

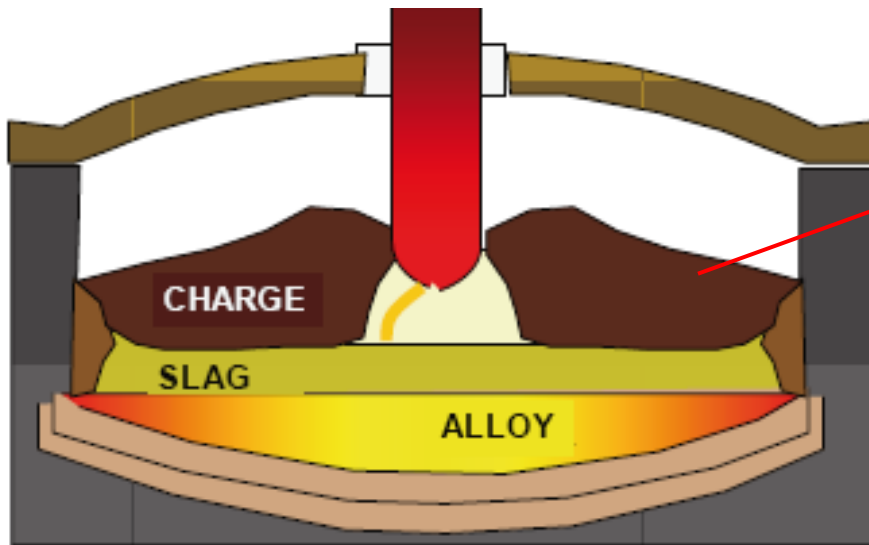
Case Study 9

Ferronickel production

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Ferronickel production



| Calcined Laterite | wt% | Char | wt% |
|--------------------------------|------|--------------------------------|------|
| FeO | 8.1 | Al ₂ O ₃ | 4.8 |
| Fe ₂ O ₃ | 20.9 | SiO ₂ | 14 |
| SiO ₂ | 43.8 | C | 81.2 |
| Al ₂ O ₃ | 6.4 | | |
| MgO | 16.8 | | |
| NiO | 2.3 | | |
| CaO | 0.1 | | |
| CoO | 0.1 | | |
| Cr ₂ O ₃ | 0.8 | | |
| MnO ₂ | 0.6 | | |
| Na ₂ O | 0.3 | | |

After removal of moisture from the laterite, char is added to react with calcined laterite.

Productions are Slag and Alloys(Fe-Ni).

After the calcination, the temperature of laterite is assumed as 500°C
Char is assumed to be added at 100°C in the EAF and react at 1600°C

We are considering **gas**, **slag** and **Fe-alloys** in this case study.

**Determine the amount of reductant
needed to produce Fe-Ni with 25% nickel**
Composition Target

Reactants Window - Laterite + Char

Reactants Window

Reactants - Equilib

File Edit Table Units **Data Search** Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

1 - 10 | 11 - 14 |

| Mass(g) | Species | Phase | T(C) | P(total)** | Stream# | Data |
|-----------|-------------------------------|-------------------------|------|------------|---------|--------|
| 8,1 | FeO | solid-FactPS wustite | 500 | 1 | 1 | FactPS |
| + 20,9 | Fe2O3 | solid-1-FToxid hematit | 500 | 1 | 1 | FToxid |
| + 43,8 | SiO2 | solid-1-FToxid quartz(l | 500 | 1 | 1 | FToxid |
| + 6,4 | Al2O3 | solid-4-FToxid corundi | 500 | 1 | 1 | FToxid |
| + 16,8 | MgO | solid-FToxid periclase | 500 | 1 | 1 | FToxid |
| + 2,3 | NiO | solid-FToxid | 500 | 1 | 1 | FToxid |
| + <4.8A> | Al2O3 | solid-4-FToxid corundi | 100 | 1 | 2 | FToxid |
| + <14A> | SiO2 | solid-1-FToxid quartz(l | 100 | 1 | 2 | FToxid |
| + <81,2A> | Al2O3: Mol. Wt. = 101.9612772 | S graphit | 100 | 1 | 2 | FactPS |
| + 0,1 | CaO | solid-FToxid lime | 500 | 1 | 1 | FToxid |

