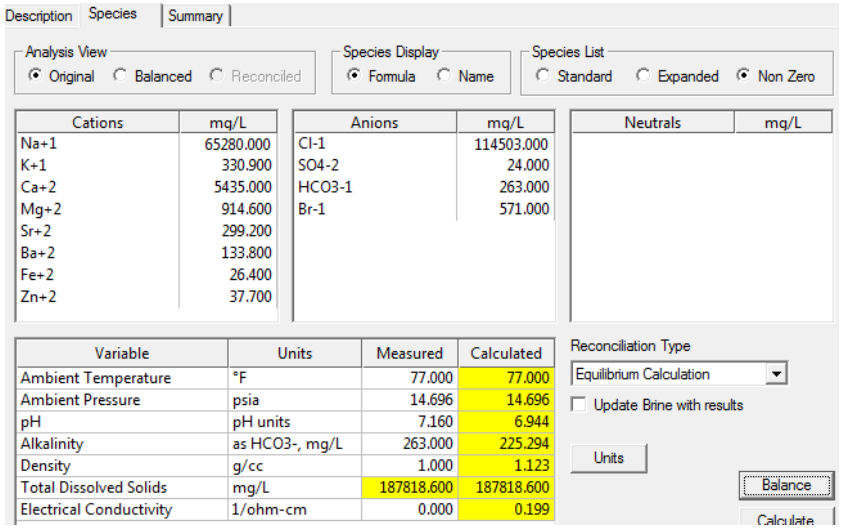
This case contains a water and gas analysis. Both are standard-type entries (nothing unique about the chemistry or conditions). The calculation results were the same except for Alkalinity, which varied by 5%. There was a difference in how the gas was handled. The Expanded gas template was on, and the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





ScaleChem Std Screen – Brine Analysis

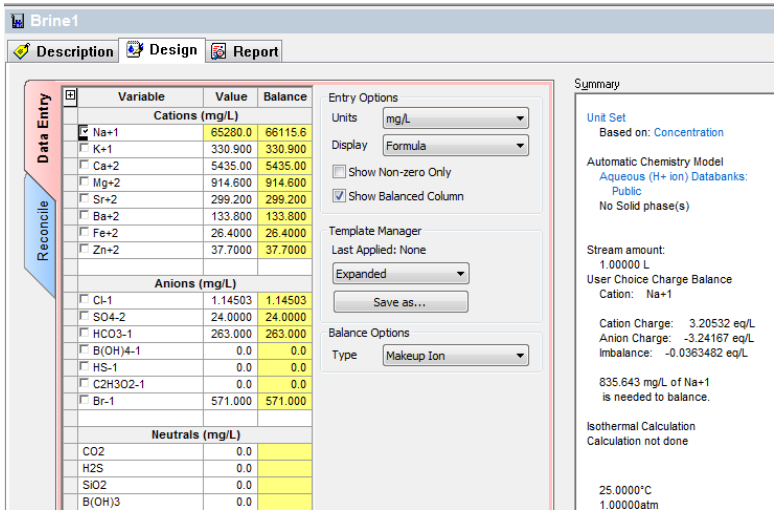
Settings - Non-zero List, Na/Cl balance, Equilibrium

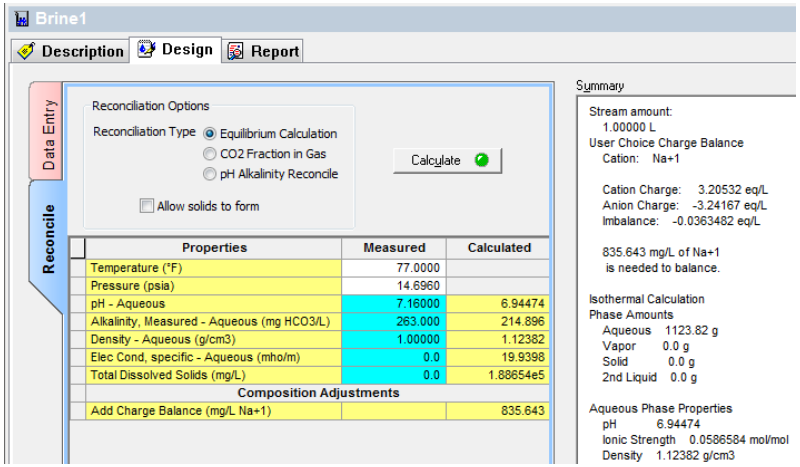


Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	6.944	6.944	
Alk	225.3	214.9	~4.8%
Balance ion	Na/Cl	Na/Cl	
Balance Value	835.6	835.6	
Density	1.123	1.124	
Saturated	CaCO3, BaSO4, FeCO3	CaCO3, BaSO4, FeCO3	

Studio ScaleChem Screen – Brine Analysis

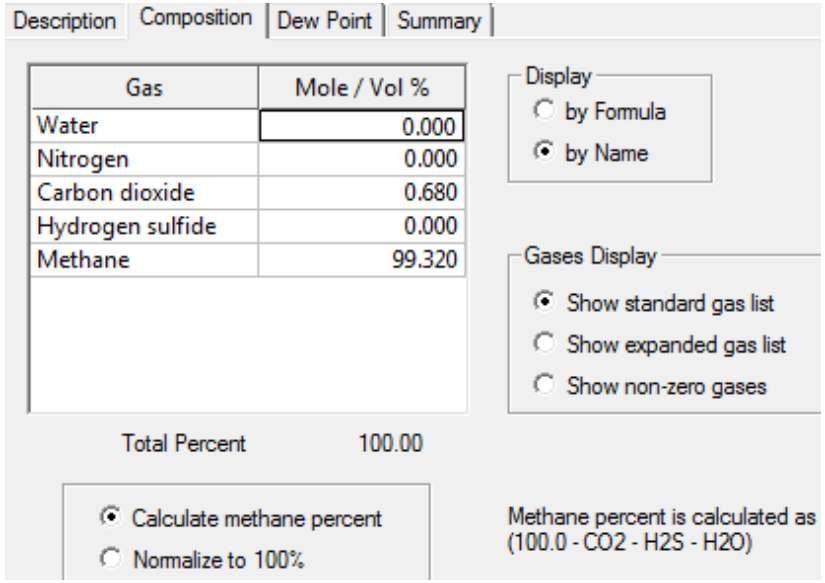
Settings - Expanded List, Makeup ion (Na+), Equilibrium

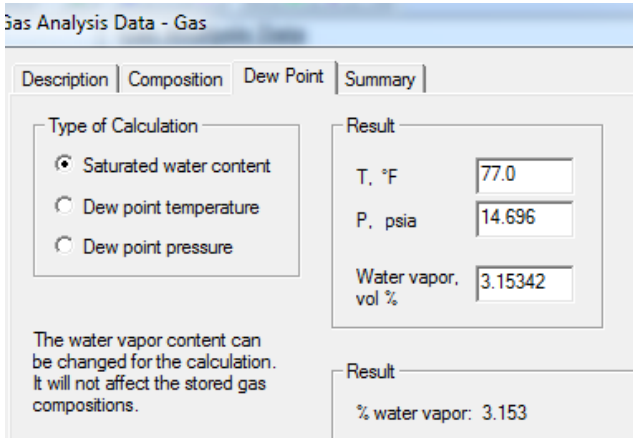




ScaleChem Std Screen – Gas Analysis

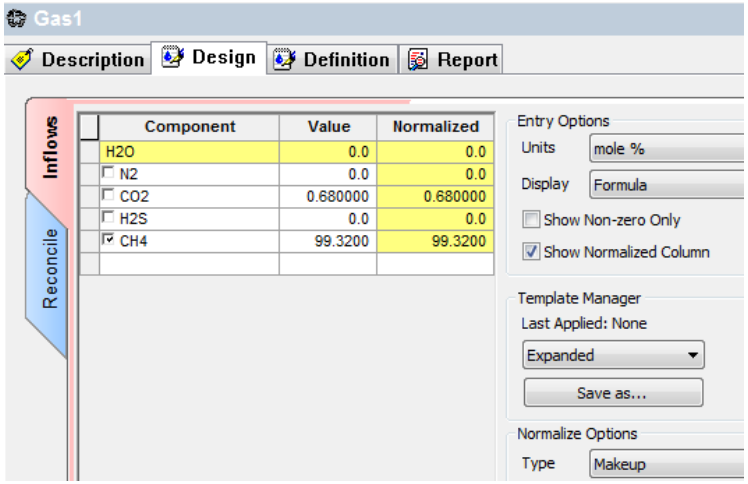
Settings - Standard Gas, Methane balance, H2O Saturation inactive

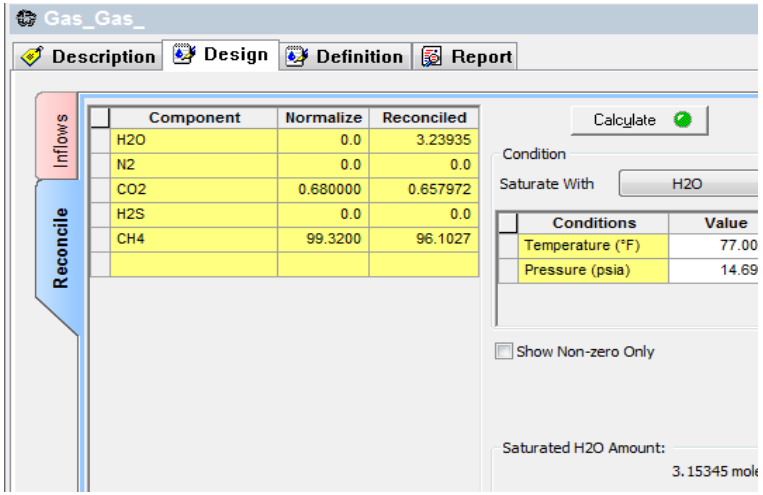




Studio ScaleChem Screen – Gas Analysis

Settings - Expanded Gas, Methane balance, H2O saturation active

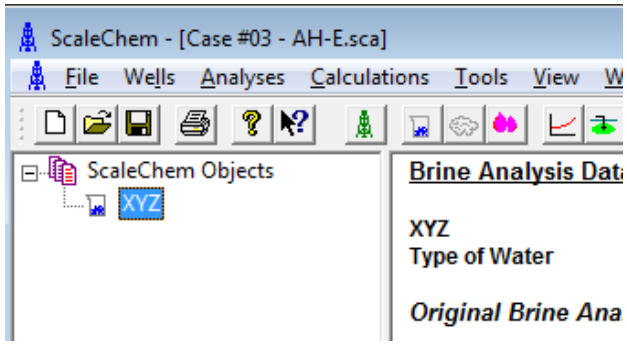


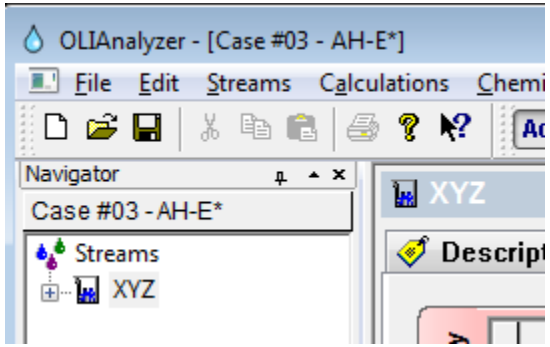


Case #3 – AH-E

Summary

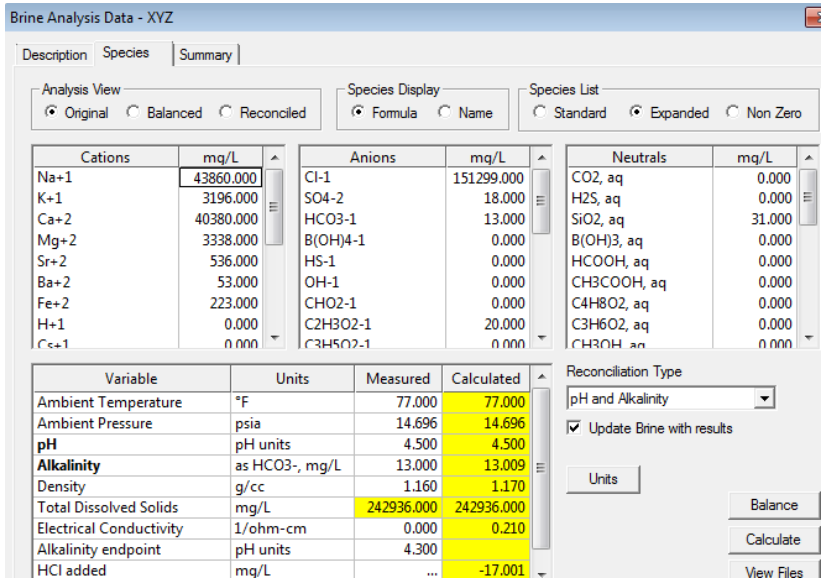
This file contains a single Brine analysis with a complex composition, and using the pH/Alkalinity reconciliation. StudioScaleChem computes the results with no problems. However, the ScaeChem Std software no longer computes this – an Unable to Reconcile result is obtained. The ScaleChem std problem will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





ScaleChem Std Screen – Brine Analysis

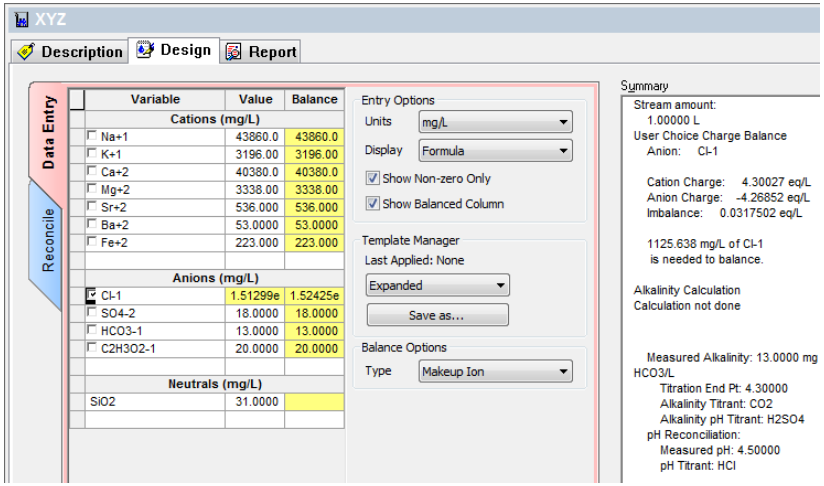
Settings - Expanded List, Na/Cl Balance, pH&Alkalinity

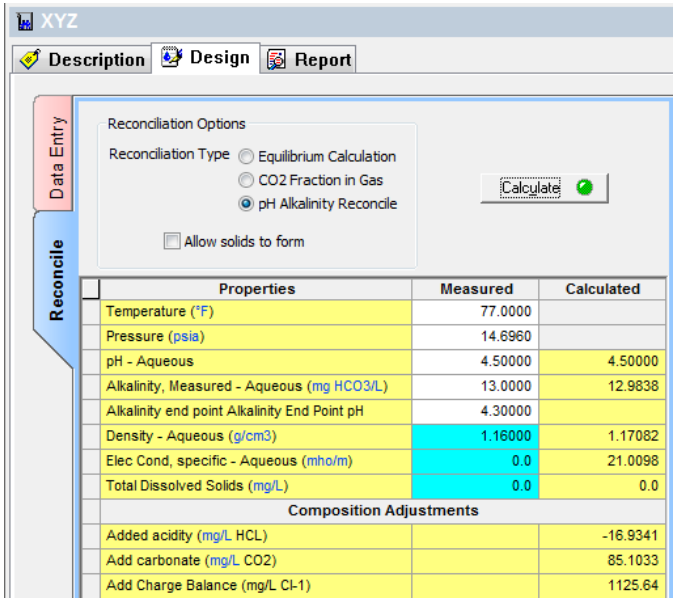


The brine no longer reconciles in the ScaleChem software. The screenshot above is from the original file, computed in an earlier version of ScaleChem std.

Studio ScaleChem Screen – Brine Analysis

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

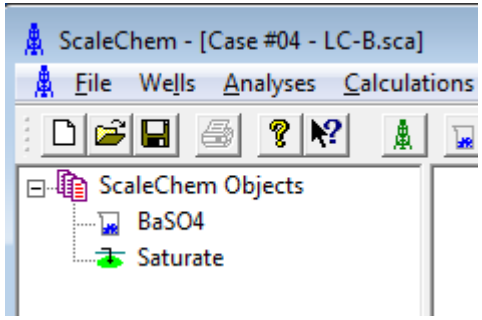


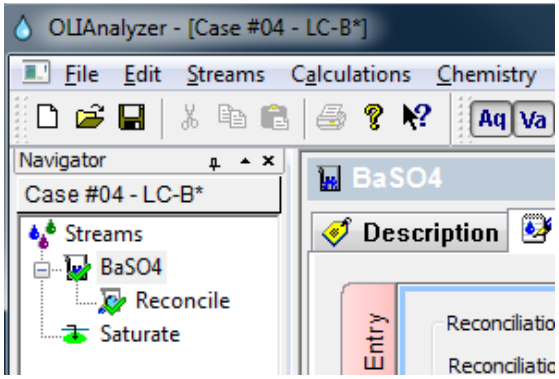


Case #4 – LC-B

Summary

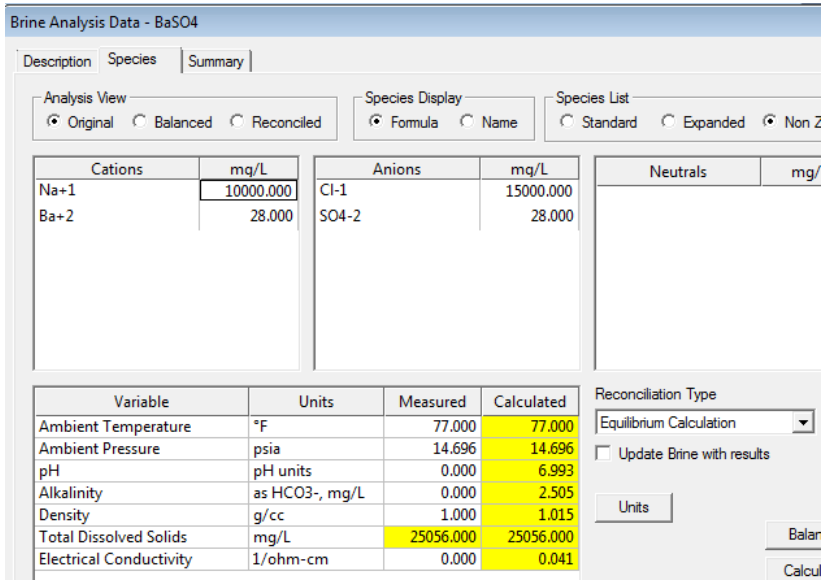
This file contains a single Brine Analysis and Saturation object. The brine analysis is basic, and the saturation calculation is being tested. Both software produced identical results. The amount of BaSO4 added is not reported in the Studio ScaleChem Report. This has been submitted to the developers. 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.





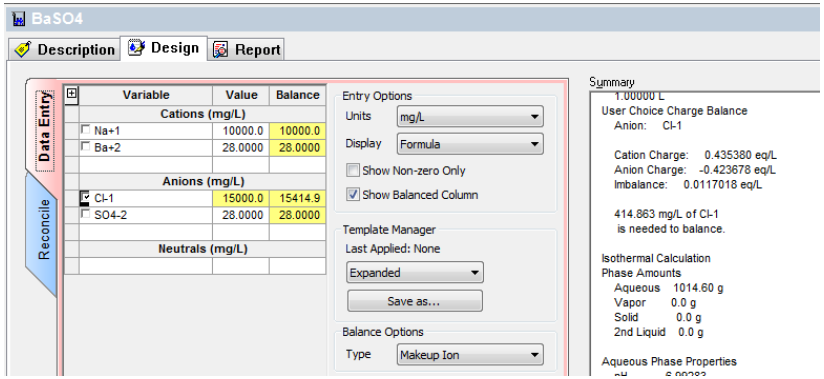
ScaleChem Std Screen – Brine Analysis

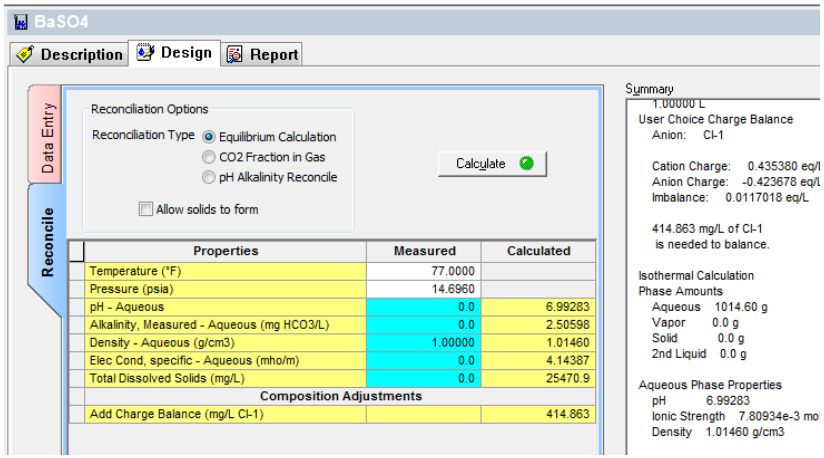
Settings - Non-zero List, Na/Cl Balance, Equilibrium



Studio ScaleChem Screen – Brine Analysis

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



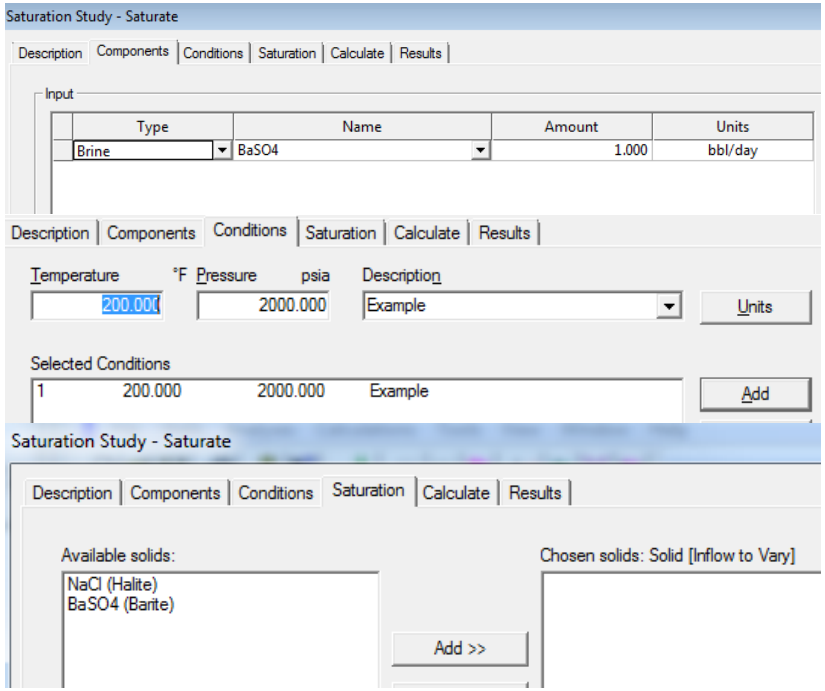


Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	6.993	6.993	
Alk	2.505	2.506	
Balance ion	Cl	Cl	
Balance Value	414.9	414.9	
Density	1.015	1.015	
Saturated	BaSO4	BaSO4	
Notes			

Notes –

ScaleChem Std Screen – Saturation

Settings –One Brine, One Condition, no Scales

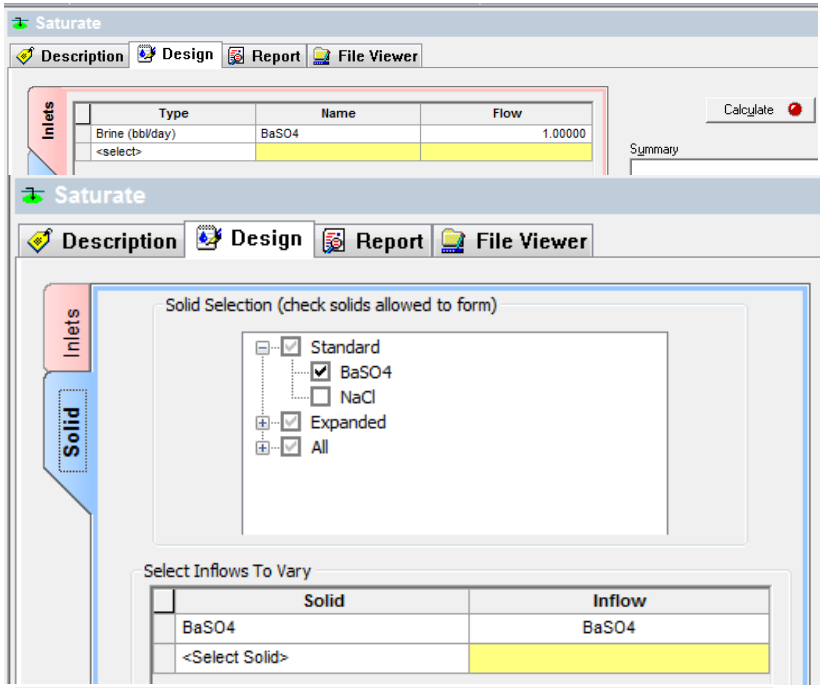


- No solids were selected in the ScaleChem Saturate
- Alkalinity is turned off in the ScaleChem.

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



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

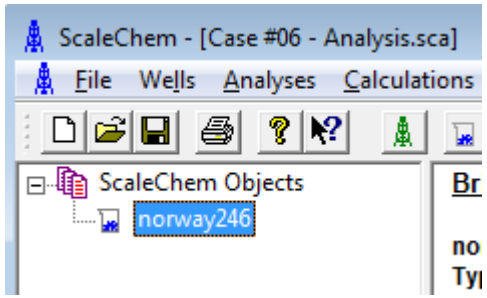
Cations	Value (mg/L)	Anions	Value (mg/L)	Neut
Na(+1)	9716.08	Cl(-1)	14977.2	
Ba(+2)	27.2050	SO4-2	27.2431	

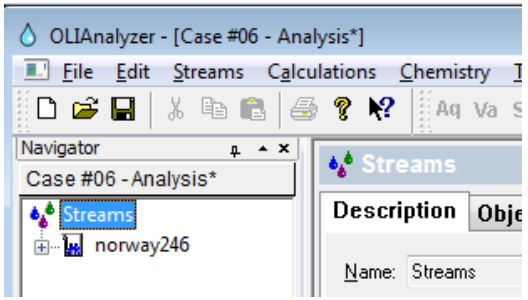
- No Alkalinity calculation is available in StudioSC Saturate
- BaSO4 does not automatically precipitate in StudioSC Saturate unless it is checked

Case #6 – Analysis

Summary

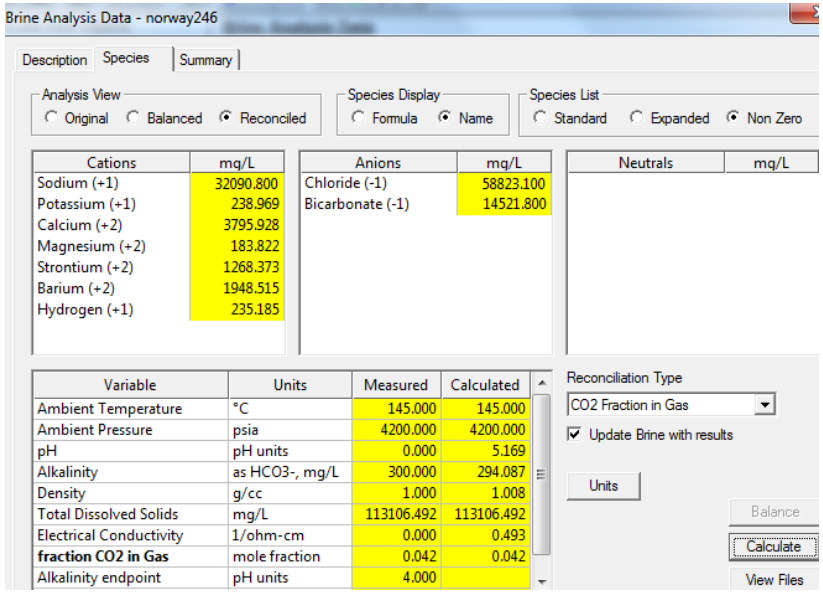
This file contains a single Brine Analysis that uses the CO2 Fraction in gas calculation. Studio SC and Sc Std produced similar results





ScaleChem Std Screen – Brine Analysis

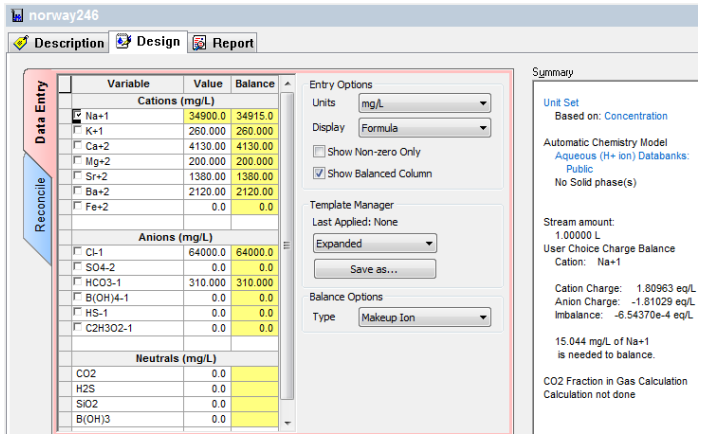
Settings - Expanded List, Na/Cl Balance, CO2 in Gas

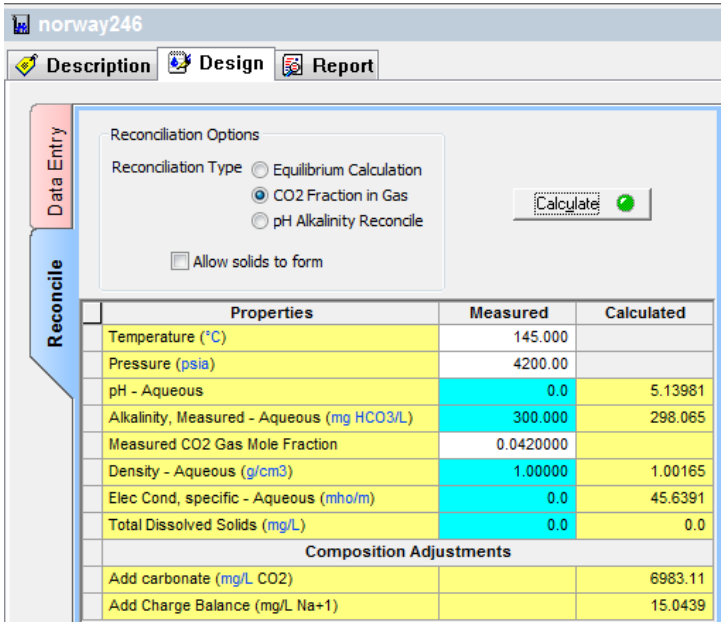


Variable	ScaleChem Std	Studio ScaleChem	% Difference
pH	5.17	5.14	
Alk	294.1	298.1	
Balance ion	Na+	Na+	
Balance Value	15..0	15.0	
Density	1.031	1.008	
Saturated	CaCO3, SrCO3	CaCO3, SrCO3	
Notes			

Studio ScaleChem Screen – Brine Analysis

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

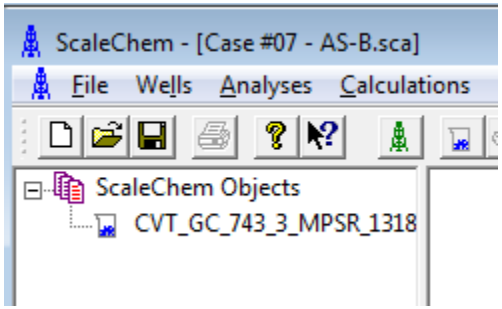


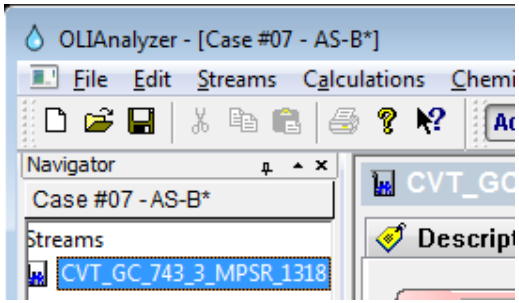


Case #7 – AS-B

Summary

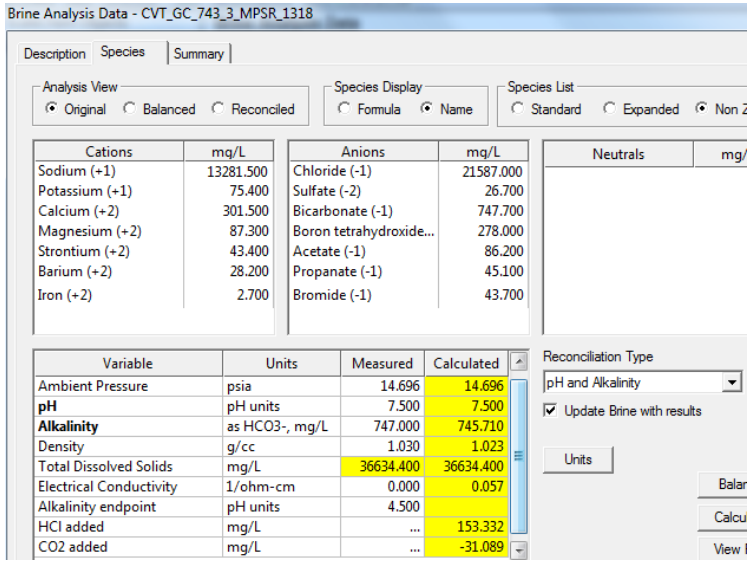
This file contains a single Brine Analysis using the pH/Alkalinity calculation. This is a duplication of a previous case, but is still presented because when tested in a previious beta-version, the pH/Alkalinity option was not selected. Also, since the above pH/Alk calculation did not work on ScaleChem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





ScaleChem Std Screen – Brine Analysis

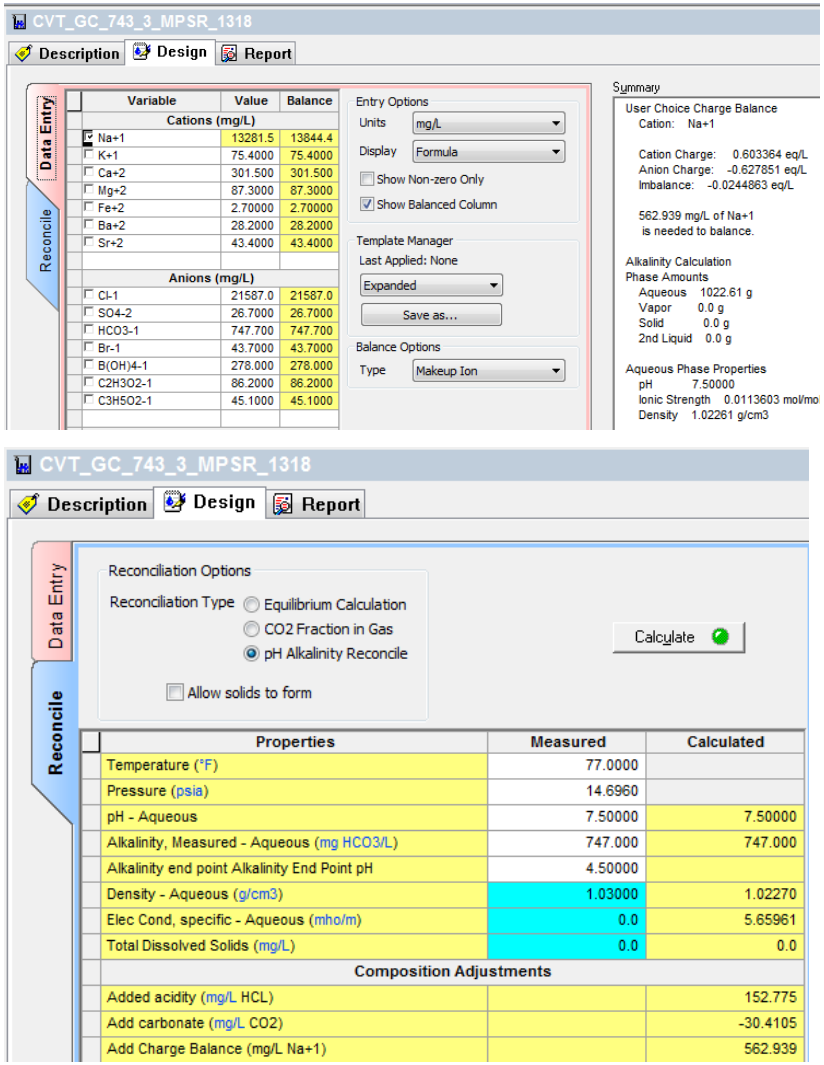
Settings - Non-zero List, Na/Cl Balance , pH&Alk Reconciliation



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	CaCO3, BaSO4, FeIICO3	CaCO3, BaSO4, FeCO3, SrCO3	
Notes			
HCl	153.3	152.8	0.3%
CO2	-31.1	-30.4	2.3%

Studio ScaleChem Screen – Brine Analysis

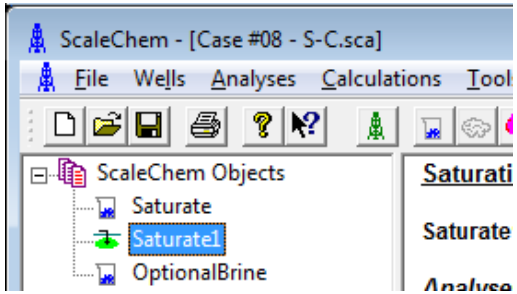
Settings - Expanded List, Makeup (Na+) BalancepH/Alkalinity

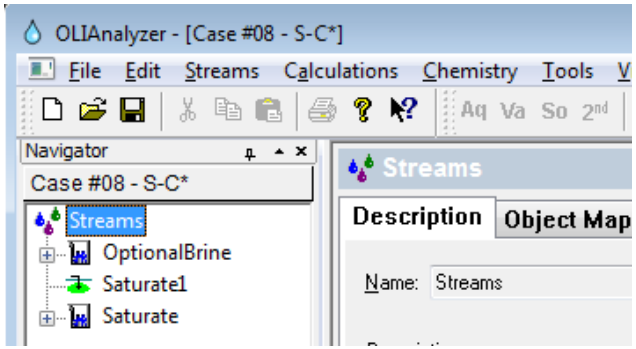


Case #8 – S-C

Summary

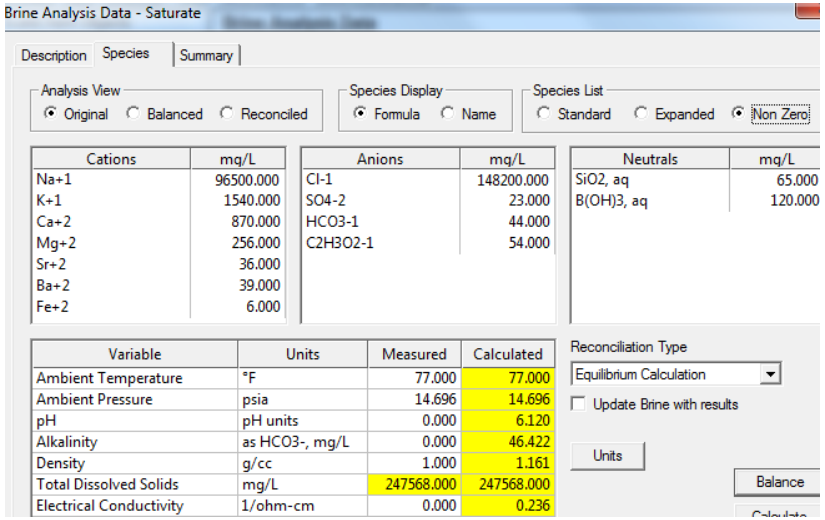
This case introduced the Optional Brine entry which is used in the ScaleScenario. The optional brine is no longer needed in StudioScaleChem This file contains One Brine Analysis, one Saturation, one Optional Brine (computed from Saturate), and one scale scenario. Also, the Advanced button is used in the Saturate, to adjust Na2SO4 and saturate BaSo4. 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.





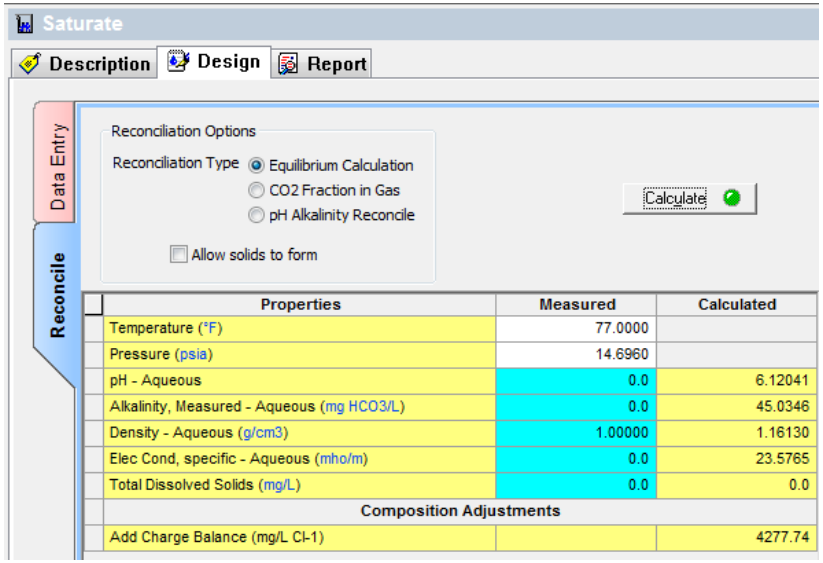
ScaleChem Std Screen – Brine Analysis

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



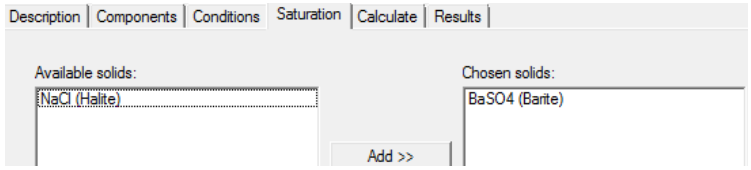
Studio ScaleChem Screen – Brine Analysis

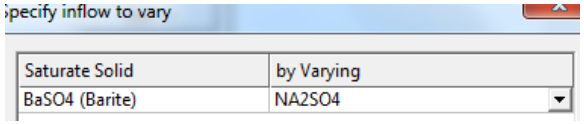
Settings - Expanded List, Na/Cl Balance, Equilibrium Reconciliation



ScaleChem Std Screen – Saturate

Settings – One Brine, One Condition, One Solid





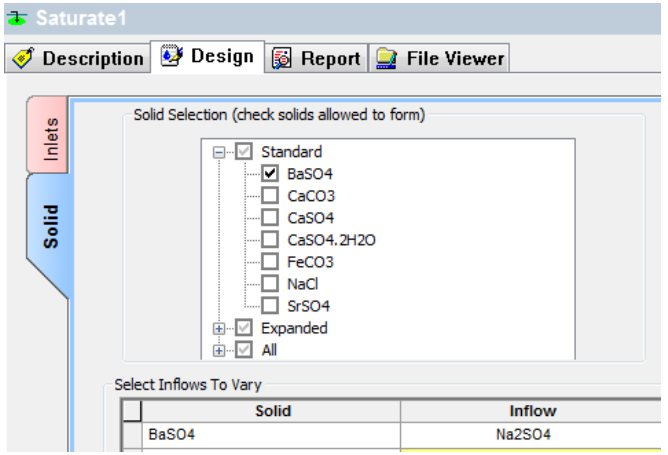
Scaling Tendencies and Solids - Point 1

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
FEIICO3	0.0	0.0000	0.2431
SIO2	0.0	0.0000	0.1309
KCL	0.0	0.0000	0.0030
MGOH2	0.0	0.0000	1.3348
SRCO3	0.0	0.0000	0.0452
BACO3	0.0	0.0000	0.0011
FEIIOH2	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	

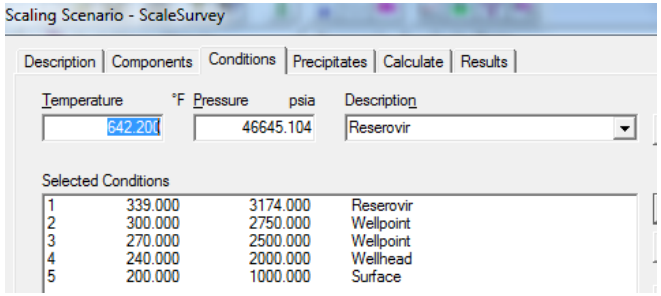
Studio ScaleChem Screen – Saturate

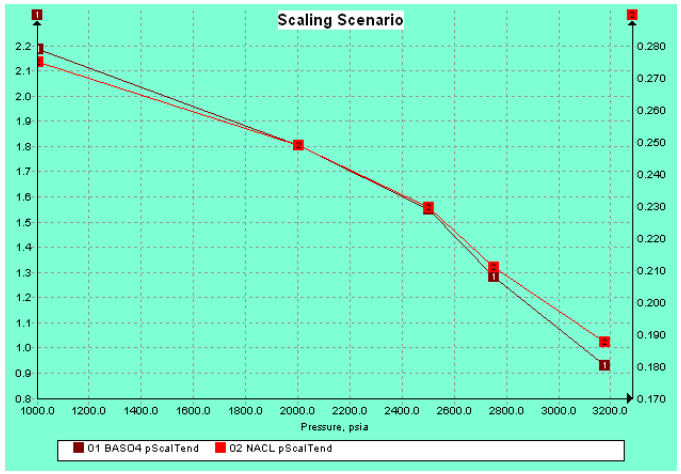
Settings - One Brine, One Condition, One Solid



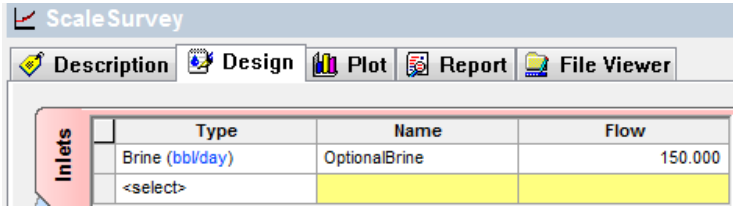
Scale Mineral	Max Scale	Pre-scaling
CaSO4.2H2O	0.0	1.13667e-3
FeCO3	0.0	0.261318
Fe(OH)2	0.0	0.0561120
SrSO4	0.0	2.70723e-3
SrCO3	0.0	0.0484794
BaSO4	3.23874e-4	1.00000
BaCO3	0.0	1.22582e-3
CaSO4	0.0	0.0308099
CaCO3	0.0	2.52624
Mg(OH)2	0.0	1.45111
SiO2	0.0	0.130858
NaCl	0.0	0.241320
KCl	0.0	3.03650e-3

ScaleChem Std Screen – Scale Scenario

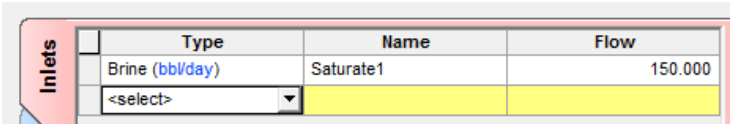


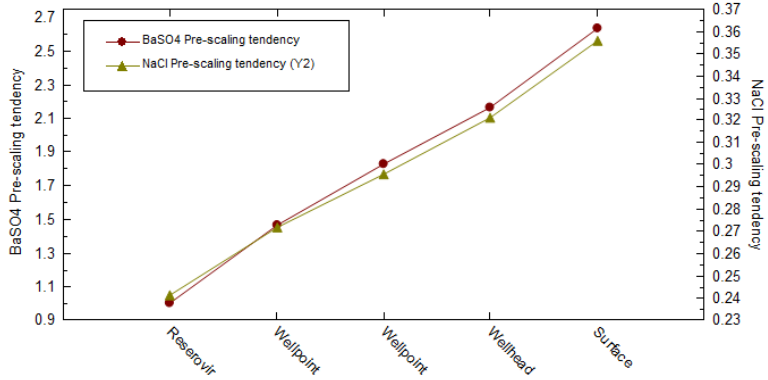


Studio ScaleChem Screen – Scale Scenario



Switch to

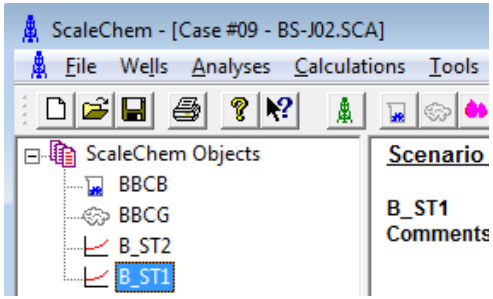


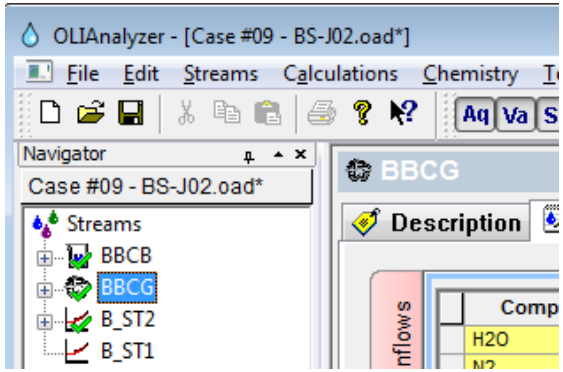


Case #9 – BS-J02

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.