Initial Conditions

Next >>

FactSage 6.3 Compound: 3/19 databases Solution: 2/19 databases

Reactants Window - Laterite + Char at 1600°C

Data Search

Data Search

Databases - 3/19 compound databases, 2/19 solution databases

| | | | |
|---|---|---------------------------------|--------------------------------|
| <input checked="" type="checkbox"/> FactPS | <input type="checkbox"/> FScopp | <input type="checkbox"/> BINS | <input type="checkbox"/> EXAM |
| <input checked="" type="checkbox"/> FToxid | <input type="checkbox"/> FSlead | <input type="checkbox"/> SGPS | <input type="checkbox"/> SGTE# |
| <input type="checkbox"/> FTsalt | <input type="checkbox"/> FSlite | <input type="checkbox"/> SGTE | <input type="checkbox"/> SGTE* |
| <input type="checkbox"/> FTmisc | <input checked="" type="checkbox"/> FSstel | <input type="checkbox"/> SGnobl | |
| <input type="checkbox"/> FTball | <input type="checkbox"/> FSnobl | <input type="checkbox"/> SGsold | |
| <input type="checkbox"/> FTDxCN | <input type="checkbox"/> FSupsi | <input type="checkbox"/> SGnucl | |
| <input type="checkbox"/> FTfritz | | | |
| <input type="checkbox"/> FTthelg | | | |
| <input type="checkbox"/> FTpulp | <input type="checkbox"/> ELEM | Other | |
| <input type="checkbox"/> FTlite | <input type="checkbox"/> FTdemo | <input type="checkbox"/> TDnucl | |

compounds only
solutions only
no database

Clear All
Select All
Add/Remove Data
RefreshDatabases

Information -
Click on a box to include (or exclude) a database in the data search. Normally databases are 'coupled' - that is both the compound and solution database (when available) will be selected. To 'uncouple' a databases click-mouse-right-button (note, this is NOT recommended).
If database is stored on your PC but not listed here then you must 'add the database to the list' - click on 'Add/Remove ...'

Options

Default

Include

- gaseous ions (plasmas)
- aqueous species
- limited data compounds (25C)

Limits

Organic species CxHy..., X(max) =

Minimum solution components: 1 2 cpts

Cancel Summary ... OK

Menu Window - Laterite + Char at 1600°C

Menu - Equilib: comments

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants [14]

(gram) 20.9 Fe + 8.1 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 + 16.8 MgO +
 (500C,s2-FSstel,#1) (500C,s1-FToxid,#1) (500C,s1-FToxid,#1) (500C,s4-FToxid,#1) (500C,s-FToxid,#1) (500C,s-FToxid,#1)

Products

Compound species
 + gas ideal real 51
 aqueous 0
 pure liquid 0
 + pure solids 116
 suppress duplicates apply
 * - custom selection species: 167

Gas

Solution species

| * | + | Base-Phase | Full Name |
|---|---|--------------|-----------|
| | C | FSstel-LIQU | LIQUID |
| | + | FSstel-FCC1 | |
| | + | FSstel-BCC1 | |
| | I | FToxid-SLAGA | ASLAGA |
| | I | FToxid-SPINA | |
| | I | FToxid-MeO_A | |
| | + | FToxid-cPyrA | |
| | + | FToxid-oPyr | |

Custom Solutions
 fixed activities
 ideal solutions
 activity coefficients

Composition target
 Element Ni - FSstel-LIQU
 Estimate ALPHA: 1
 Mass(g): 0

Legend
 I - immiscible 4
 C - composition target
 - element: Ni

Final Conditions

| <A> | | T(C) | P(atm) |
|-----|-----|------|--------|
| | | 1600 | 1 |

10 steps Table

FactSage 6.3 C:\...\EquiReactor_Composition_Target-10Ni-No1-

Selection of Gas phases

Selection - Equilib - no results -

File Edit Show Sort

Selected: 51/53 GAS Duplicates selected.