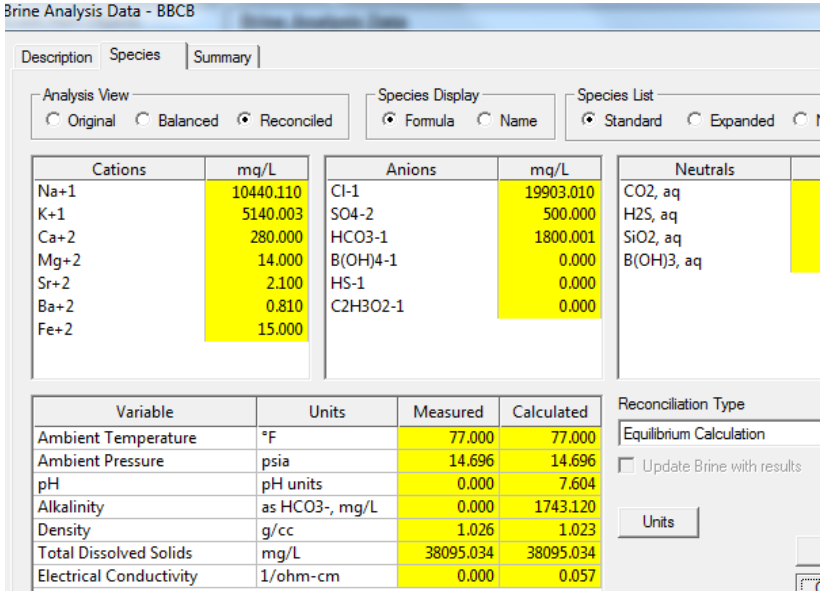
The second scale scenario, B_ST1 did not converge in Studio SC





ScaleChem Std Screen – Brine Analysis

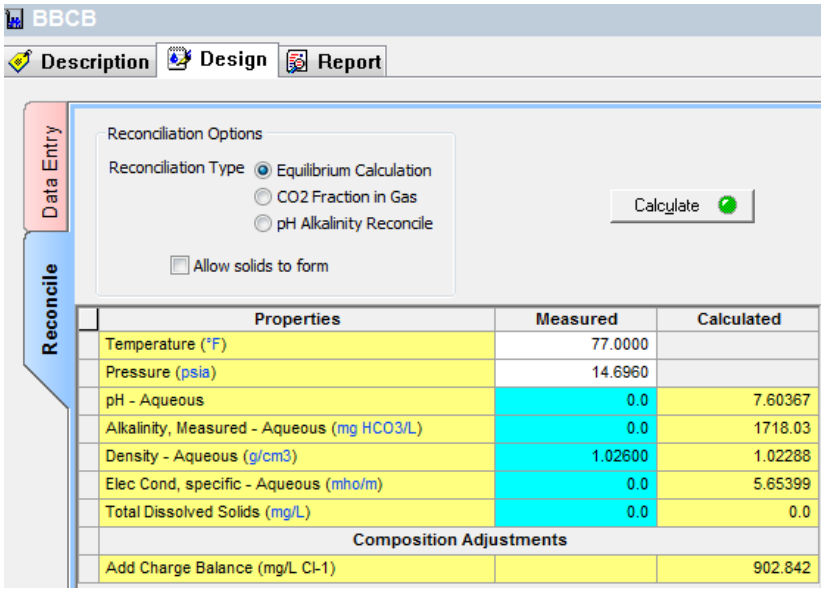
Settings – Standard List, Na/Cl Balance, Equilibrium



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

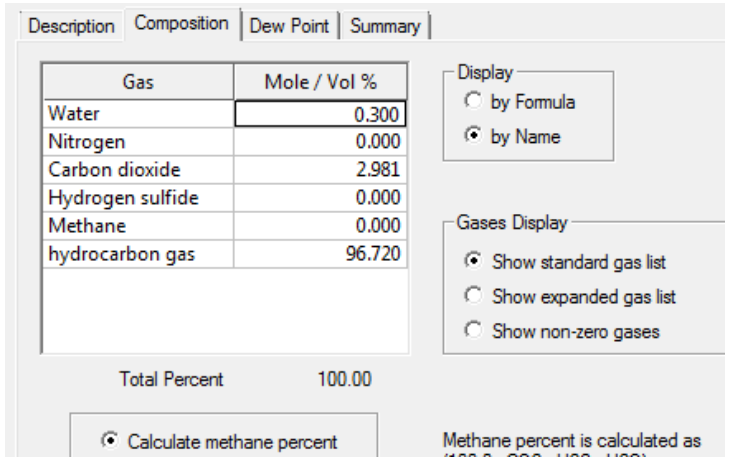
Settings - Expanded List, Na/Cl Balance, Equilibrium

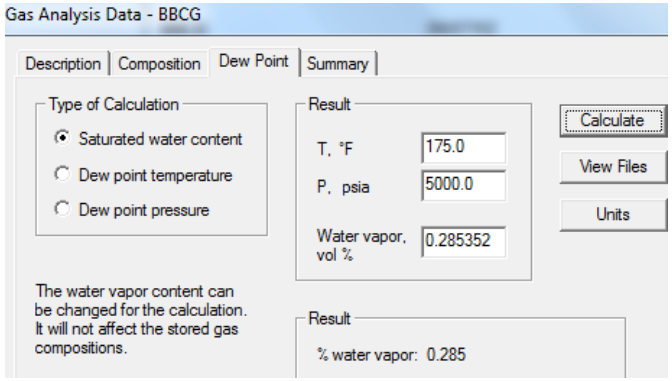


Notes – Na+ was removed instead of Cl- being added.

ScaleChem Std Screen – Gas Analysis

Settings – Standard gas, H2O Sat (no conditions)

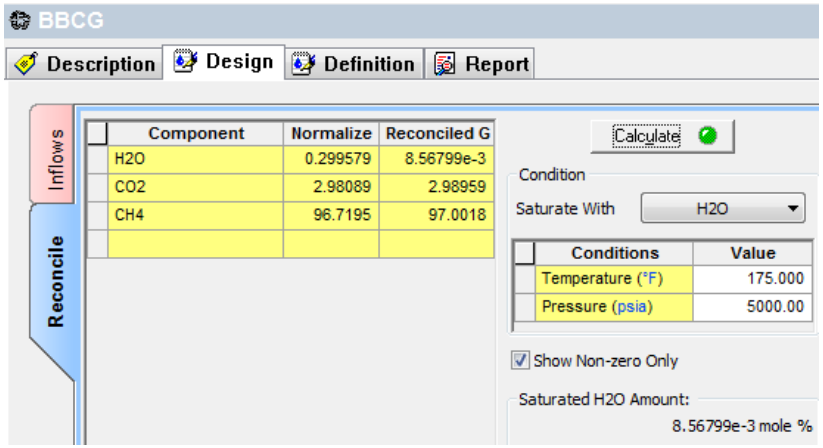


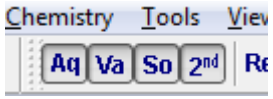


- ScaleChem Std did not converge gas (undefined Chemistry model)
- Hydrocarbon Gas no longer exists. Methane is now used. The software does not automatically switch this over

Studio ScaleChem Screen – Gas Analysis

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



- 

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

40.000 4999.693 selected point Units

Selected Conditions

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

Add Remove

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	CACO3 pScalTend	BASO4 pScalTend	FEIICO3 pScalTend	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	CACO3 pScalTend	BASO4 pScalTend	FEIICO3 pScalTend	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 | Conditions

Location	Temperature (°F	Pressure (psia)	Drop Solids
selected point	40.0000	4999.69	
selected point	40.0000	4499.72	
selected point	40.0000	2999.82	
selected point	40.0000	999.939	
selected point	40.0000	349.979	
selected point	40.0000	149.991	
<Enter Location Name>			

Calculate

Summary

Unit Set

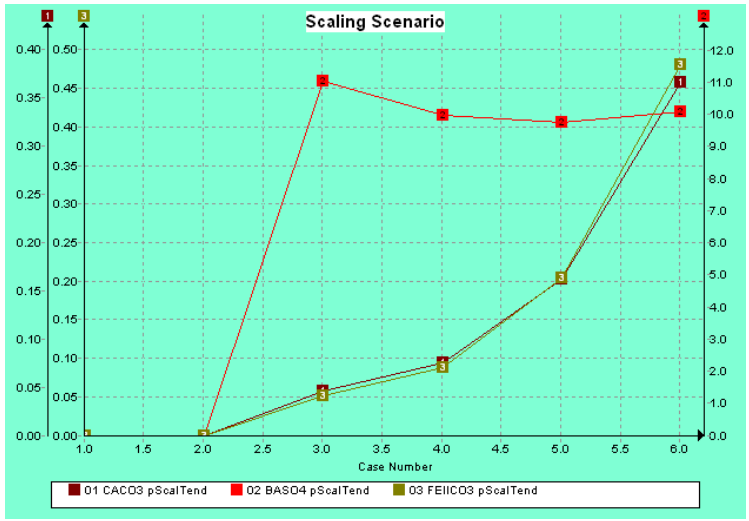
Based on: Scale

B_ST2

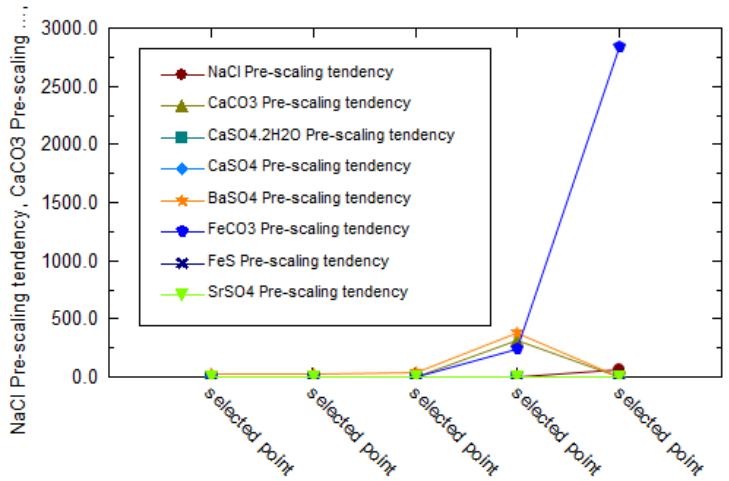
Description | Design | Plot | Report | File Viewer

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

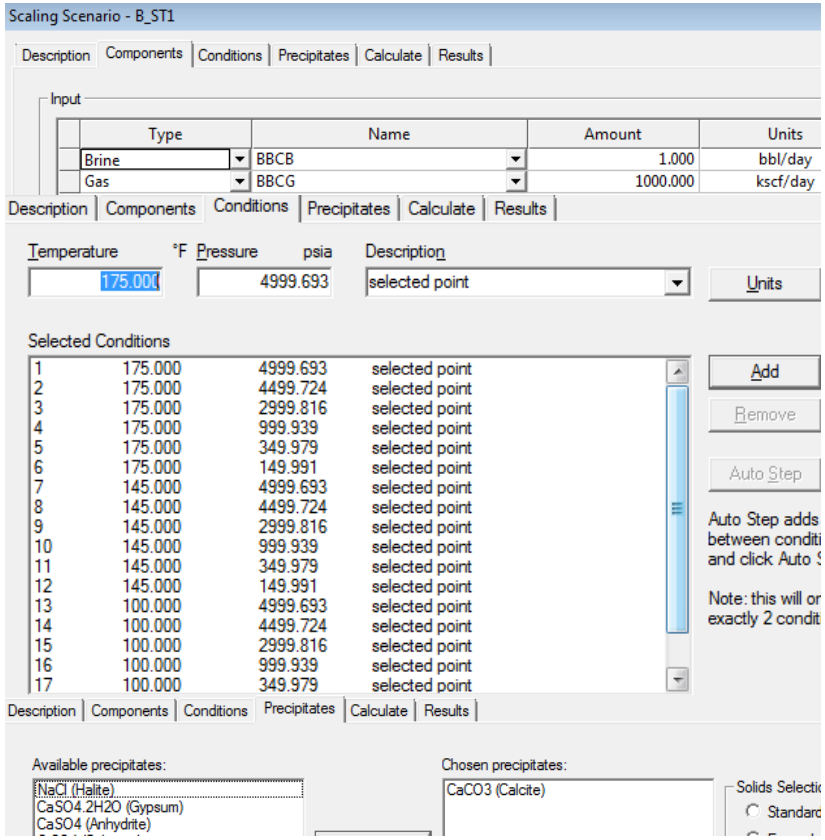


Locations	pH - Aqueous	FeCO3 Pre-scaling tendency	CaCO3 Pre-scaling tendency	BaSO4 Pre-scaling tendency
1	5.4828	0.201487	0.158251	22.1753
2	5.53517	0.292763	0.222678	24.1525
3	5.72079	1.34714	0.906613	33.3832
4	5.92132	235.359	311.973	379.394
5	6.50555	2831.33	5.34E-03	0.0392377
6				

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.

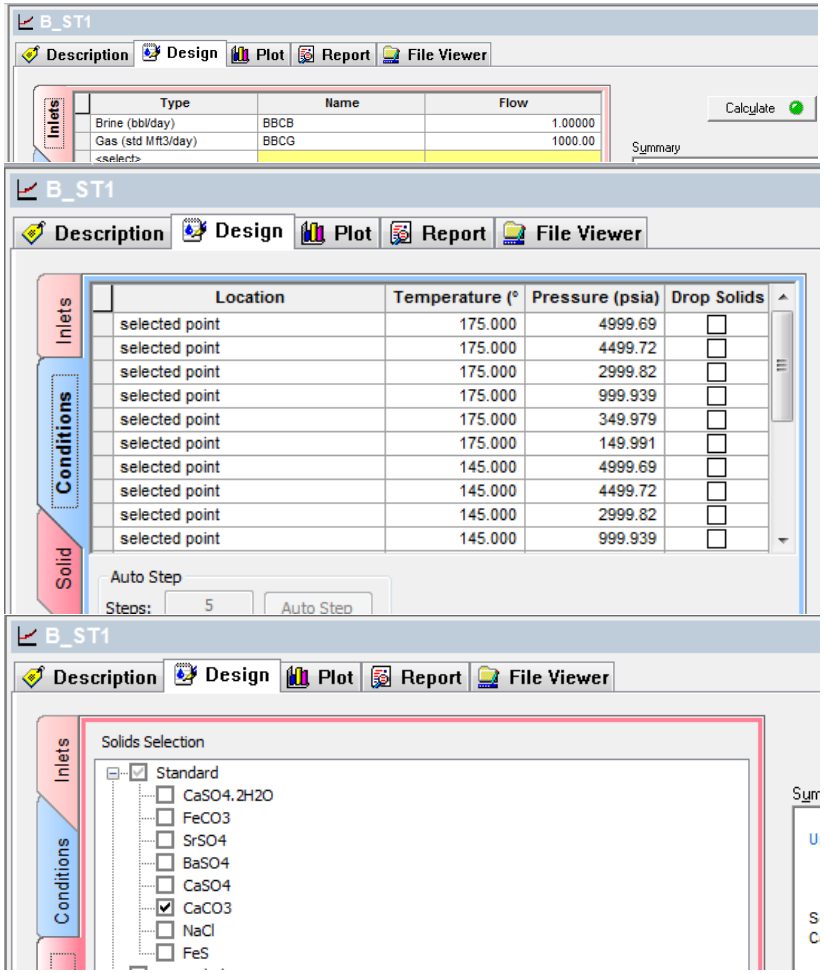
ScaleChem Std Screen – Scale Scenario

Settings -

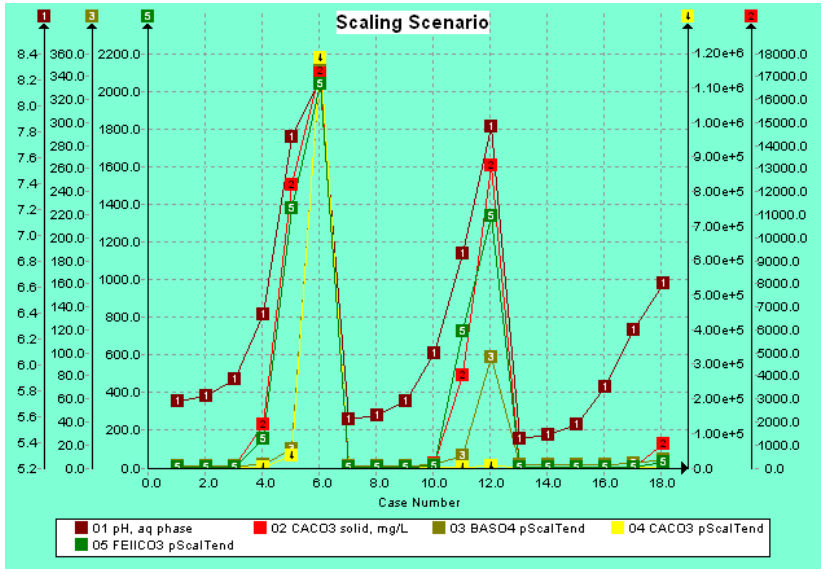


Studio ScaleChem Screen – Scale Scenario

Settings -



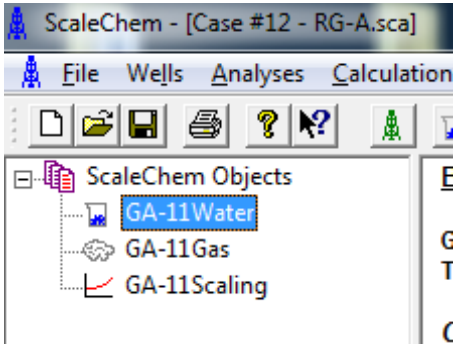
B_ST1 did not converge in StudioSC

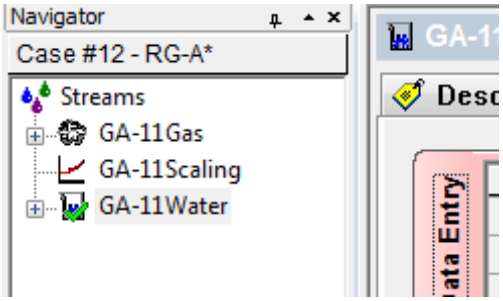

Scaling Scenario
Case Number
01 pH, aq phase
02 CACO3 solid, mg/L
03 BASO4 pScalTend
04 CACO3 pScalTend
05 FEIICO3 pScalTend

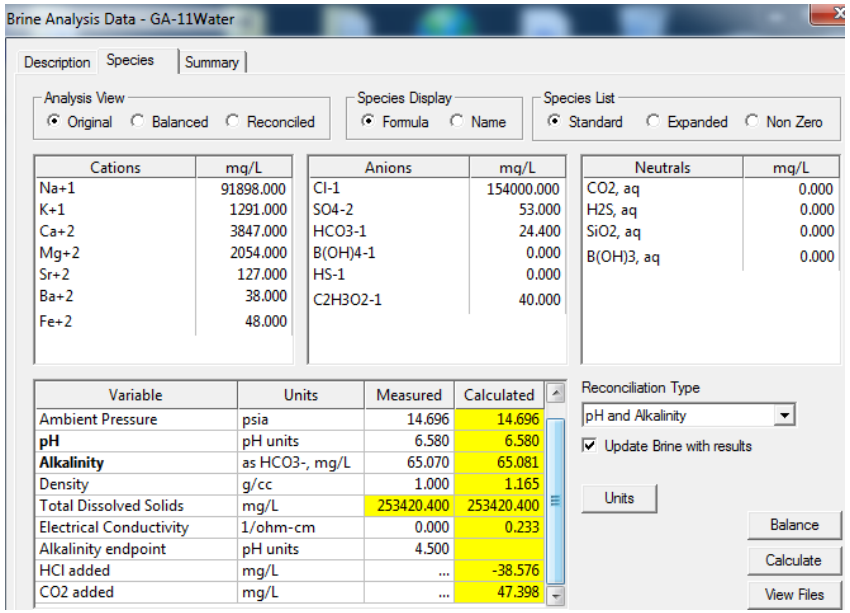
Notes –

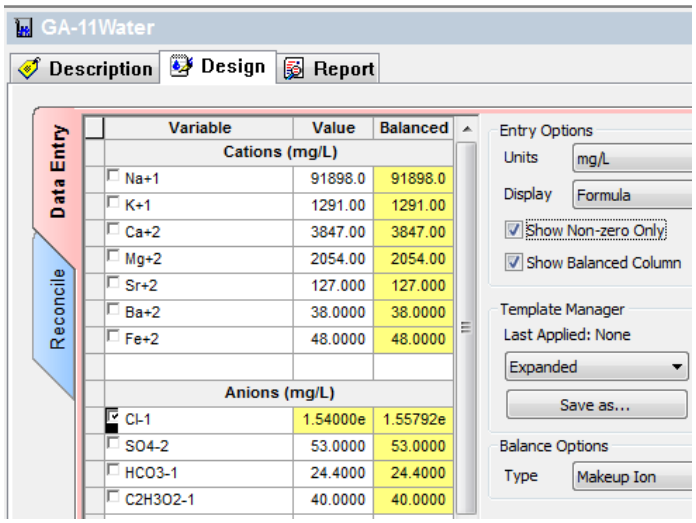
Case #12 – RG-A

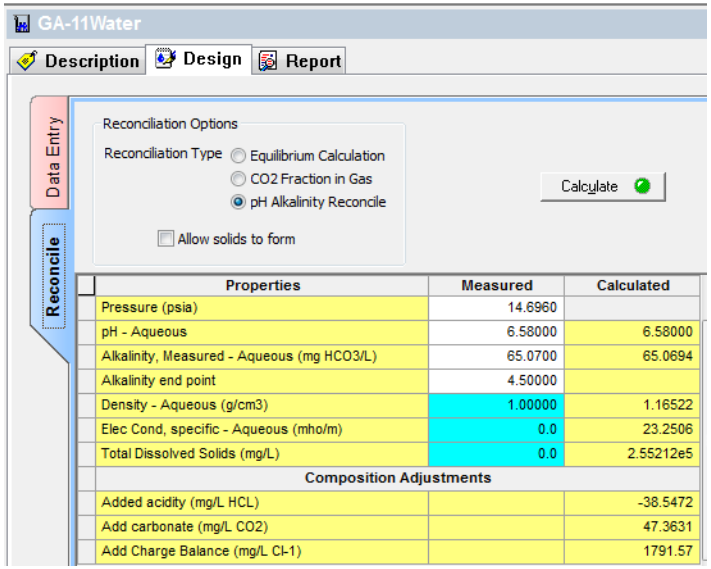
This case contains a water analysis set for pH and Alkalinity and a sour gas analysis. The gas to water ratio is low, 0.004MMscf/bbl. This file contains sulfur and all the solids are selected in the scale tendency. Therefore, we are focusing on the scale scenario results. There is a table at the bottom 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

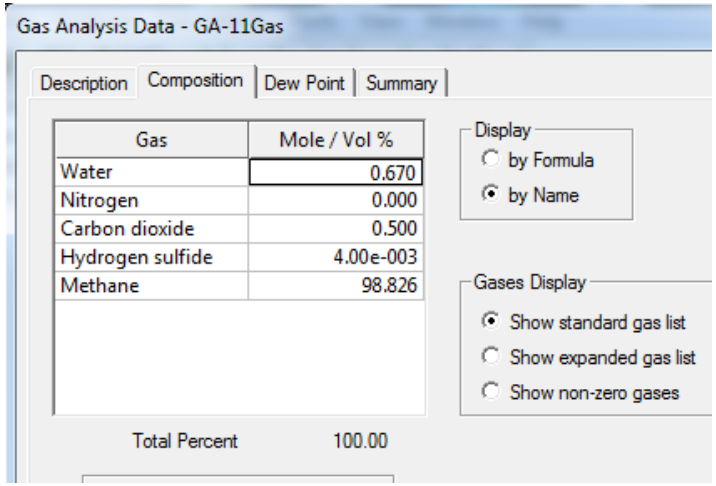


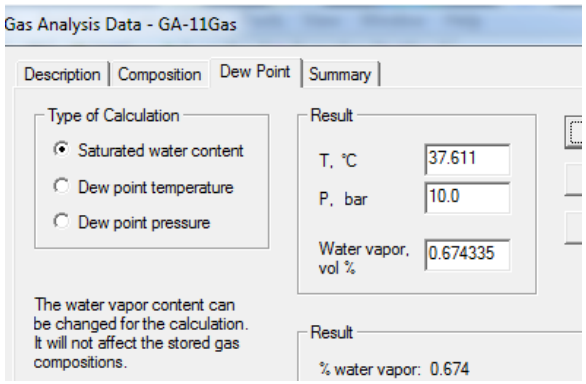


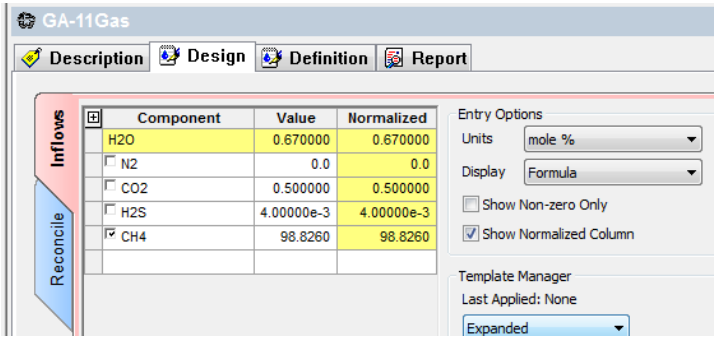

Brine Analysis Data - GA-11Water
Description
Species
Summary
Analysis View
Original
Balanced
Reconciled
Species Display
Formula
Name
Species List
Standard
Expanded
Non Zero
Cations | mg/L
Na+1 | 91898.000
K+1 | 1291.000
Ca+2 | 3847.000
Mg+2 | 2054.000
Sr+2 | 127.000
Ba+2 | 38.000
Fe+2 | 48.000
Anions | mg/L
Cl-1 | 154000.000
SO4-2 | 53.000
HCO3-1 | 24.400
B(OH)4-1 | 0.000
HS-1 | 0.000
C2H3O2-1 | 40.000
Neutrals | mg/L
CO2, aq | 0.000
H2S, aq | 0.000
SiO2, aq | 0.000
B(OH)3, aq | 0.000
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

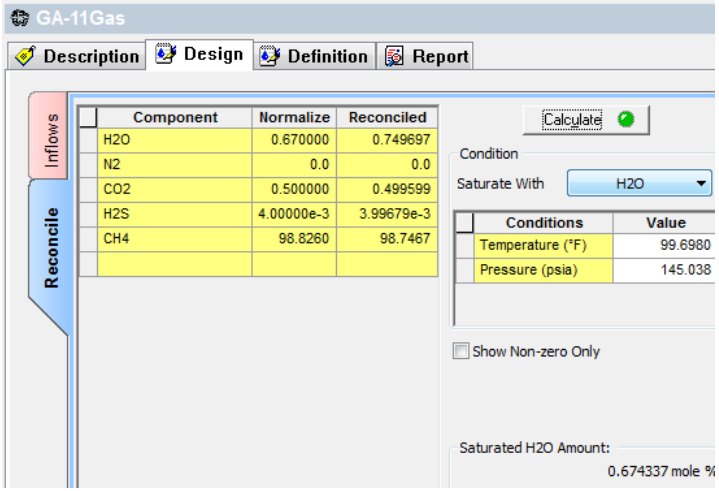

GA-11Water
Description
Design
Report
Data Entry
Reconcile
Variable | Value | Balanced
Cations (mg/L)
Na+1 | 91898.0 | 91898.0
K+1 | 1291.00 | 1291.00
Ca+2 | 3847.00 | 3847.00
Mg+2 | 2054.00 | 2054.00
Sr+2 | 127.000 | 127.000
Ba+2 | 38.0000 | 38.0000
Fe+2 | 48.0000 | 48.0000
Anions (mg/L)
Cl-1 | 1.54000e | 1.55792e
SO4-2 | 53.0000 | 53.0000
HCO3-1 | 24.4000 | 24.4000
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

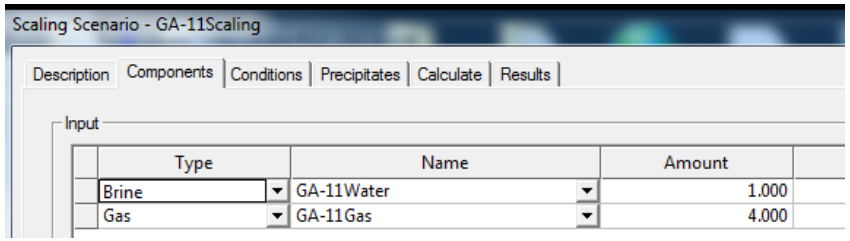

GA-11Water
Description
Design
Report
Data Entry
Reconcile
Reconciliation Options
Reconciliation Type
Equilibrium Calculation
CO2 Fraction in Gas
pH Alkalinity Reconcile
Allow solids to form
Calculate
Properties | Measured | Calculated
Pressure (psia) | 14.6960
pH - Aqueous | 6.58000 | 6.58000
Alkalinity, 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

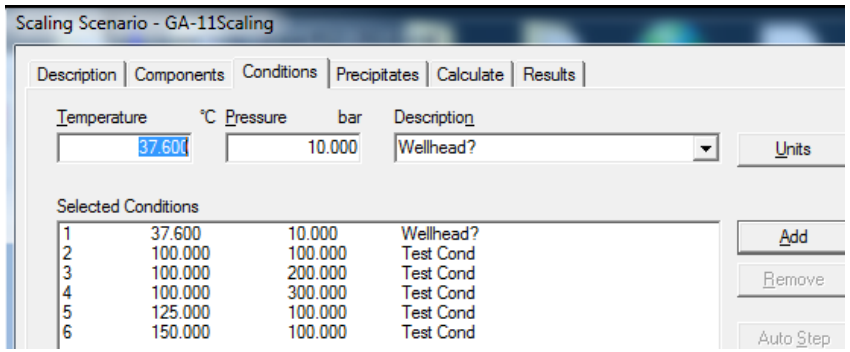

Gas Analysis Data - GA-11Gas
Description
Composition
Dew Point
Summary
Gas
Mole / Vol %
Water
0.670
Nitrogen
0.000
Carbon dioxide
0.500
Hydrogen sulfide
4.00e-003
Methane
98.826
Total Percent
100.00
Display
by Formula
by Name
Gases Display
Show standard gas list
Show expanded gas list
Show non-zero gases

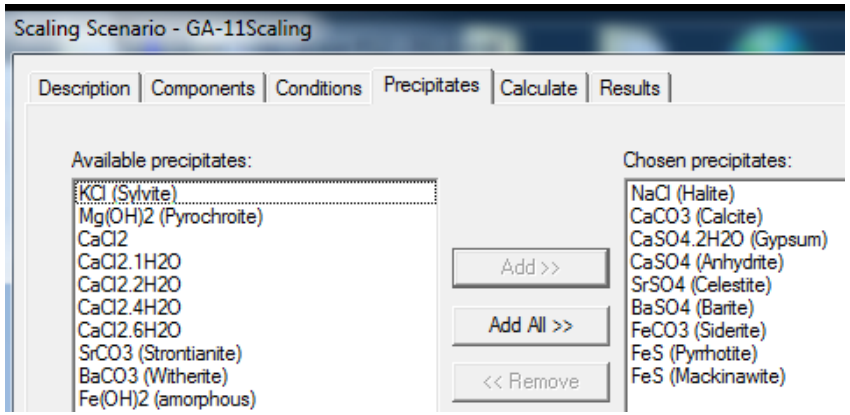

Gas Analysis Data - GA-11Gas
Description
Composition
Dew Point
Summary
Type of Calculation
Saturated water content
Dew point temperature
Dew point pressure
Result
T, °C
37.611
P, bar
10.0
Water vapor, vol %
0.674335
The water vapor content can be changed for the calculation. It will not affect the stored gas compositions.
Result
% water vapor: 0.674

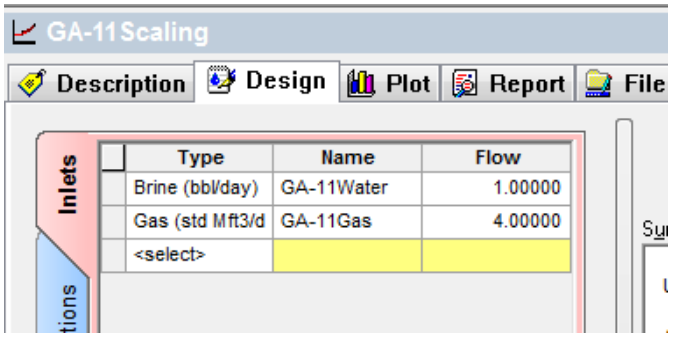

GA-11Gas
Description
Design
Definition
Report
Inflows
Reconcile
Component
Value
Normalized
H2O
0.670000
0.670000
N2
0.0
0.0
CO2
0.500000
0.500000
H2S
4.00000e-3
4.00000e-3
CH4
98.8260
98.8260
Entry Options
Units
mole %
Display
Formula
Show Non-zero Only
Show Normalized Column
Template Manager
Last Applied: None
Expanded

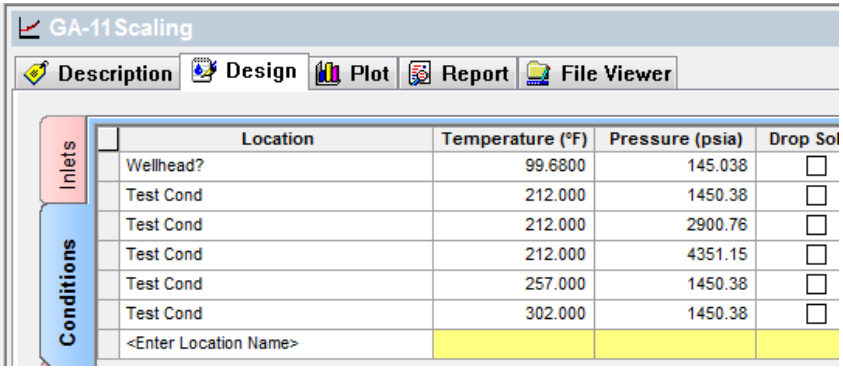

GA-11Gas
Description
Design
Definition
Report
Inflows
Reconcile
Component
Normalize
Reconciled
H2O
0.670000
0.749697
N2
0.0
0.0
CO2
0.500000
0.499599
H2S
4.00000e-3
3.99679e-3
CH4
98.8260
98.7467
Calculate
Condition
Saturate With
H2O
Conditions
Value
Temperature (°F)
99.6980
Pressure (psia)
145.038
Show Non-zero Only
Saturated H2O Amount:
0.674337 mole %

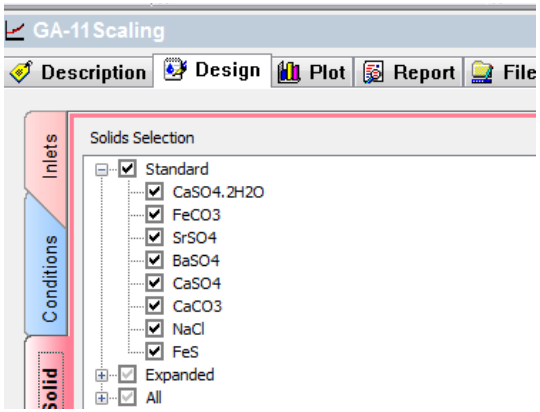

Scaling Scenario - GA-11Scaling
Description
Components
Conditions
Precipitates
Calculate
Results
Input
Type
Name
Amount
Brine
GA-11Water
1.000
Gas
GA-11Gas
4.000


Scaling Scenario - GA-11Scaling
Description
Components
Conditions
Precipitates
Calculate
Results
Temperature
°C
Pressure
bar
Description
37.600
10.000
Wellhead?
Units
Selected Conditions
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)
Add >>
Add All >>
<< Remove
Chosen precipitates:
NaCl (Halite)
CaCO3 (Calcite)
CaSO4.2H2O (Gypsum)
CaSO4 (Anhydrite)
SrSO4 (Celestite)
BaSO4 (Barite)
FeCO3 (Siderite)
FeS (Pyrrhotite)
FeS (Mackinawite)


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
Conditions
Location
Temperature (°F)
Pressure (psia)
Drop Sol
Wellhead?
99.6800
145.038
Test Cond
212.000
1450.38
Test Cond
212.000
2900.76
Test Cond
212.000
4351.15
Test Cond
257.000
1450.38
Test Cond
302.000
1450.38
<Enter Location Name>

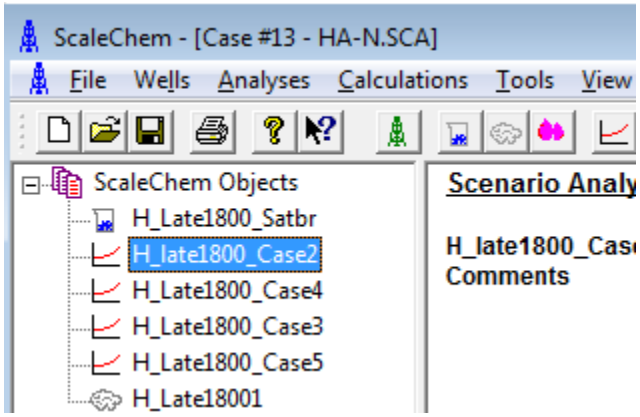

GA-11Scaling
Description
Design
Plot
Report
File
Inlets
Conditions
Solids Selection
Standard
CaSO4.2H2O
FeCO3
SrSO4
BaSO4
CaSO4
CaCO3
NaCl
FeS
Expanded
All

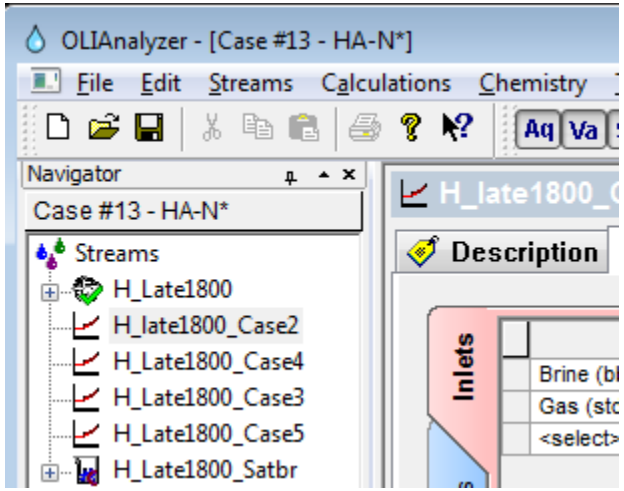
ScaleChem Std								
Pressure, bar		NACL p	CACO3 p	CASO4.2H2O p	CASO4 p	BASO4 p	FEIICO3 p	FEIIS p
bar		ScalTend	ScalTend	ScalTend	ScalTend	ScalTend	ScalTend	ScalTend
10	1	0.444	0.046	0.02	0.027	4.099	0.021	13.329
100	2	0.359	0.084	0.011	0.042	1.492	0.022	3.809
200	3	0.353	0.05	9.63E-03	0.038	1.578	0.014	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.

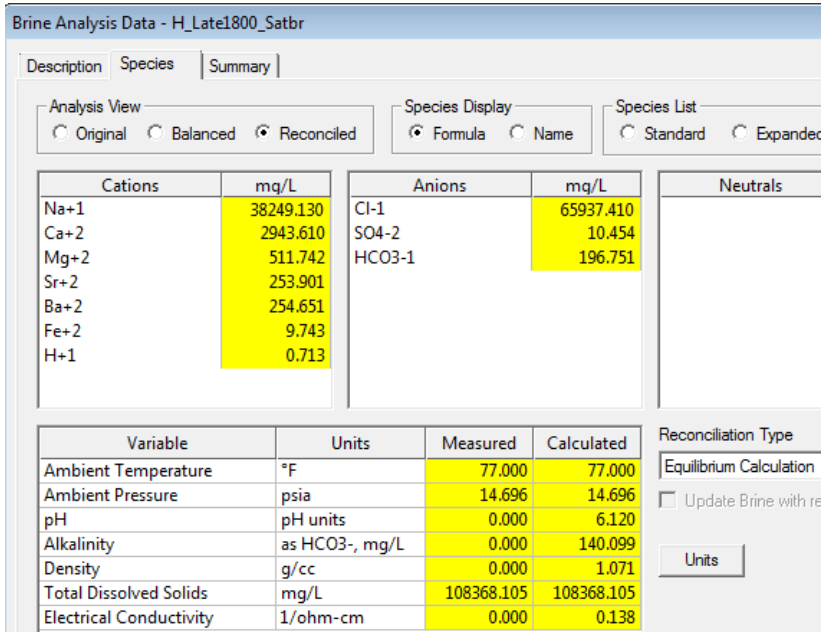
With regard to the Scale Scenario results, the computed values of Studio SC are different from ScaleChem Std.





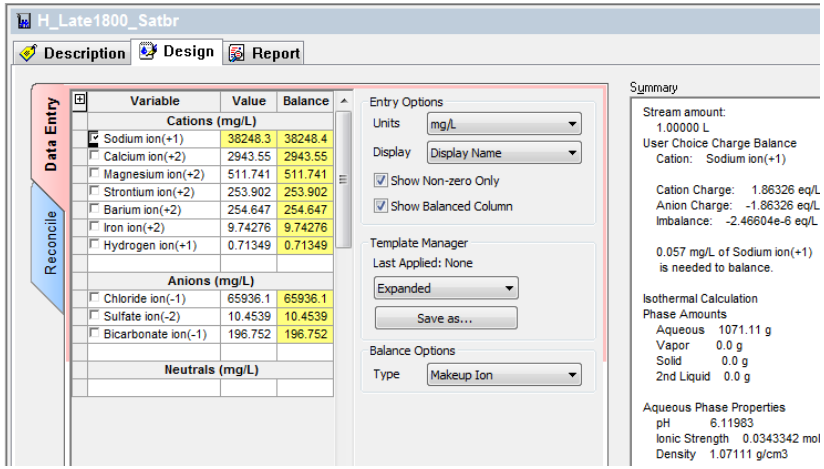
ScaleChem Std Screen – Brine Analysis

Settings – Standard List, Na/Cl Balance, Equilibrium



Studio ScaleChem Screen – Brine Analysis

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

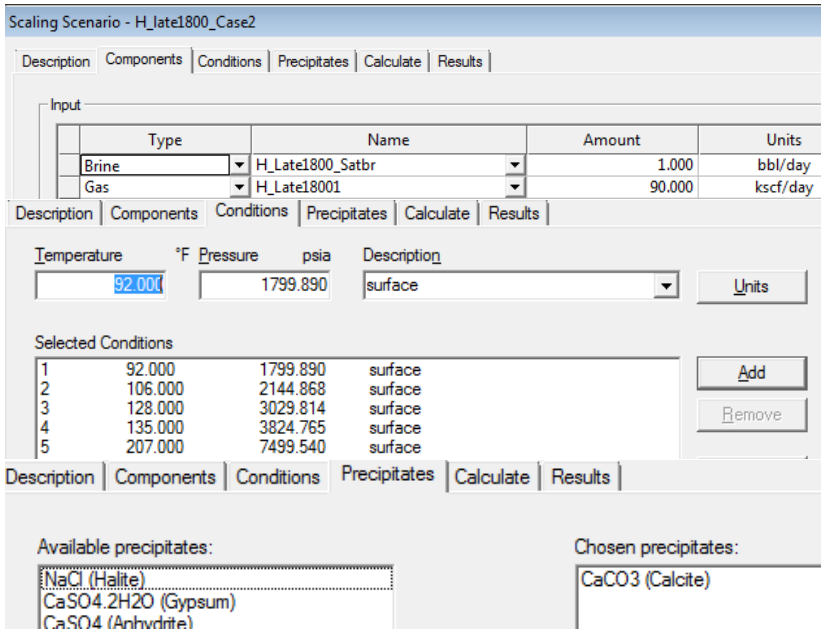


Notes –

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			

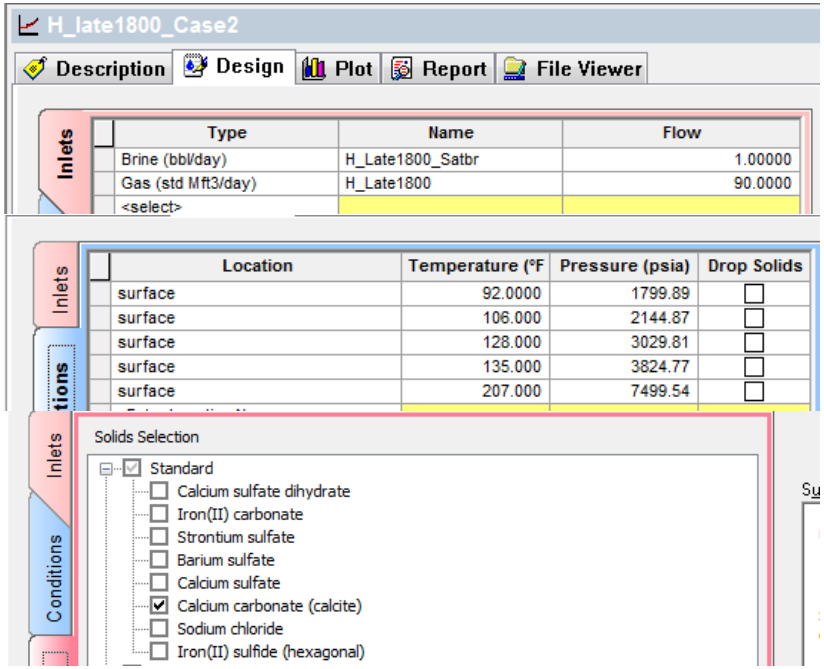
ScaleChem Std Screen – Scale Scenario

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



Studio ScaleChem Screen – Scale Scenario

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



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

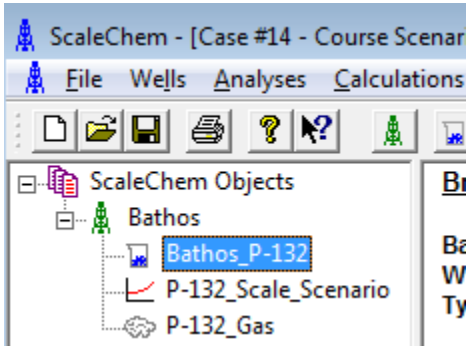
ScaleChem Std								
Pressure	CACO3 solid	BASO4	CACO3	CASO4.2H2O	CASO4	FEIICO3	SRSO4	NACL
psia	mg/L	pST	pST	pST	pST	pST	pST	pST
1799.89	0	11.01	0.15	0.00	0.00	0.03	0.01	0.04
2118.87	0	9.71	0.19	0.00	0.00	0.04	0.01	0.04
2609.84	0	7.58	0.27	0.00	0.00	0.08	0.01	0.04
4135.75	0	6.67	0.27	0.00	0.00	0.08	0.01	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%

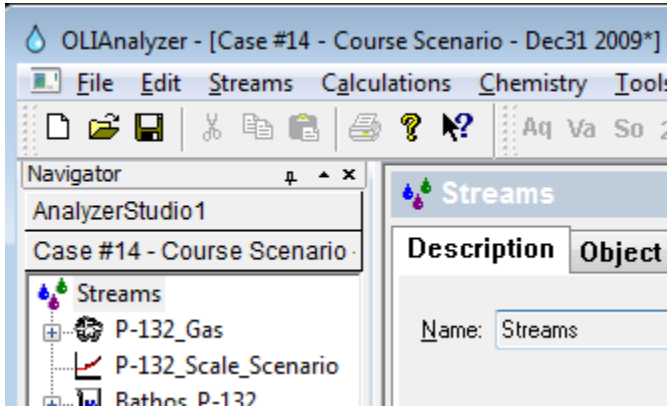
H_late1800_Case5

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

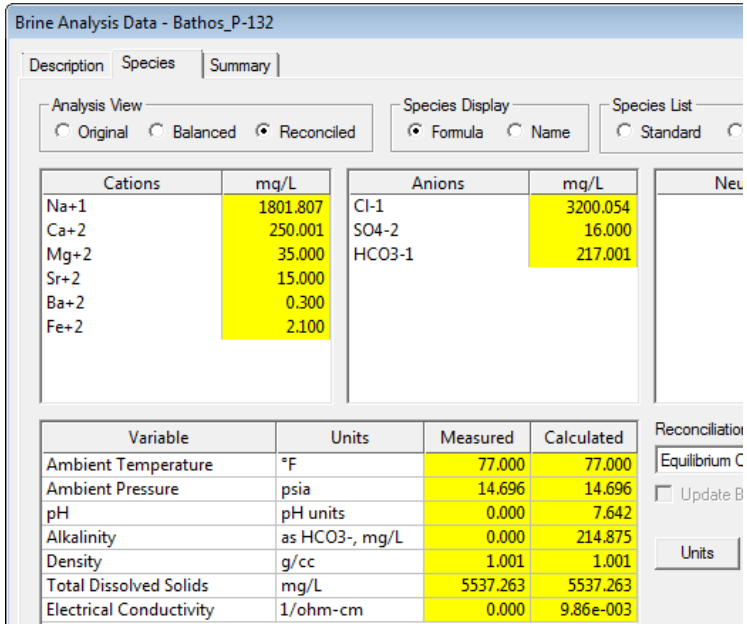
This file contains the output of chapters 2 and 3 of the ScaleChem Course Scenario. This scenario contains a high CO2 content gas and a brine at moderate temperatures and pressures. The main comparison is the CaCO3 scale tendency.





ScaleChem Std Screen – Brine Analysis

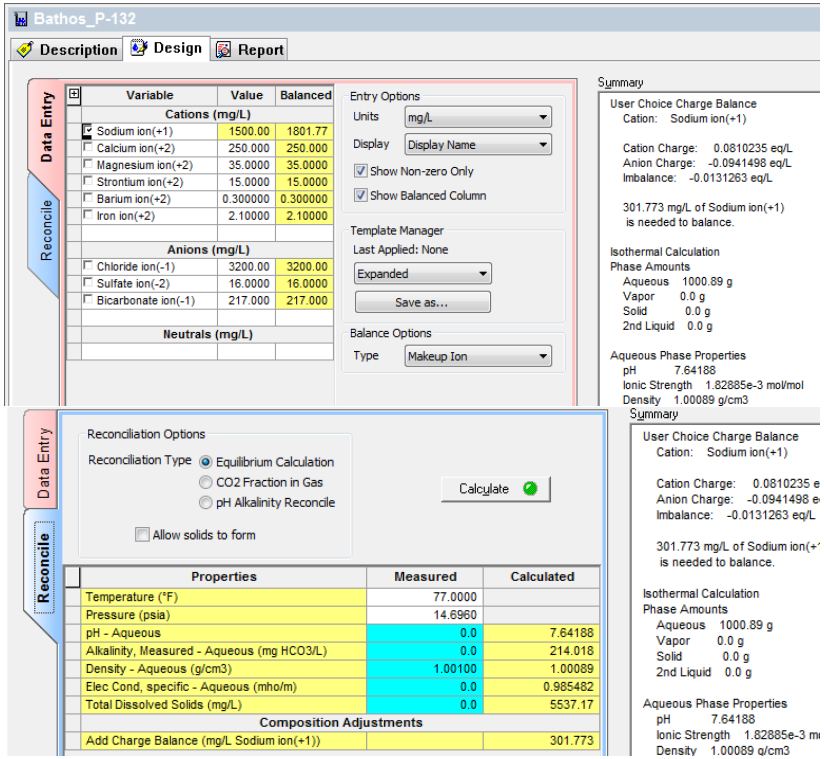
Settings - Expanded List, Na/Cl Balance, Equilibrium



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

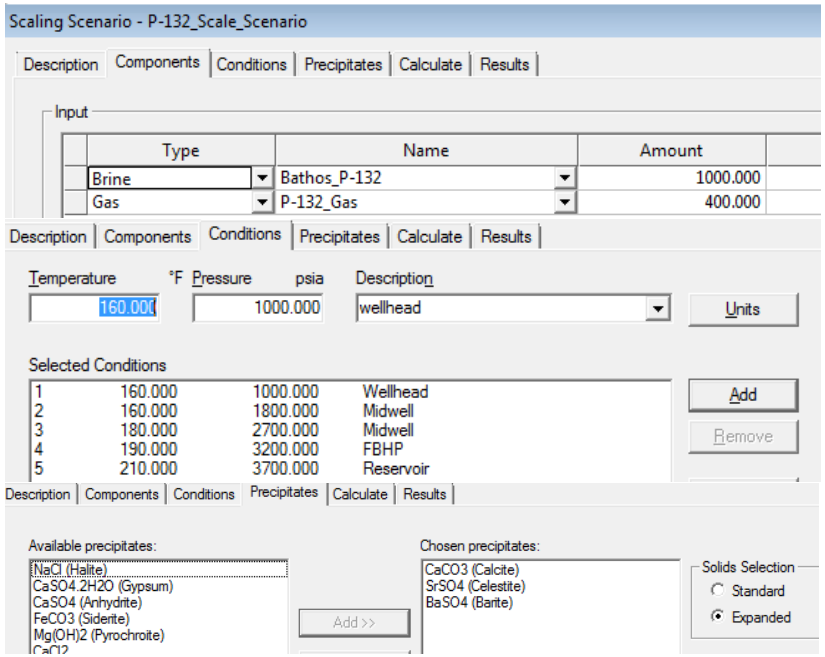
Studio ScaleChem Screen – Brine Analysis

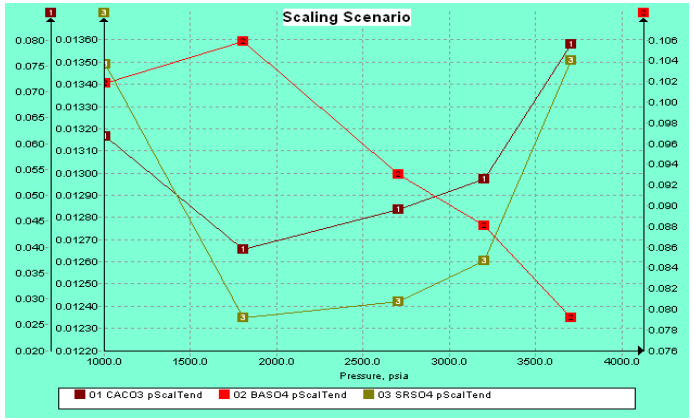
Settings - Expanded List, Na/Cl Balance, **Equilibrium Reconciliation**



ScaleChem Std Screen – Scale Scenario

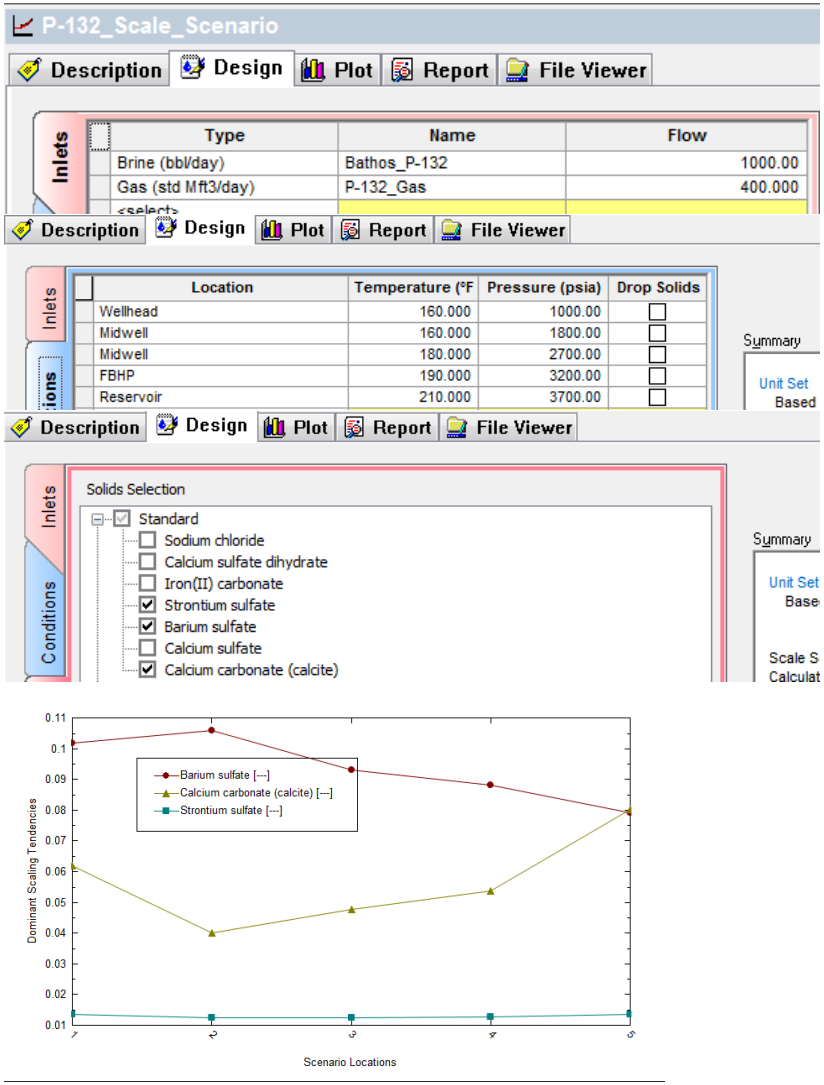
Settings – One Brine, One Gas, five conditions, three scales





Studio ScaleChem Screen – Scale Scenario

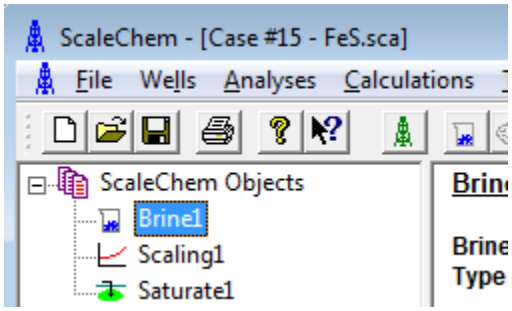
Settings – One brine, one gas, five conditions, three scales

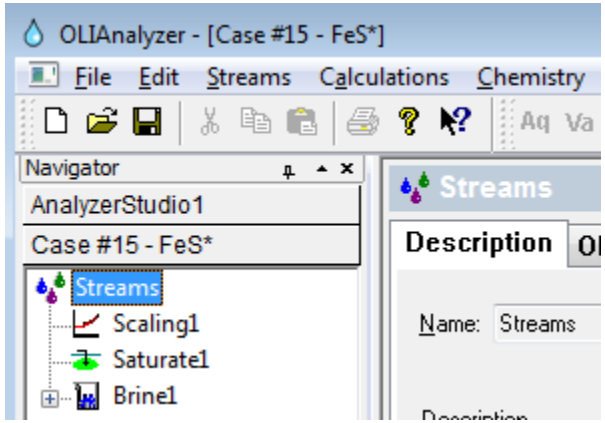


ScaleChem Std								
Pressure	BASO4	CACO3	SRSO4	CASO4.2H2O	CASO4	FEIICO3	NACL	
psia	pST	pST	pST	pST	pST	pST	pST	
1000	0.10	0.06	0.01	0.00	0.01	0.05	0.00	
1800	0.11	0.04	0.01	0.00	0.01	0.03	0.00	
2700	0.09	0.05	0.01	0.00	0.01	0.04	0.00	
3200	0.09	0.05	0.01	0.00	0.01	0.05	0.00	
3700	0.08	0.08	0.01	0.00	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

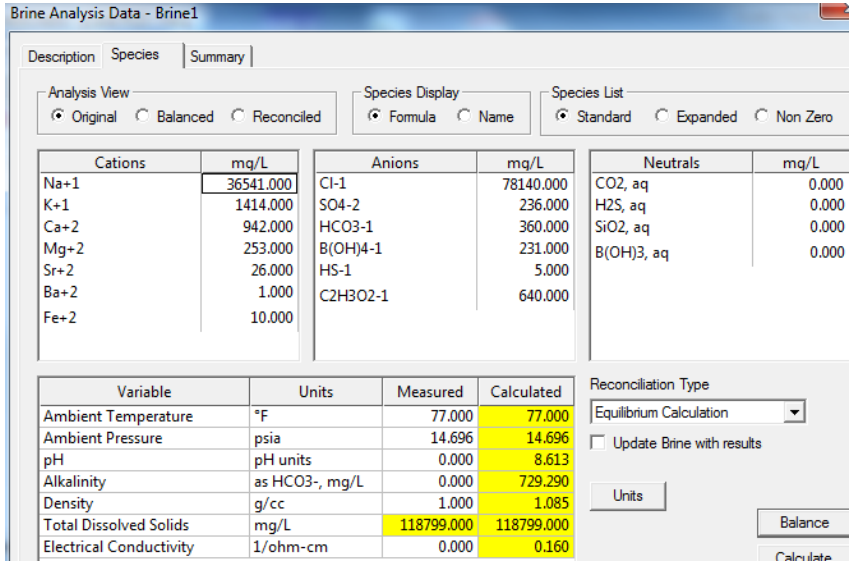
This file contains one Brine Analysis, one Saturation, and one Scaling for a fluid saturated with FeS and CaCO3 in a gas containing relatively high concentrations of CO2 and H2S. This is a high TDS brine with high concentrations of organic acids and borates. The saturation calculation appears to work properly in ScaleChem Std. the Saturation calculation failed to converge in Studio SC.



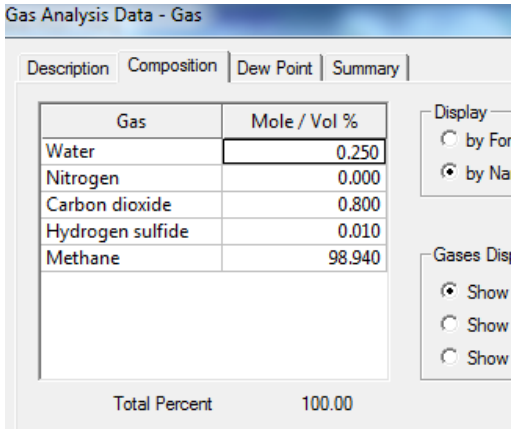


ScaleChem Std Screen – Brine/Gas Analysis

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

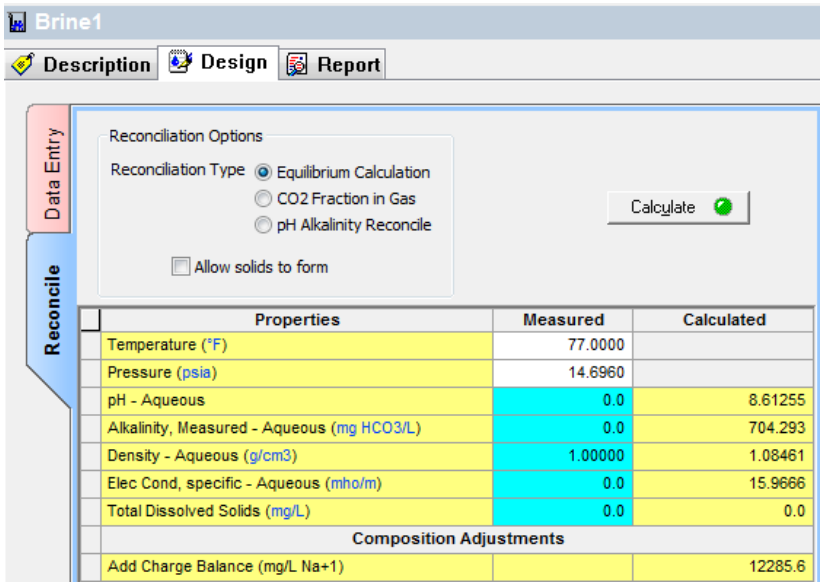


Settings – Standard gas, no water saturation

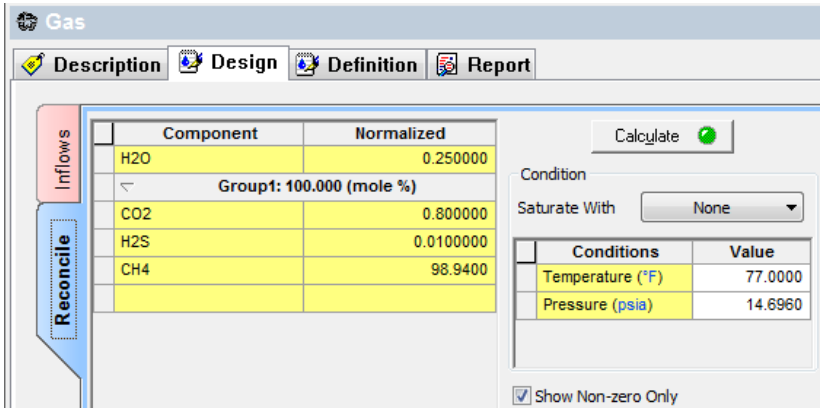


Studio ScaleChem Screen – Brine/Gas Analysis

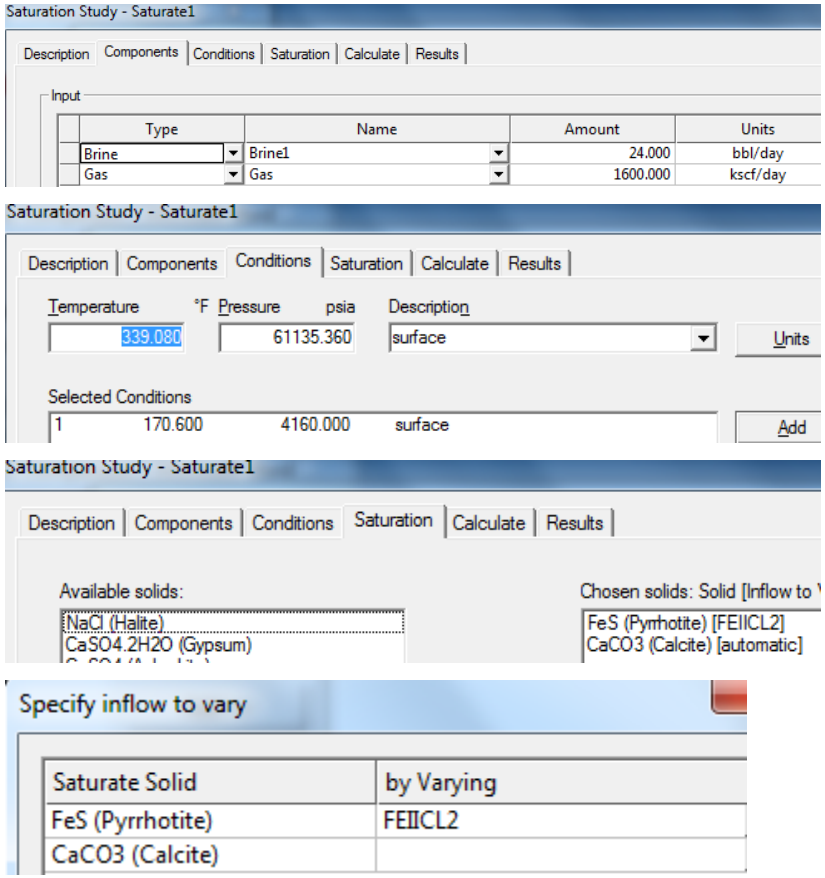
Settings - Expanded List, Na/Cl Balance, **Equilibrium**



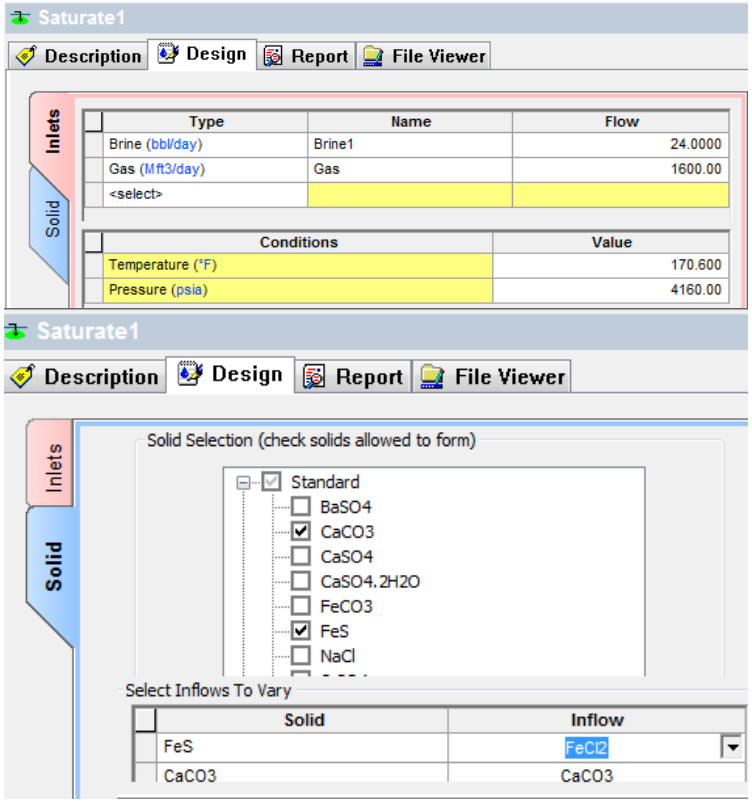
Settings – Expanded gas, water saturation ON and USED



ScaleChem Std Screen – Saturate

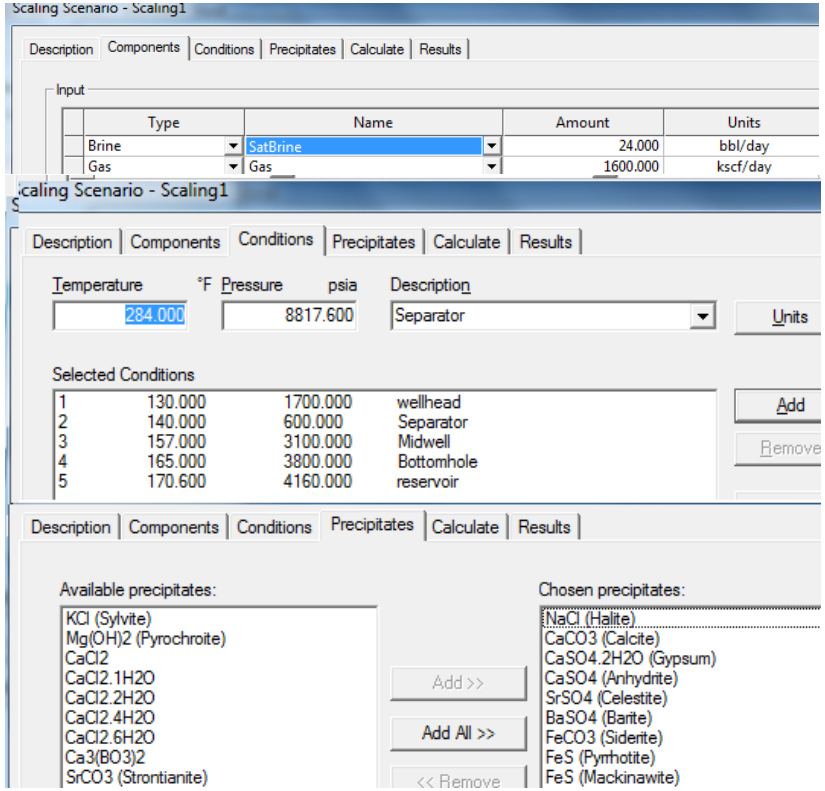


Studio ScaleChem Screen – Saturate



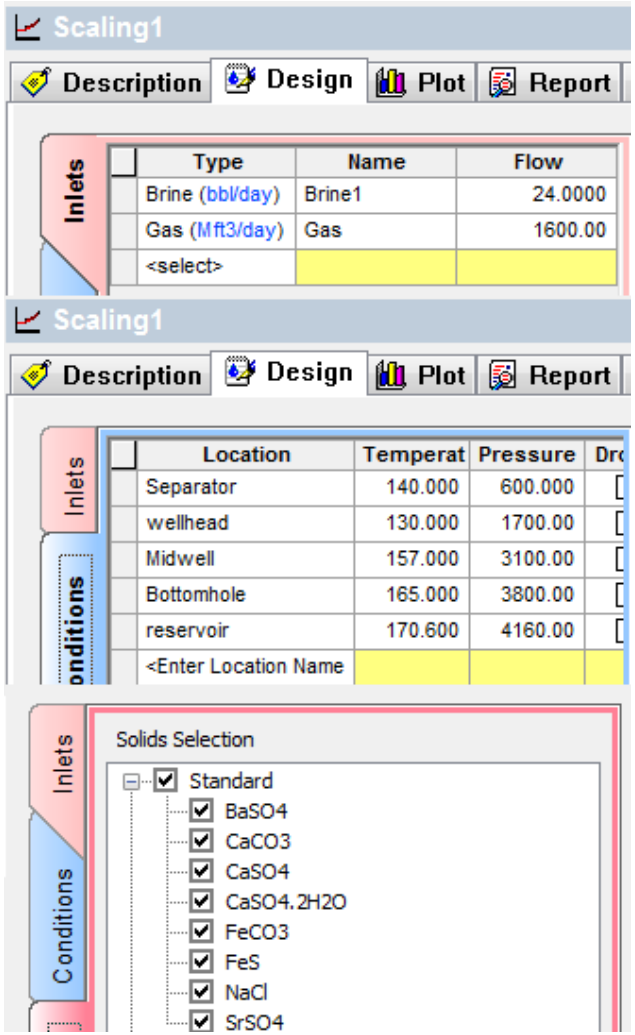
ScaleChem Std Screen – Scale Scenario

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



Studio ScaleChem Screen – Scale Scenario

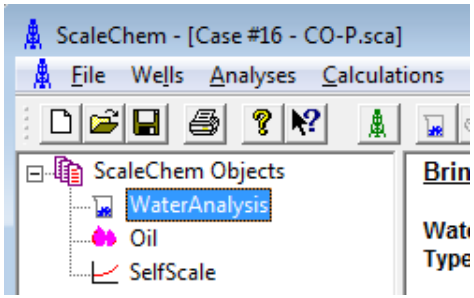
Settings – Conversion is the same

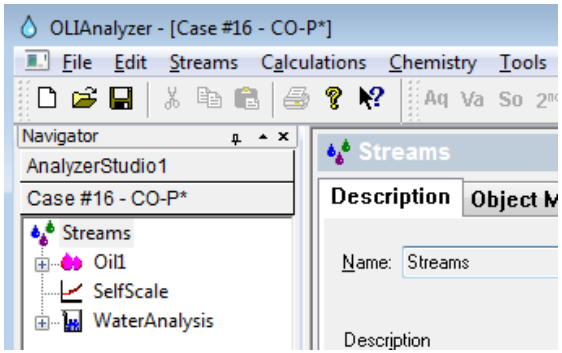


ScaleChem Std											
Pressure	FEIIS pST	FEIICO3 pST	pH	CACO3 mg/l	CACO3 pST	FeS pST	CO2 aq (mg/l)	H2S, aq (mg/l)	Hac, vap (molfx)	Water rate l/hr	Gas rate l/hr
1700	1.16	1.57E-03	5.91	0	0.67		291.448	8.886	2.48E-08	159	17799
600	3.34	4.62E-03	6.16	204	2.29		129.616	4.232	1.87E-08	154	54311
3100	1.11	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	0.040353	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

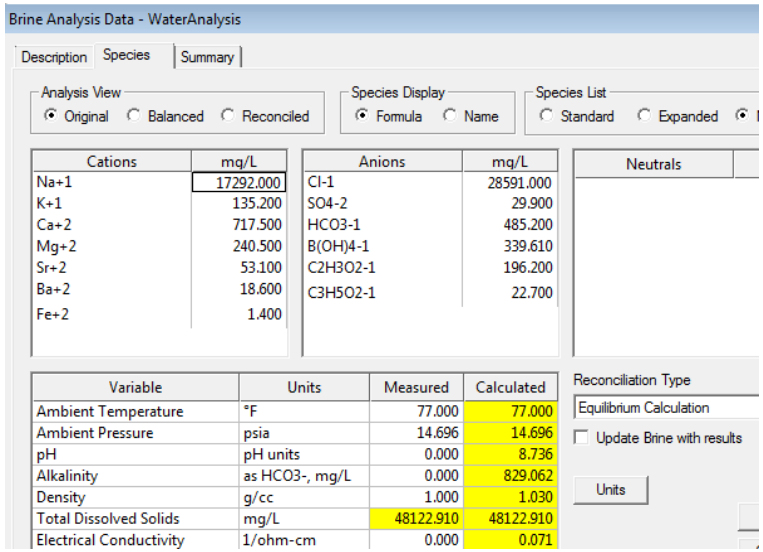
This file contains one brine, one oil and one scale scenario. The oil phase includes pure components up to C40 (the maximum in ScaleChem). In addition, the starting pressure is 11000 psia (758bar). The oil phase density differed between the two calculations. Also the PVT curve calculator and plot needs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





ScaleChem Std Screen – Brine Analysis

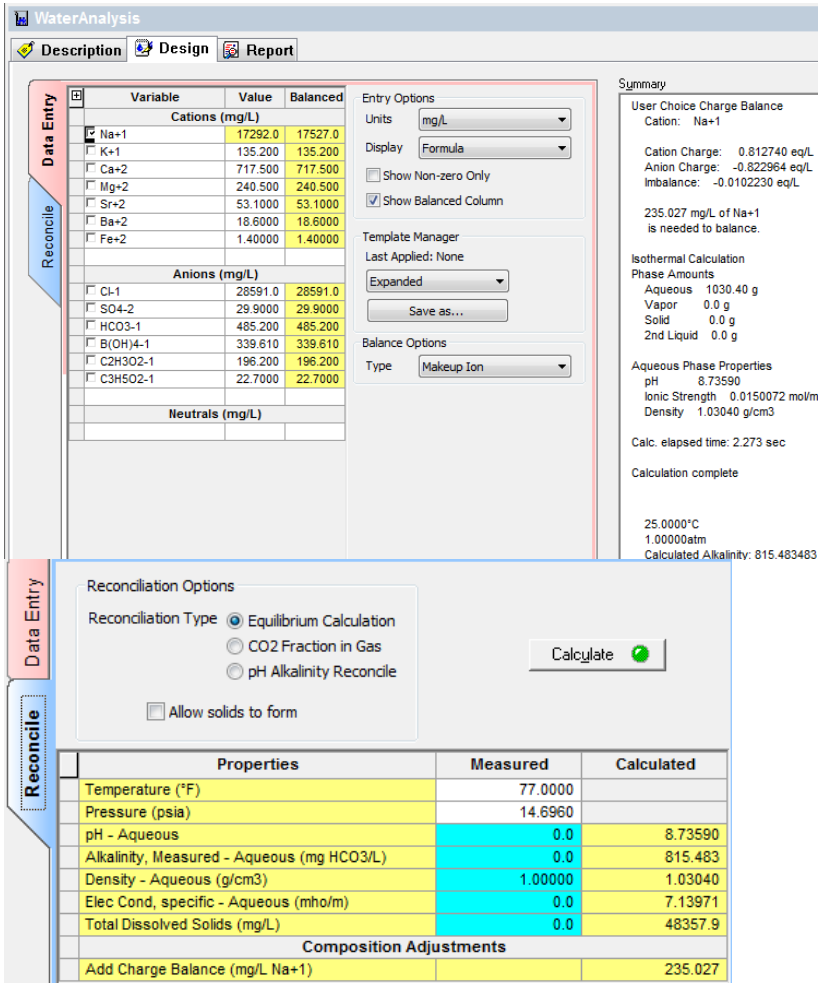
Settings –Standard, Na/Cl balance Equilibrium



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

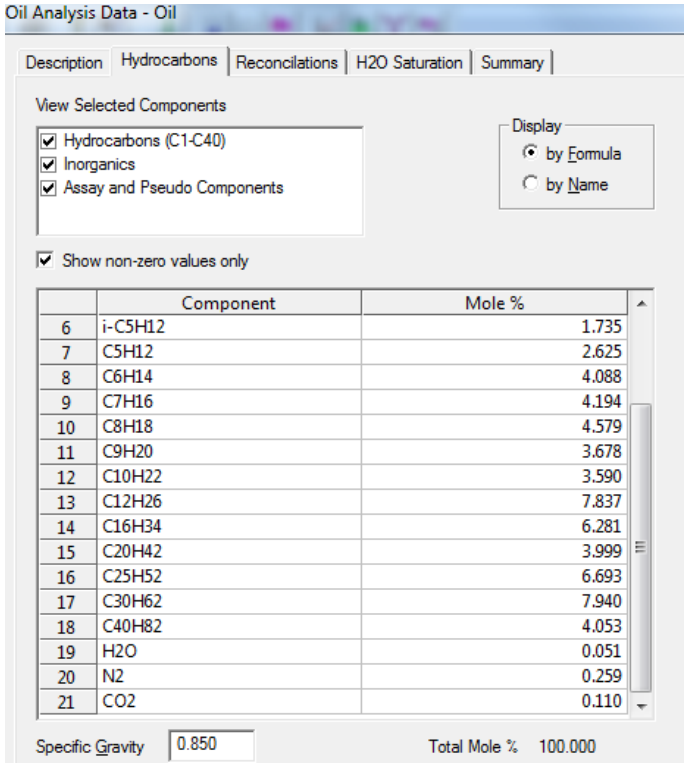
Settings – Expanded List, Makeup(Na=), Equilibrium



Notes –

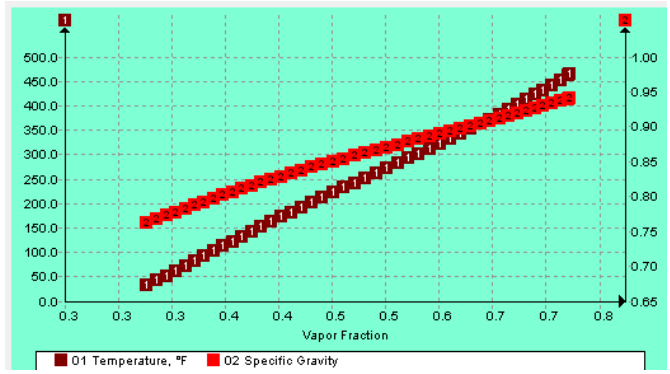
ScaleChem Std Screen – Oil Analysis

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



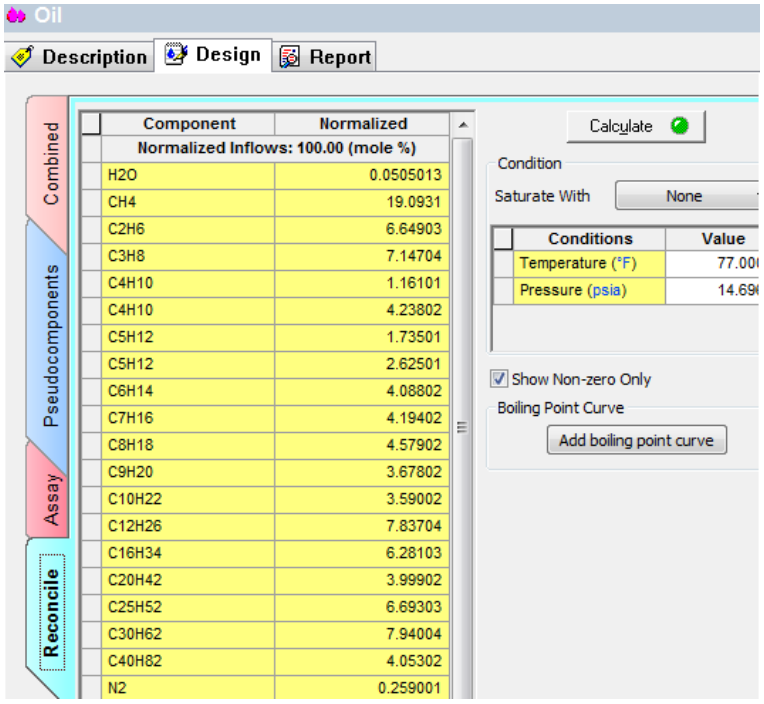
	Component	Mole %
6	i-C5H12	1.735
7	C5H12	2.625
8	C6H14	4.088
9	C7H16	4.194
10	C8H18	4.579
11	C9H20	3.678
12	C10H22	3.590
13	C12H26	7.837
14	C16H34	6.281
15	C20H42	3.999
16	C25H52	6.693
17	C30H62	7.940
18	C40H82	4.053
19	H2O	0.051
20	N2	0.259
21	CO2	0.110

Specific Gravity 0.850 Total Mole % 100.000

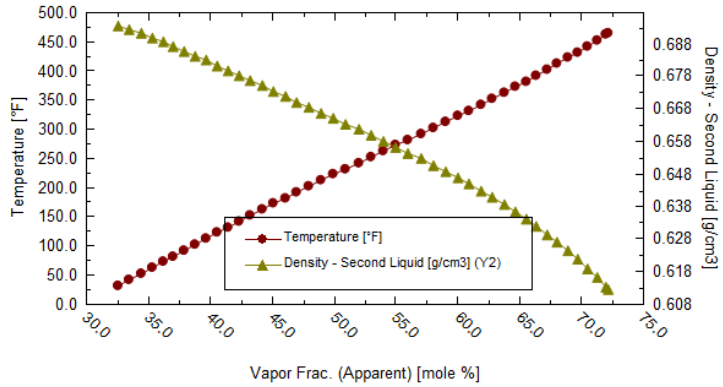


Studio ScaleChem Screen – Oil Analysis

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

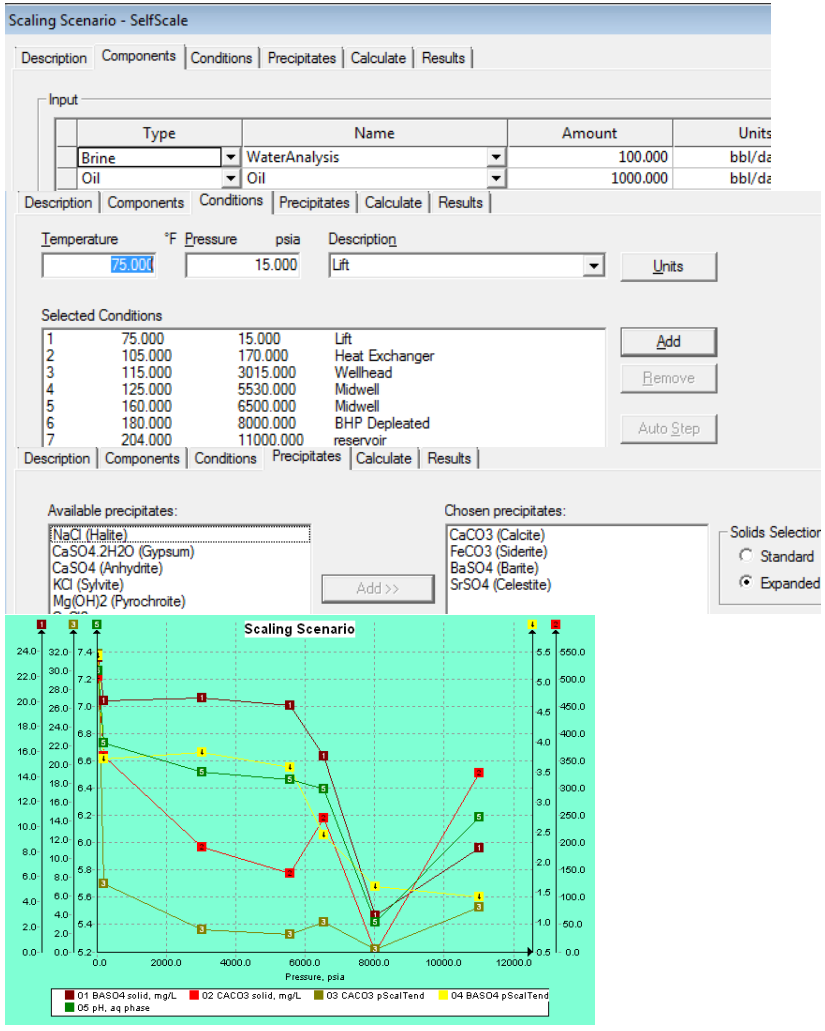


Component	Normalized
Normalized Inflows: 100.00 (mole %)	
H2O	0.0505013
CH4	19.0931
C2H6	6.64903
C3H8	7.14704
C4H10	1.16101
C4H10	4.23802
C5H12	1.73501
C5H12	2.62501
C6H14	4.08802
C7H16	4.19402
C8H18	4.57902
C9H20	3.67802
C10H22	3.59002
C12H26	7.83704
C16H34	6.28103
C20H42	3.99902
C25H52	6.69303
C30H62	7.94004
C40H82	4.05302
N2	0.259001



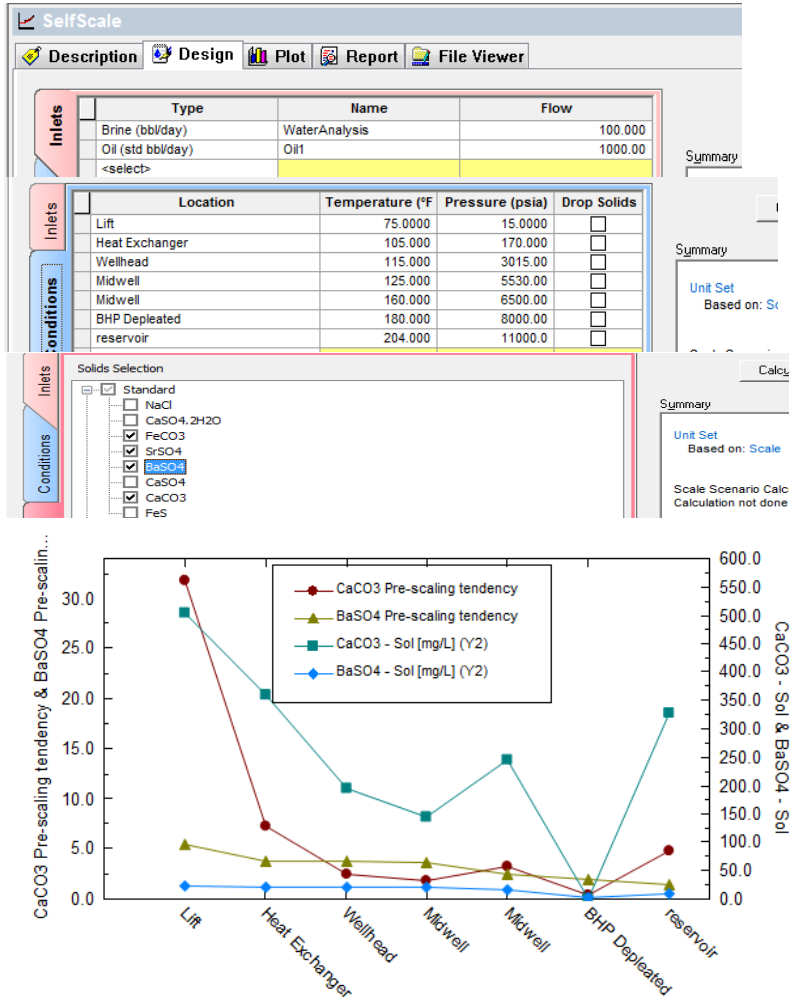
ScaleChem Std Screen – Scale Scenario

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

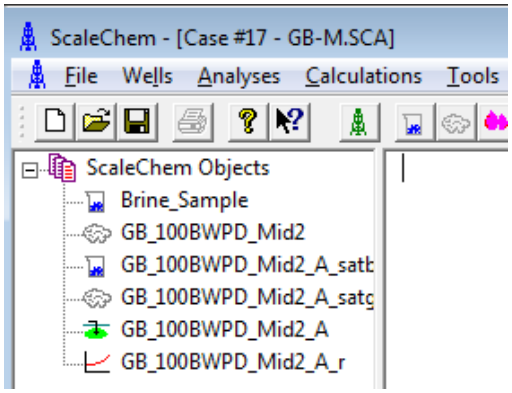
ScaleChem Std						
Pressure	BASO4 mg/l	CACO3 mg/l	CACO3 pST	BASO4 pST	pH	H2O (org), molfx
15	24	504	32	5	7.3	4.65E-04
170	20	358	7	4	6.7	1.01E-03
3015	20	192	2	4	6.5	9.93E-04
5530	20	143	2	4	6.5	1.03E-03
6500	16	244	3	2	6.4	2.02E-03
8000	3		0.3	2	5.4	
11000	8	327	5	1	6.2	3.42E-03
StudioSC						
15	23	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%

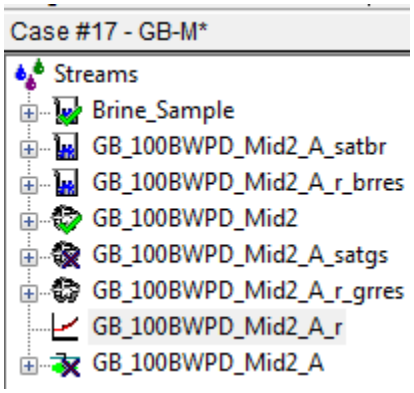
Case #17 – GB-M-

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 2nd Liquid on automatically because it had just been installed. Consequently, the gas phase was forced into the Aqueous phase. THe 2nd Liquid needed to be turned on manually, and the calculation worked as expected thereafter. This calculation also uses the Advanced button, in which CaCO3 is saturated by adding Na2CO3 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 CaF2 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.

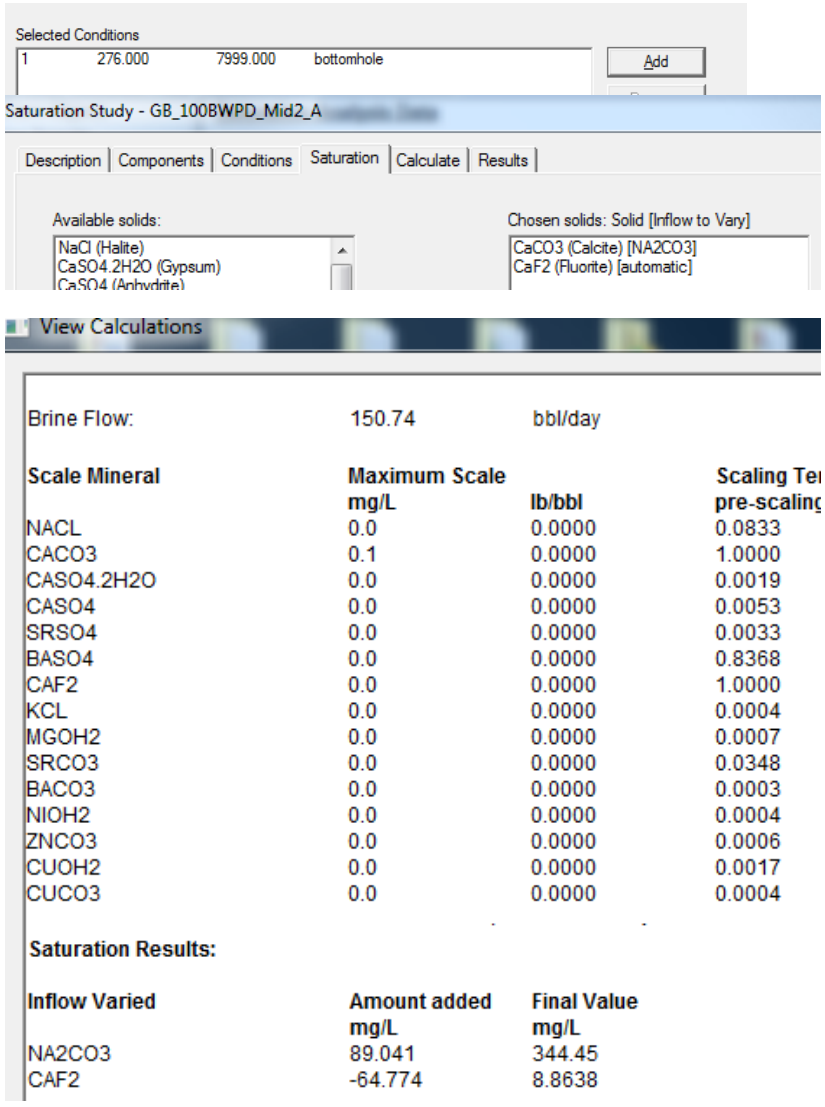
There are two additional streams that are computed from the last scale calculation. They represent the reservoir gas and brine. These are transferred to Studio SC, but are not needed since the optional brine/gas/oil has been eliminated. The inputs to the Scale scenario in Studio SC were therefore changed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





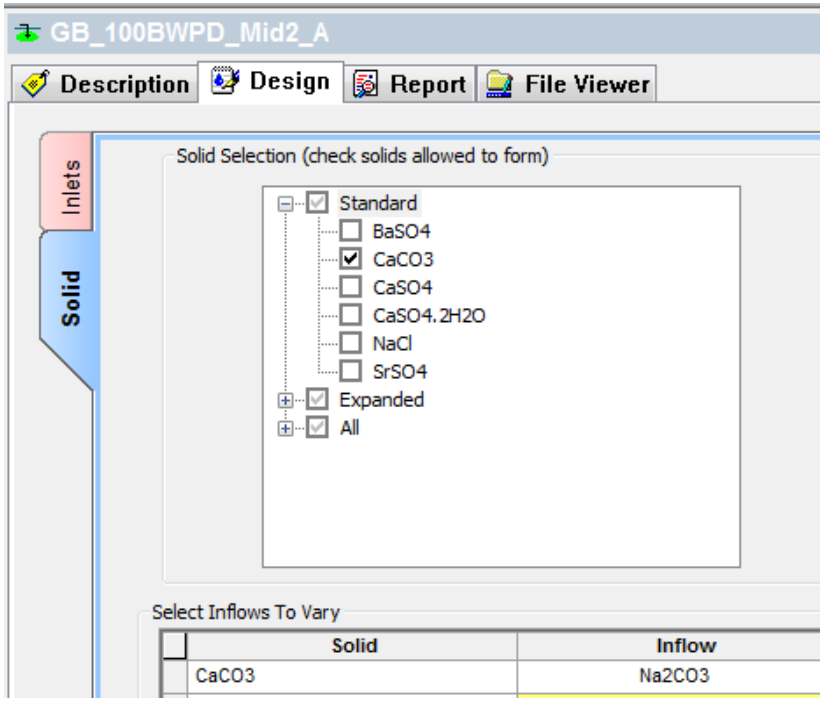
ScaleChem Std Screen – Saturate

Settings – CaCO3, CaF2 sat,



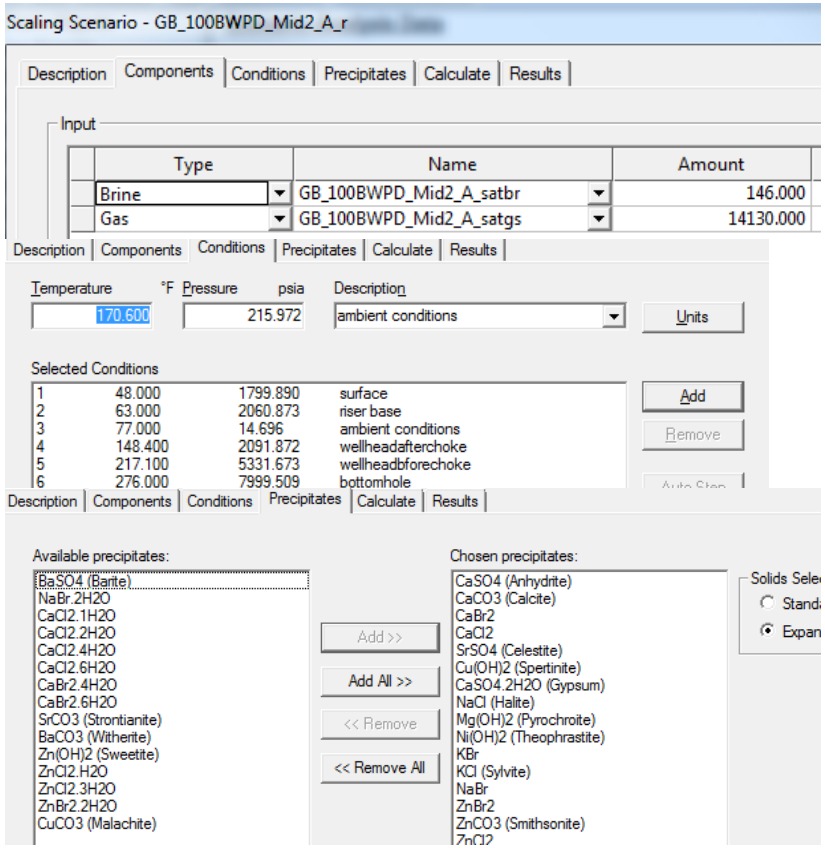
Studio ScaleChem Screen – Saturate

Settings – The Saturated solids did not transfer



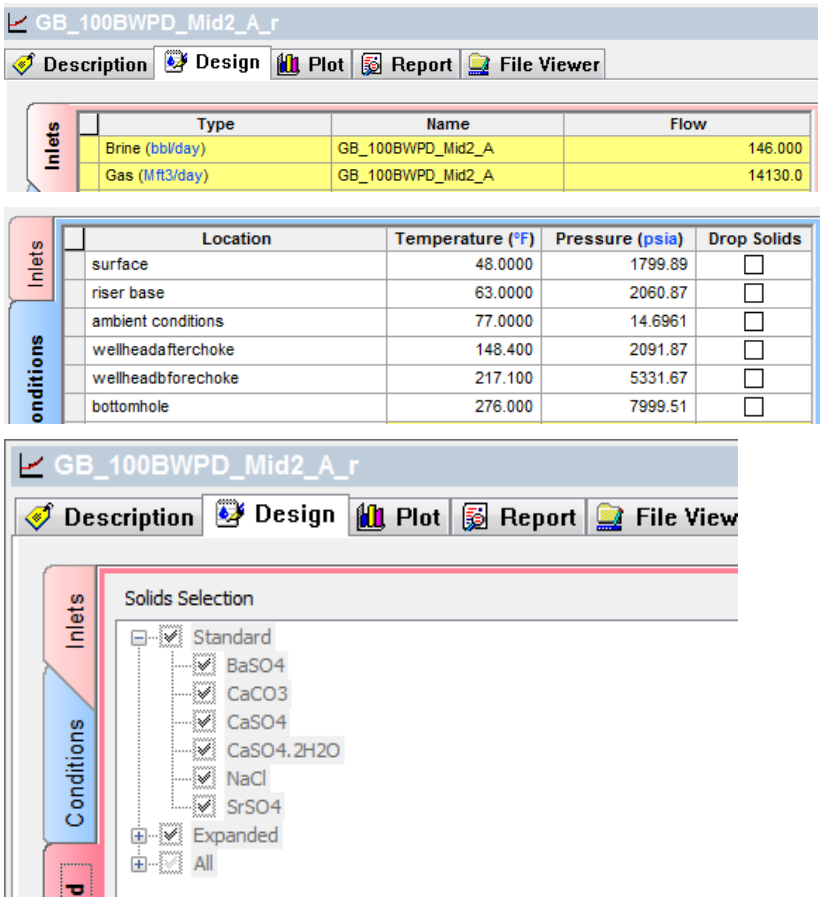
ScaleChem Std Screen – Scale Scenario

Settings – Six conditions, most solids, no special conditions



Studio ScaleChem Screen – Scale Scenario

Settings – The scaling solids did not transfer



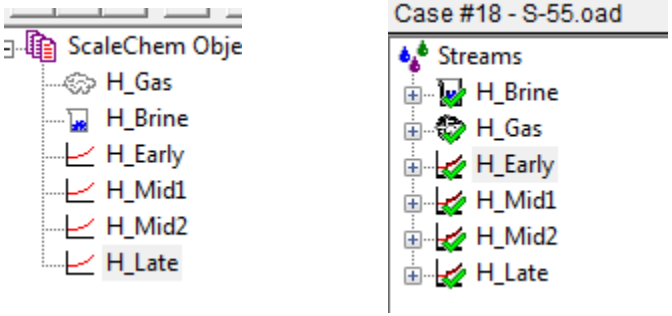
ScaleChem Std							
Pressure	pH	CAF2-pST	CACO3-pST	BASO4-pST	CACO3 mg/l	BASO4 mg/l	CAF2 mg/l
1799.89	5.5	22.3	0.1	3.4	0.0	13.9	6.9
2060.87	5.6	15.3	0.1	3.2	0.0	13.3	6.5
14.696	6.7	83.2	15.6	5.6	133.4	25.3	12.1
2091.87	5.6	11.0	0.1	3.0	0.0	13.0	6.1
5331.67	5.6	3.9	0.2	2.1	0.0	9.9	4.3
7999.51	5.8	1.0	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

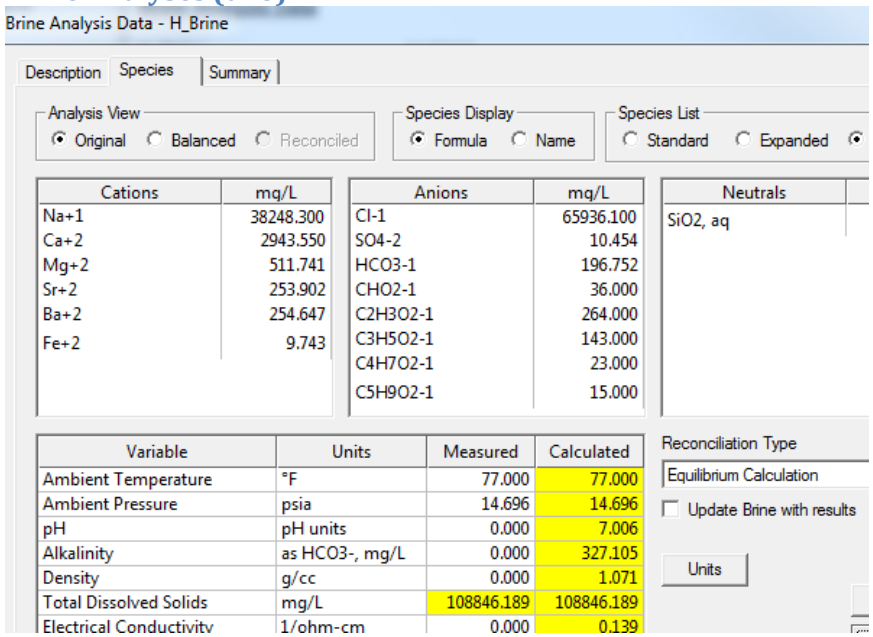
This file contains two brines, one gas and four scale scenario. This is a straightforward case, and was selected for review because the brine contained high concentrations of organic acids and silica and the gas contained all the hydrocarbons plus ammonia. The scale scenarios are for different well phases,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

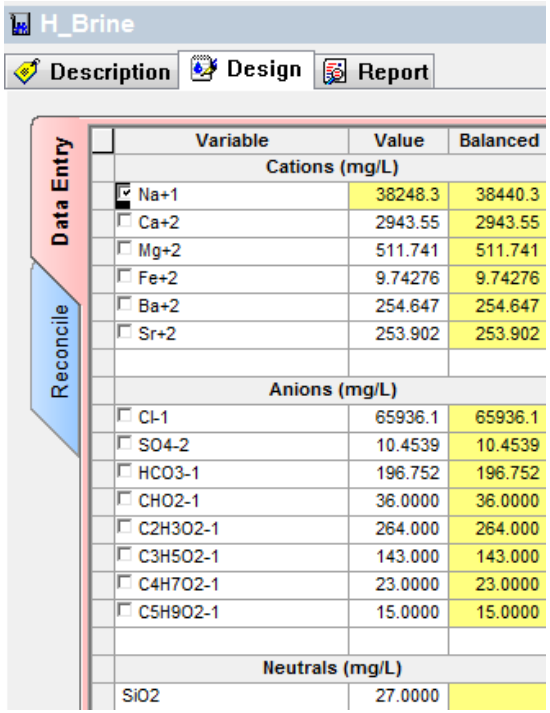
The ScaleChem Std default had second liquid off. This created an initial difference in the results between the two software. The 2nd liquid was turned on, and these are the results that are presented below.

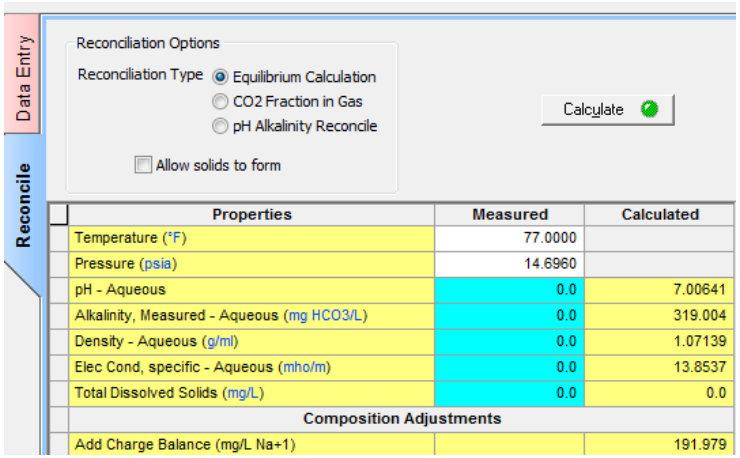
The scale tendency results are consistent between the two software, with the exception of one scenario, Mid2, which shows significant difference for FeCO3 and CaSO4. However, these solid phases are well below saturation, so this difference is due to the difference of small numbers, and it does not affect overall decisions about scaling.



Brine Analyses (two)







	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%

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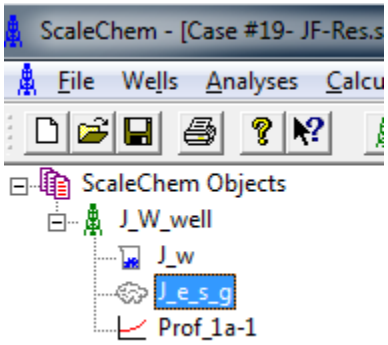
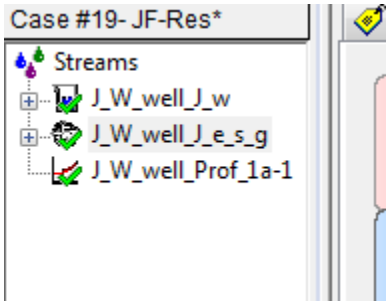
Case #19 – JF-Res

This file contains One brine, two gases, and two scale scenarios. The Brine analyses are similar, with no difference in the amount of HCl/CO2 required to set the pH and Alkalinity. The gas analysis however differs. The H2O saturation is not automatically included in SCStd. As a result, the H2O saturation sent to the scale scenario is 0.528. By comparison, the H2O 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.

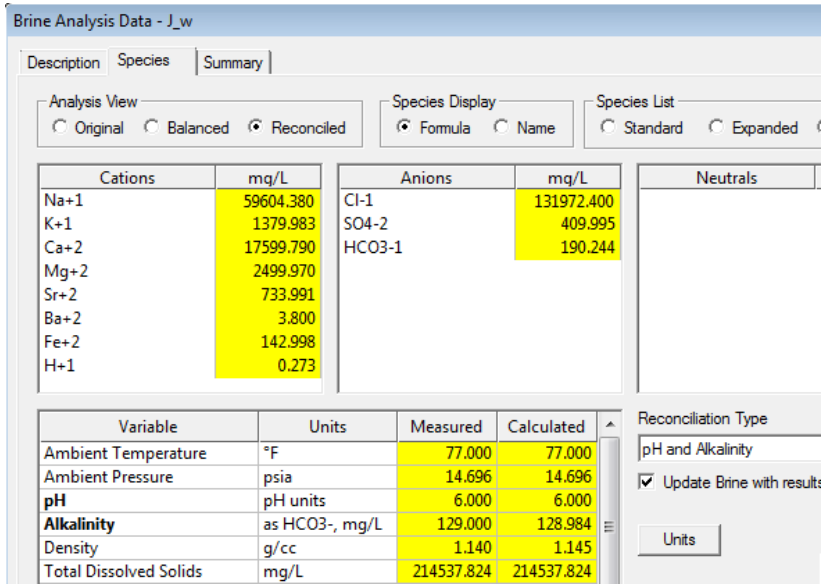
There is significant difference in the scaling results between the two software. This is the most severe of the cases observed. It appears to be due to calculations in water volume. StudioSC computes a water volume that is between 4 and 100 times larger than ScaleChem STd. This data is presented in the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





ScaleChem Std Screen – Brine Analysis

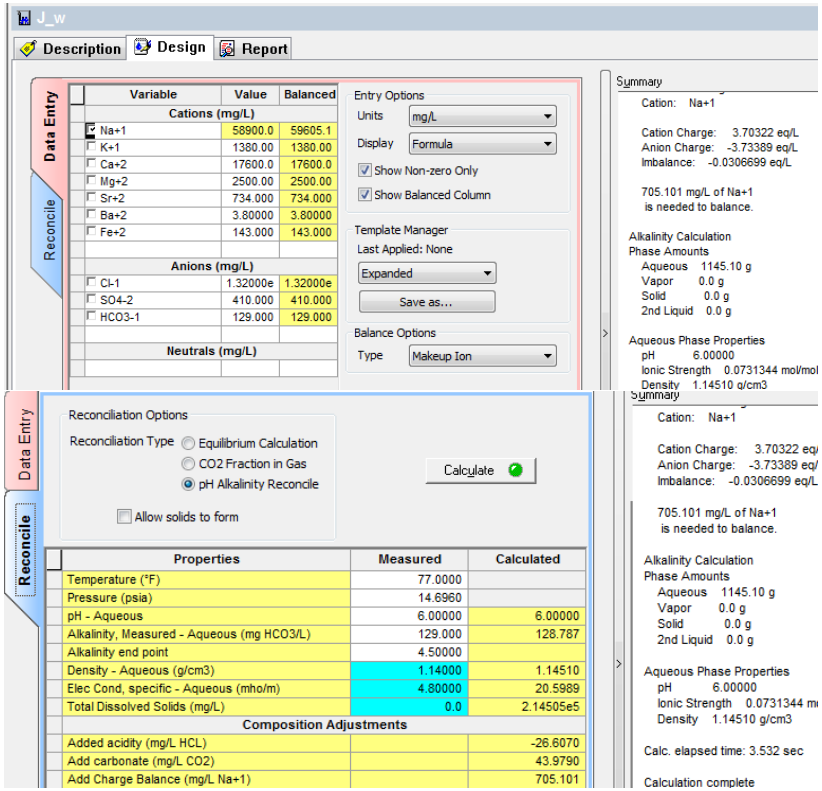
Settings –Expanded, Na/Cl, pH&Alk



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

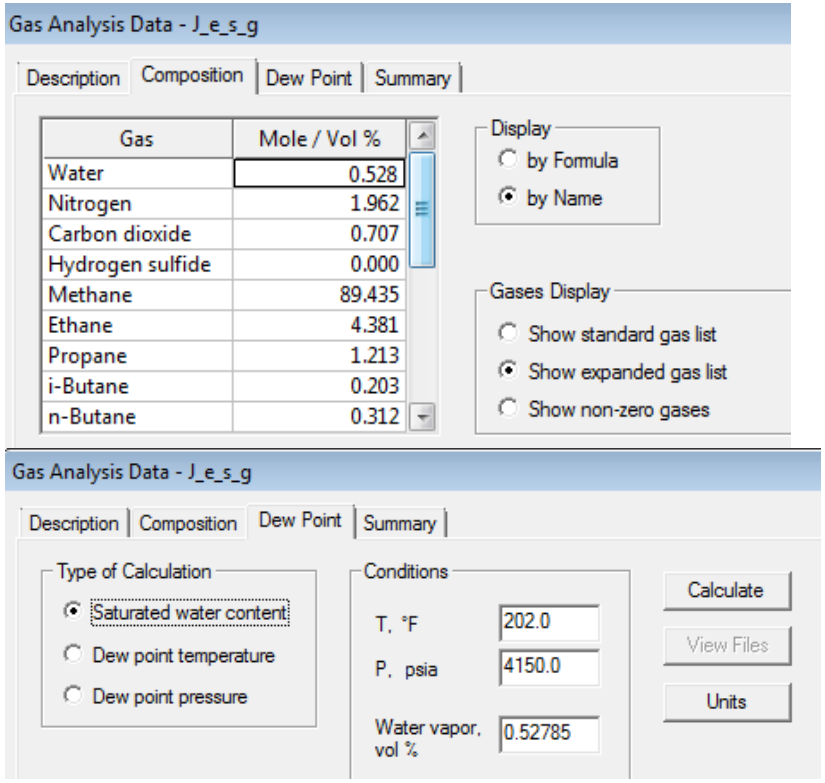
Settings – Expanded, Makeup (Na+), pH&Alk



Notes – The results are the same. Nothing new observed

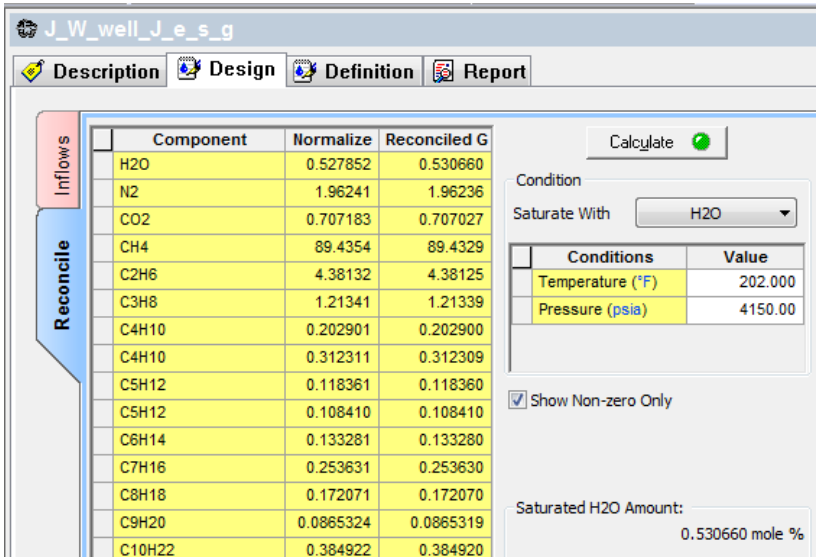
ScaleChem Std Screen – Gas Analysis

Settings – Expanded, H2O Sat On

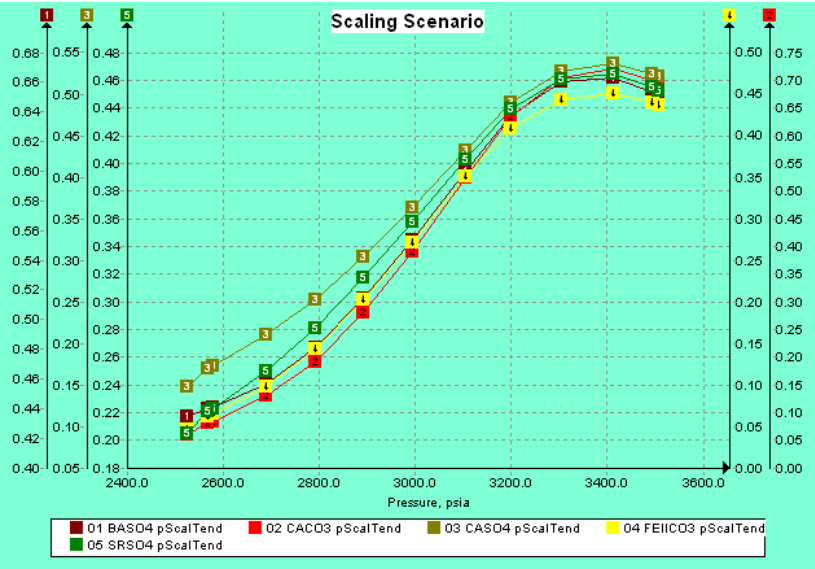


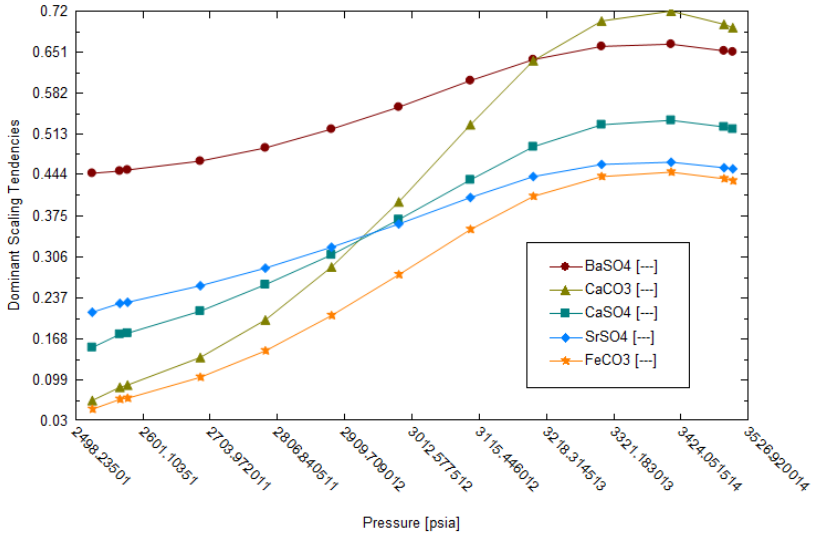
Studio ScaleChem Screen – Gas Analysis

Settings – Expanded gas, H2O sat on for both



Notes –. Results are the same





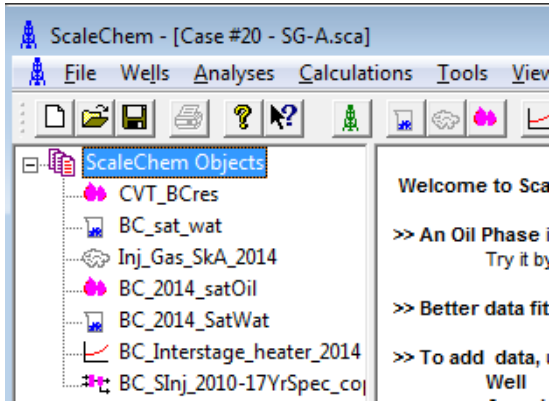
ScaleChem Std									
Pressure	KgMoles (Aq)	Water Vol (bbl/day)	pH	BASO4	CACO3	CASO4	FEIICO3	NACL	SRSO4
3503	119	13	5.2	0.65	0.68	0.52	0.432	0.085	0.45
3490	119	13	5.2	0.65	0.69	0.52	0.435	0.086	0.45
3409	117	13	5.3	0.66	0.71	0.53	0.446	0.089	0.46
3302	118	13	5.3	0.65	0.70	0.52	0.439	0.088	0.46
3198	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

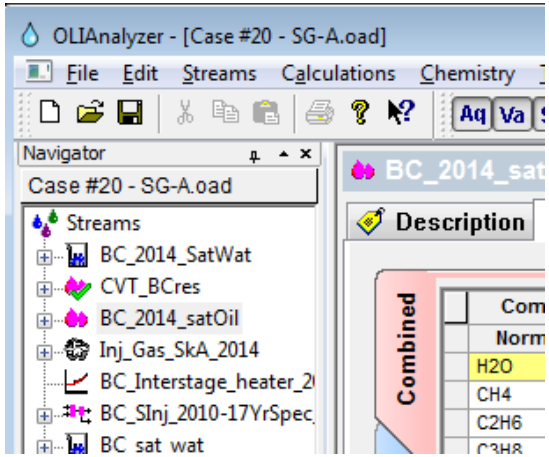
3490	481	56	4.8	0.14	0.024	0.092	0.018	3.64E-03	0.09
3409	383	45	4.9	0.18	0.041	0.119	0.031	5.66E-03	0.11
3302	425	50	4.9	0.16	0.032	0.105	0.024	4.63E-03	0.10
3198	887	103	4.6	0.08	0.006	0.044	0.005	1.16E-03	0.04
3102	2674	311	4.4	0.02	0.001	0.011	0.001	1.55E-04	0.012
2992	5907	687	4.2	0.010	0.000	0.004	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 sill 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.

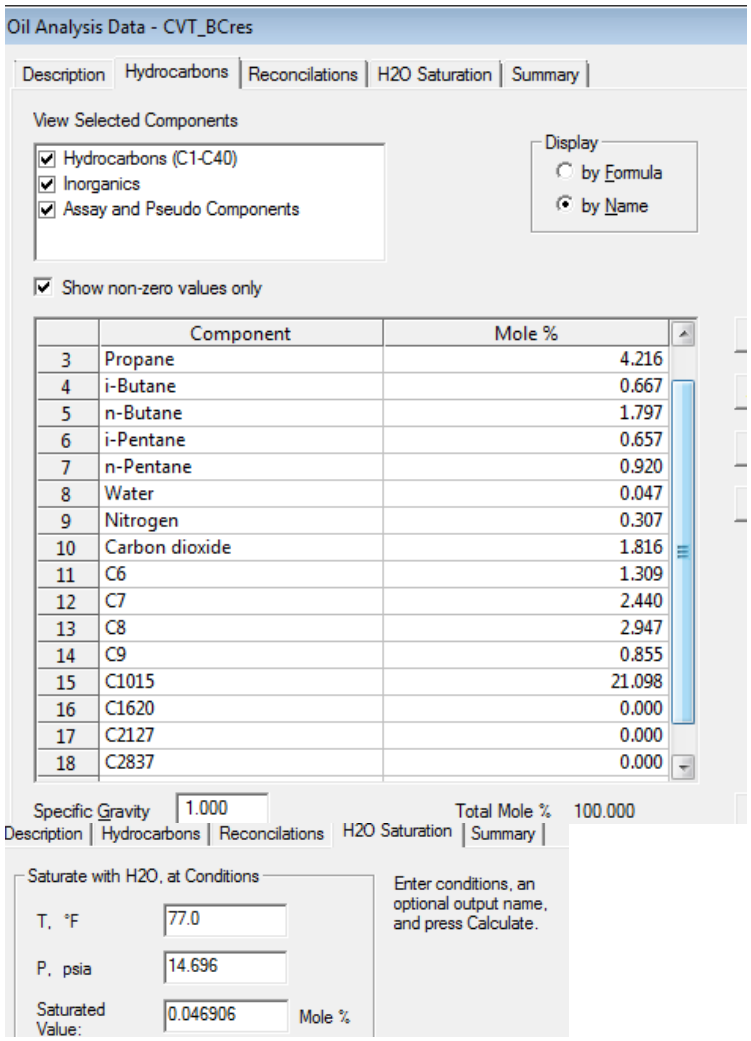




The brines and gas analyses are similar between ScaleChem Std and Studio SC. Their results are not presented.

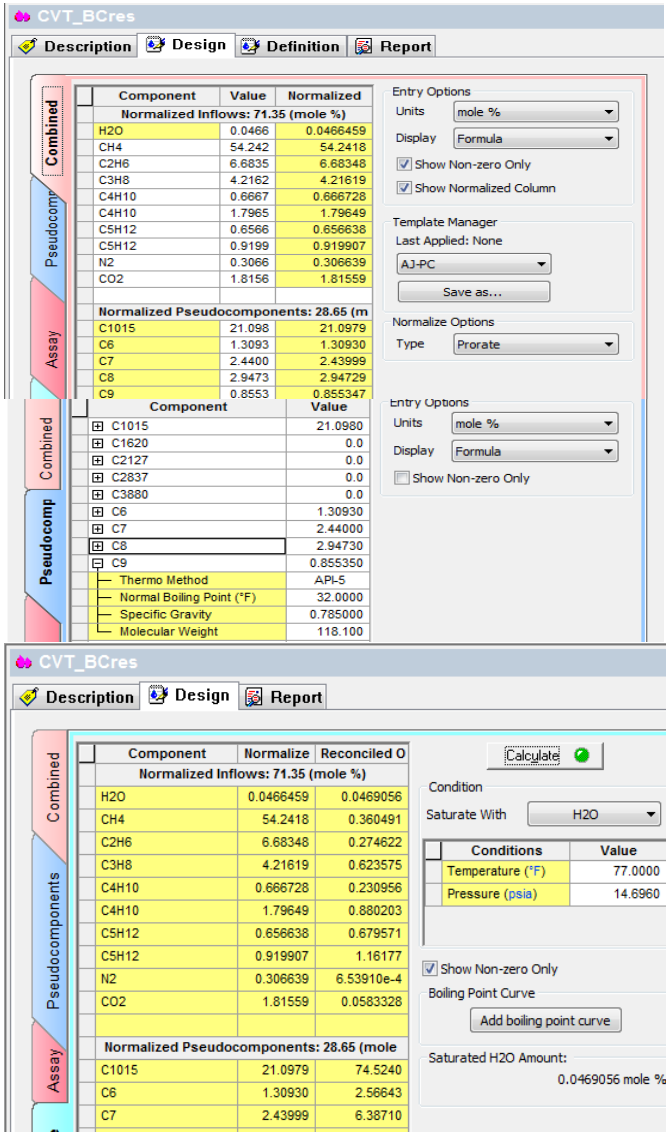
ScaleChem Std Screen – Oil Analysis

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



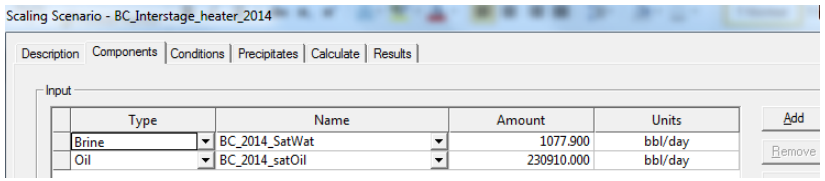
Studio ScaleChem Screen – Oil Analysis

Settings – Pure/Pseudo Comp., no Water Sat



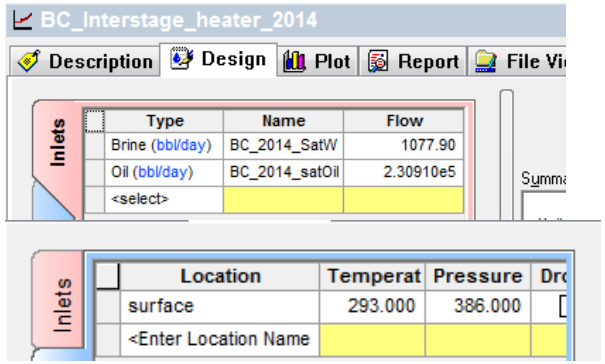
Scale Scenario – BC-Interstage Heater

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



Scale Scenario – BC-Interstage Heater

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



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		kscf/day
Oil Flow:	2.31E+05	2.31E+05	bbl/day

Components	Oil Mole %	Components	Oil Mole %
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	☑
2	Node2		293.0	386.0	☑

Add / Remove / Units

Node1 Inlets

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

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

Add / Remove / Units / More...

Node2 Inlets

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

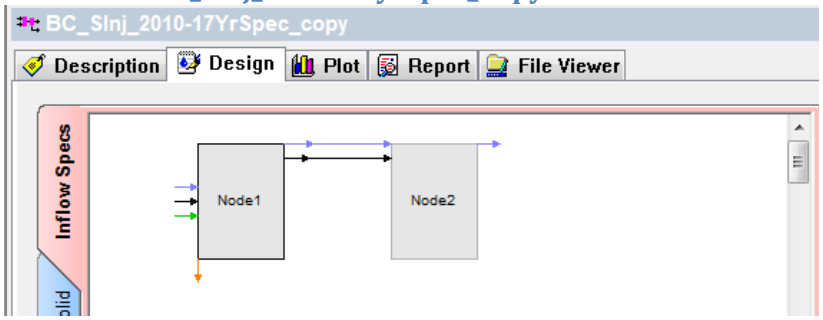
Type	Name	Amount	
Brine fro...	Node1	Calculated	Carry soli...
Oil from ...	Node1	Calculated	Drop solids

Add / Remove / Units

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>		

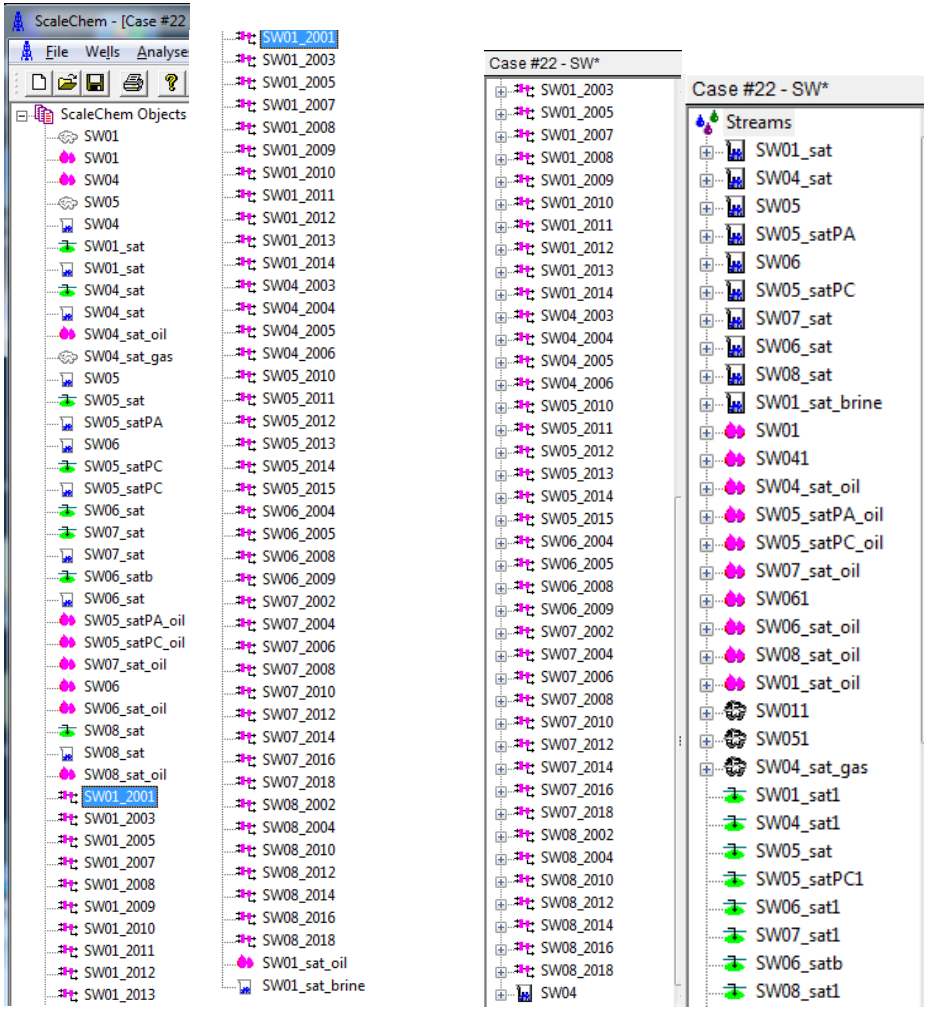
NODE	CACO3 mg/l	CACO3-pST	pH
1	271.5	8.19	5.21
2		8.19	5.21

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 different 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
SW04_sat_oil
SW04_sat_gas
SW05
SW05_sat
SW05_satPA
SW06
SW05_satPC
SW05_satPC
SW06_sat
SW07_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

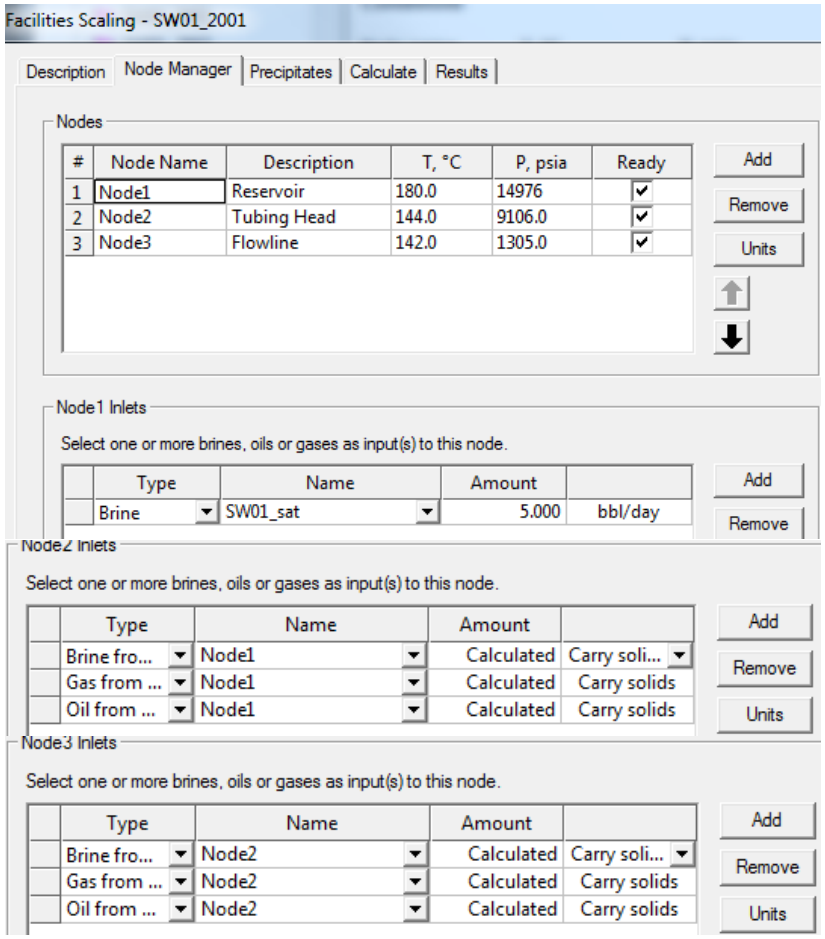
There are fifty facility calculations in the ScaleChem file and the first fifteen facilities were computed. There was little difference for most of the facility objects. However, several of them produced significant differences;

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 CaCO3 scale mass. This is similar to what was observed in Case #20.

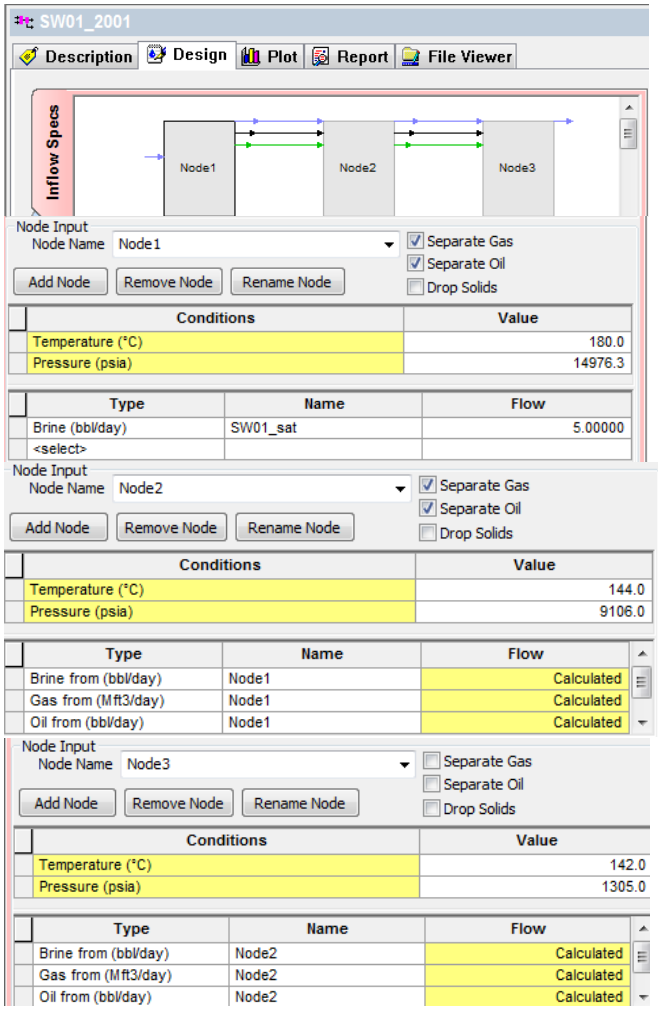
Secondly, none of the scales selected for precipitation in the ScaleChem facilities objects were imported to the StudioSC objects. Therefore, users would need to check to be sure that these scales are selected before running the calculation.

c

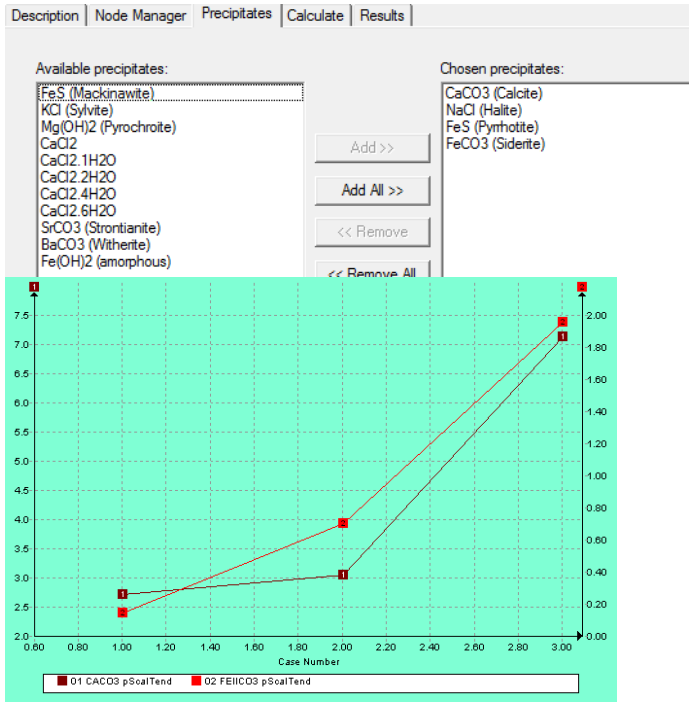
ScaleChem Std Screen – Facilities

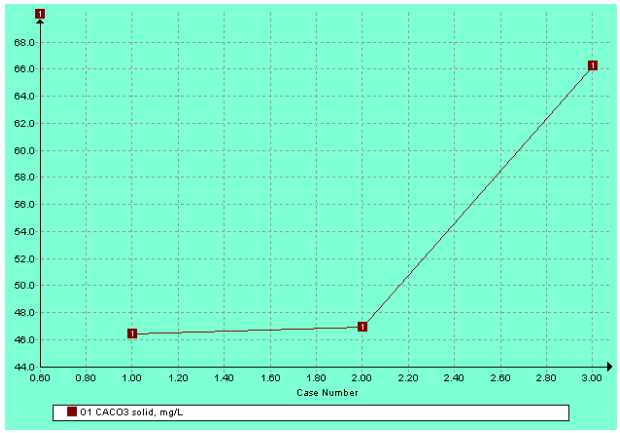


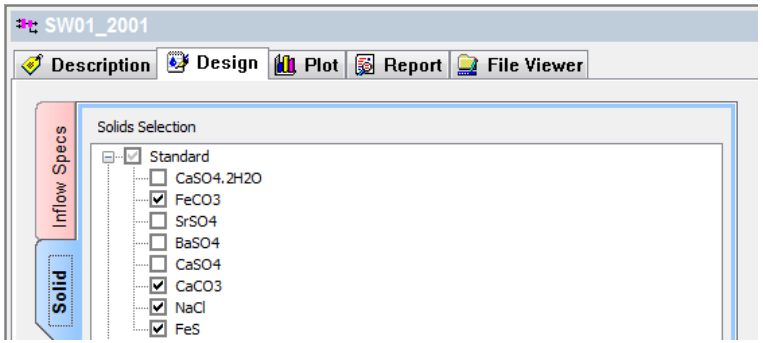
Studio ScaleChem Screen – Facilities

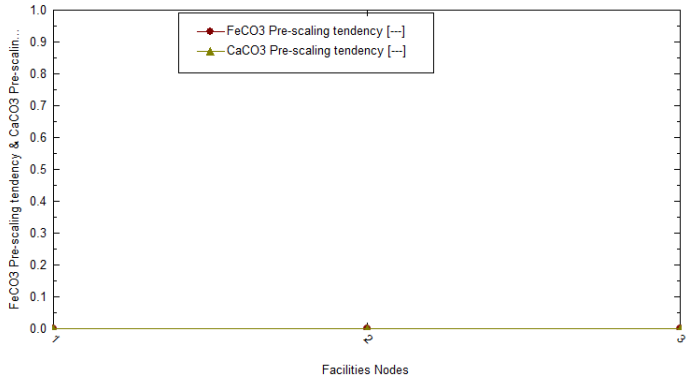


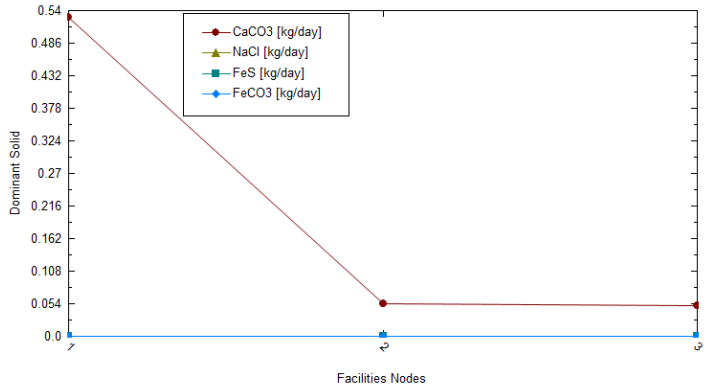
Notes –

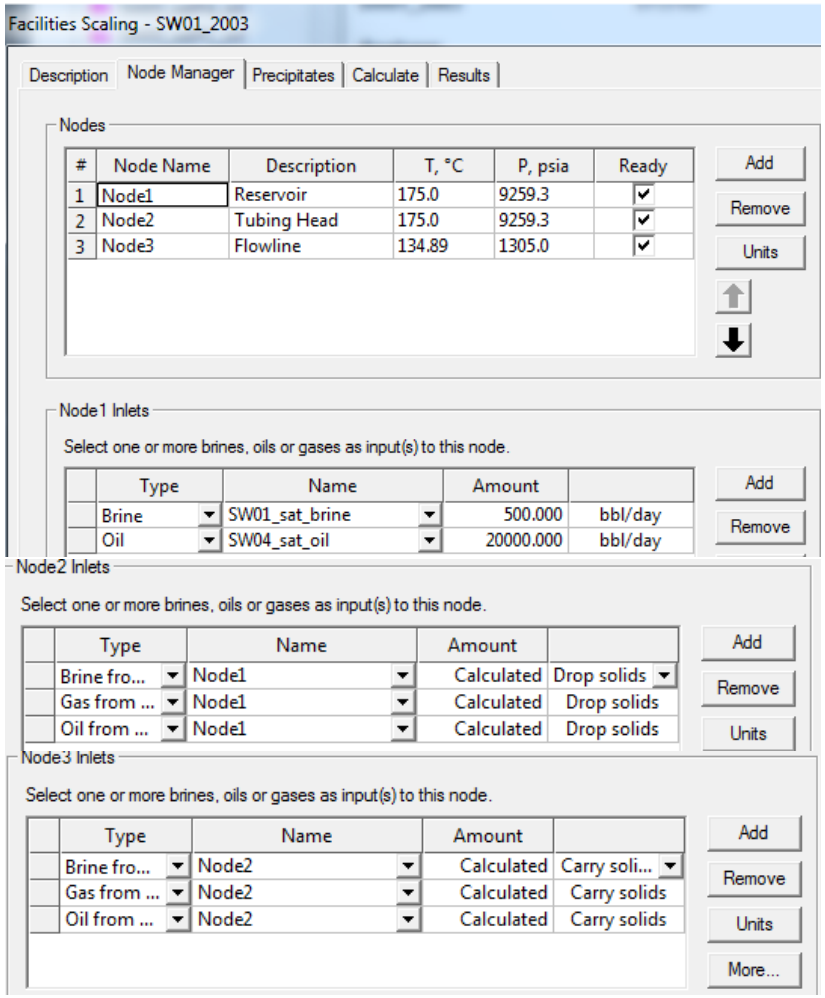

Description
Node Manager
Precipitates
Calculate
Results
Available precipitates:
FeS (Mackinawite)
KCl (Sylvite)
Mg(OH)2 (Pyrochroite)
CaCl2
CaCl2.1H2O
CaCl2.2H2O
CaCl2.4H2O
CaCl2.6H2O
SrCO3 (Strontianite)
BaCO3 (Witherite)
Fe(OH)2 (amorphous)
Add >>
Add All >>
<< Remove
<< Remove All
Chosen precipitates:
CaCO3 (Calcite)
NaCl (Halite)
FeS (Pyrrhotite)
FeCO3 (Siderite)
Case Number
01 CACO3 pScalTend
02 FEIICO3 pScalTend

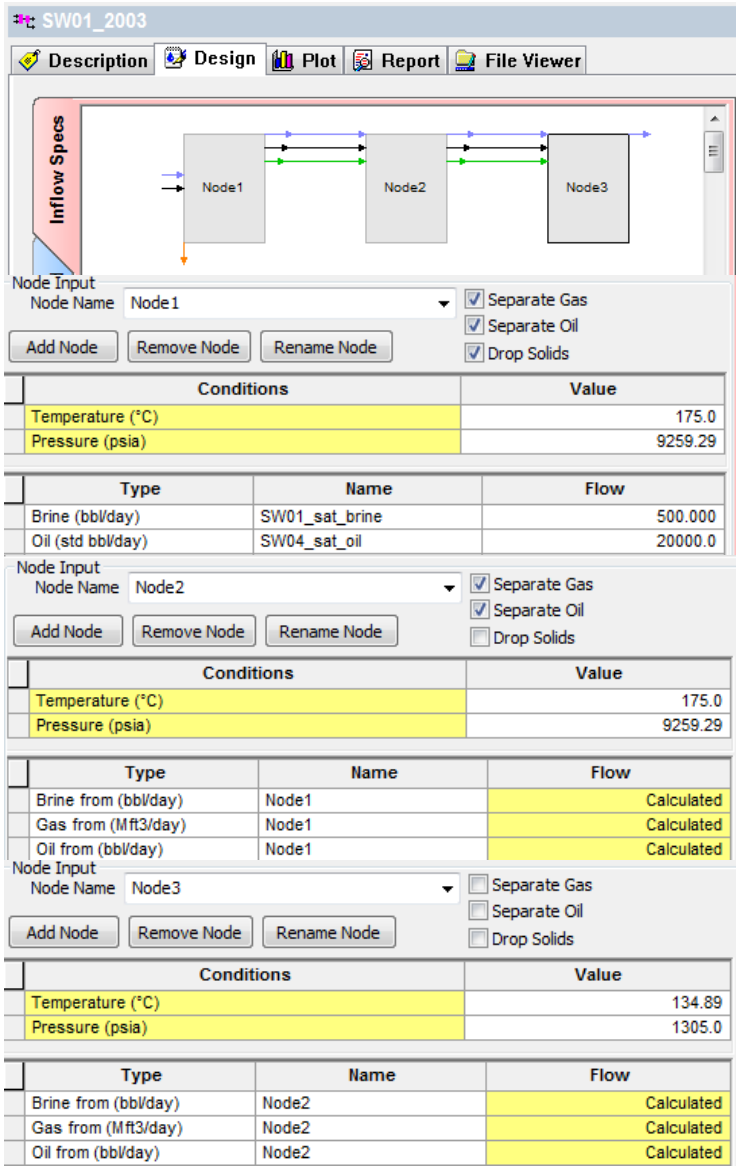

Case Number
01 CACO3 solid, mg/L

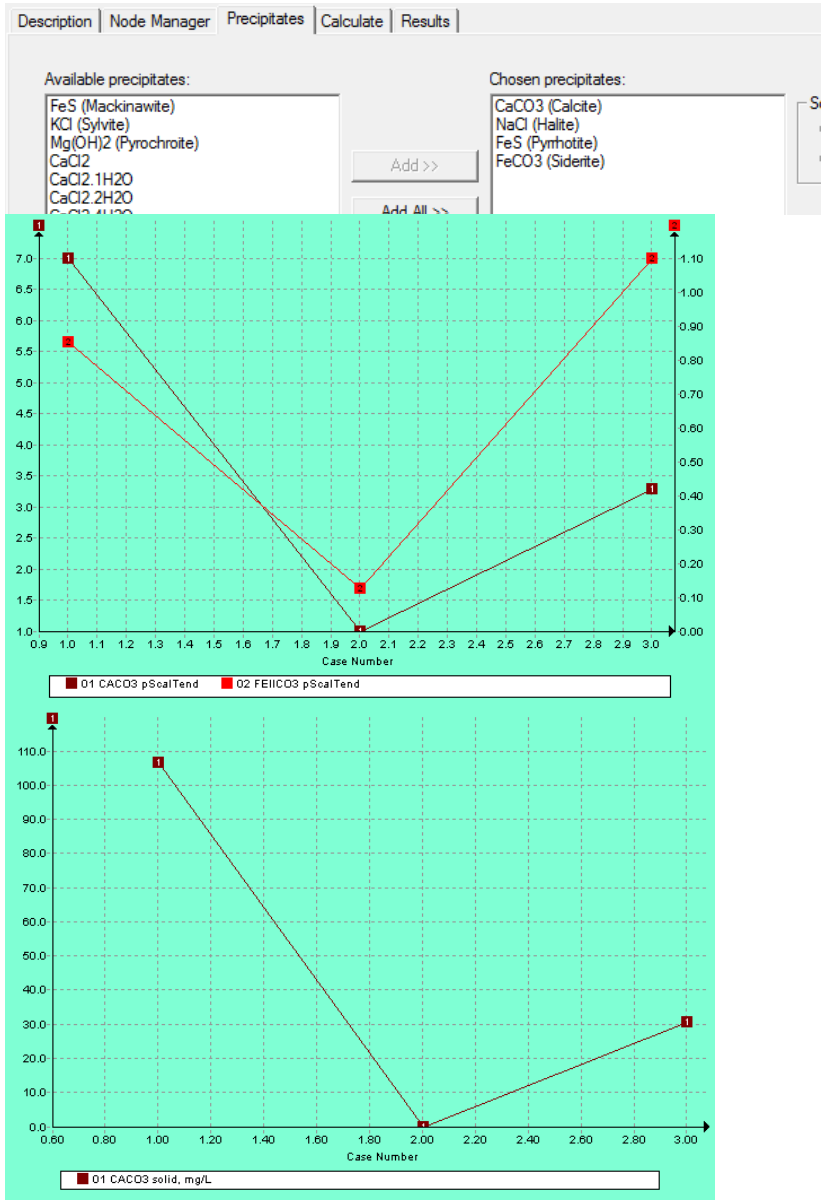

SW01_2001
Description
Design
Plot
Report
File Viewer
Inflow Specs
Solid
Solids Selection
Standard
CaSO4.2H2O
FeCO3
SrSO4
BaSO4
CaSO4
CaCO3
NaCl
FeS

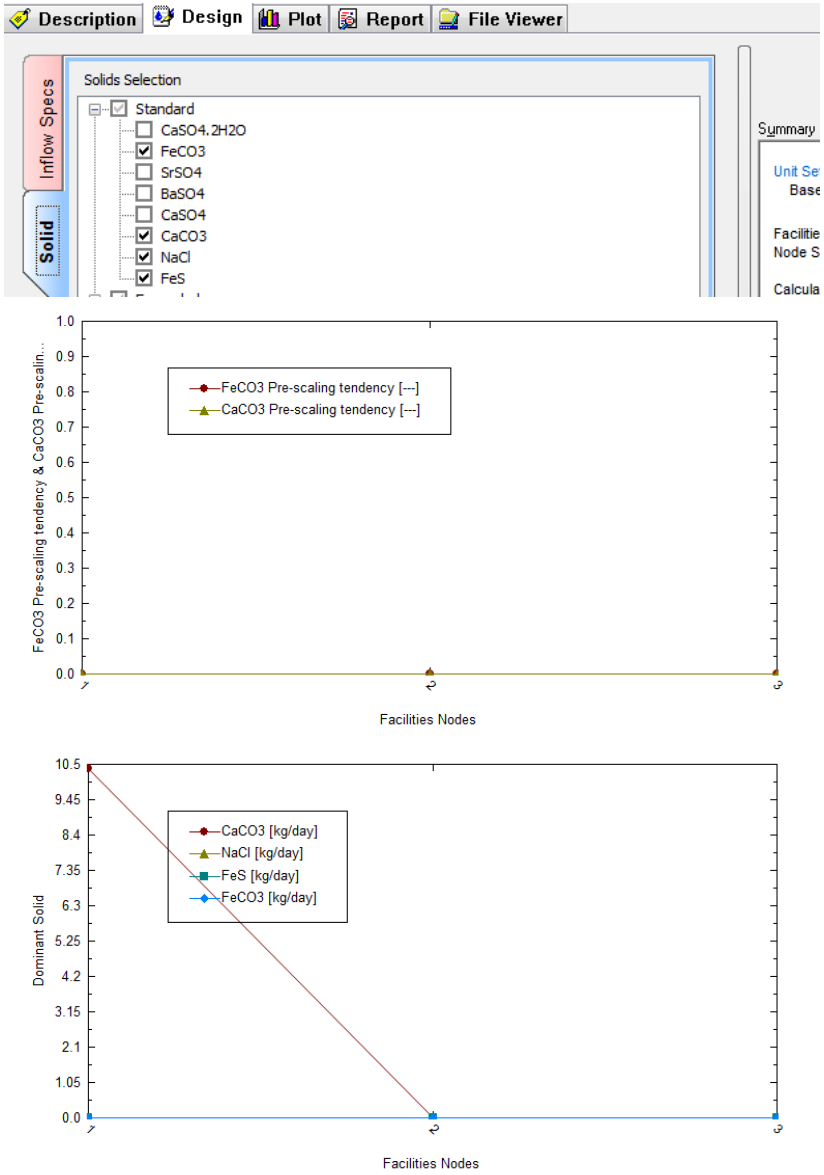

FeCO3 Pre-scaling tendency [---]
CaCO3 Pre-scaling tendency [---]
FeCO3 Pre-scaling tendency & CaCO3 Pre-scalin...
Facilities Nodes


CaCO3 [kg/day]
NaCl [kg/day]
FeS [kg/day]
FeCO3 [kg/day]
Dominant Solid
Facilities Nodes


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
2 | Node2 | Tubing Head | 175.0 | 9259.3
3 | Node3 | Flowline | 134.89 | 1305.0
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 fro... | 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 fro... | 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
Node1
Node2
Node3
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
Add >>
Add All >>
Chosen precipitates:
CaCO3 (Calcite)
NaCl (Halite)
FeS (Pyrrhotite)
FeCO3 (Siderite)
Case Number
01 CACO3 pScalTend
02 FEIICO3 pScalTend
Case Number
01 CACO3 solid, mg/L


Description
Design
Plot
Report
File Viewer
Inflow Specs
Solid
Solids Selection
Standard
CaSO4.2H2O
FeCO3
SrSO4
BaSO4
CaSO4
CaCO3
NaCl
FeS
Summary
FeCO3 Pre-scaling tendency [---]
CaCO3 Pre-scaling tendency [---]
FeCO3 Pre-scaling tendency & CaCO3 Pre-scalin...
Facilities Nodes
CaCO3 [kg/day]
NaCl [kg/day]
FeS [kg/day]
FeCO3 [kg/day]
Dominant Solid
Facilities Nodes

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	