- no results -

| | Code | Species | Data | Phase | T | V | Activity | Minimum | Maximum |
|---|------|---------|--------|-------|---|---|----------|---------|---------|
| | 1 | O2(g) | FSstel | g | | | | | |
| | 2 | Al(g) | FSstel | gas | | | | | |
| + | 3 | C(g) | FactPS | gas | | | | | |
| + | 4 | C2(g) | FactPS | gas | | | | | |
| + | 5 | C3(g) | FactPS | gas | | | | | |
| + | 6 | C4(g) | FactPS | gas | | | | | |
| + | 7 | C5(g) | FactPS | gas | | | | | |
| + | 8 | O(g) | FactPS | gas | | | | | |
| + | 9 | O2(g) | FactPS | gas | | | | | |
| + | 10 | O3(g) | FactPS | gas | | | | | |
| + | 11 | CO(g) | FactPS | gas | | | | | |
| + | 12 | C2O(g) | FactPS | gas | | | | | |
| + | 13 | CO2(g) | FactPS | gas | | | | | |
| + | 14 | C3O2(g) | FactPS | gas | | | | | |

Show Selected Select All Select/Clear... Clear OK

Menu Window - Laterite + Char at 1600°C

Menu - Equilib: comments

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants [14]

(gram) 20.9 Fe + 8.1 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 + 16.8 MgO +
 (500C,s2-FSstel,#1) (500C,s1-FToxid,#1) (500C,s1-FToxid,#1) (500C,s4-FToxid,#1) (500C,s-FToxid,#1) (500C,s-FToxid,#1)

Products

Compound species
 * + gas ideal real 51
 aqueous 0
 pure liquids 0
 pure solids 116
 suppress duplicates apply

Pure solids 167

Composition target
 Element Ni - FSstel-LIQU
 Estimate ALPHA: 1
 Mass(g): 0

Final Conditions

<A> T(C) P(atm) Delta H(kJ/mol)

10 steps Table 10

FactSage 6.3 C:\...\EquiReactor_Composition_Target-10Ni-No1-a.DAT

Selection of Solid phases

Selection - Equilib - no results -

File Edit Show Sort

Selected: 116/456 **SOLID** Duplicates selected

| + | Code | Species | Data | Phase | T | V | Activity | Minimum | Maximum |
|---|------|---------------|--------|-----------------|---|---|----------|---------|---------|
| + | 220 | MnNi3(s) | FSstel | mnni3_mnni3 | | o | | | |
| + | 221 | Na2O(s) | FToxid | solid-a | | | | | |
| + | 222 | Na2O(s2) | FToxid | solid-b | | | | | |
| + | 223 | Na2O(s3) | FToxid | solid-c | | | | | |
| + | 224 | MgO(s) | FToxid | periclase | | V | | | |
| + | 225 | Al2O3(s) | FToxid | gamma | | | | | |
| + | 226 | Al2O3(s2) | FToxid | delta | | | | | |
| + | 227 | Al2O3(s3) | FToxid | kappa | | | | | |
| + | 228 | Al2O3(s4) | FToxid | corundum(alpha) | | V | | | |
| + | 229 | NaAlO2(s) | FToxid | solid-a | | | | | |
| + | 230 | NaAlO2(s2) | FToxid | solid-b | | | | | |
| + | 231 | NaAlO14(s) | FToxid | beta-alumina | | | | | |
| + | 232 | Na2Al12O19(s) | FToxid | beta2-alumina | | | | | |
| + | 233 | SiO2(s) | FToxid | quartz(l) | | V | | | |

Show Selected Select All Select/Clear... Clear OK

Menu Window - Laterite + Char at 1600°C

Menu - Equilib: comments

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants [14]

(gram) 20.9 Fe + 8.1 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 + 16.8 MgO +
 (500C,s2-FSstel,#1) (500C,s1-FToxid,#1) (500C,s1-FToxid,#1) (500C,s4-FToxid,#1) (500C,s-FToxid,#1) (500C,s-FToxid,#1)

Products

Compound species

- * + gas ideal real 51
- aqueous 0
- pure liquids 0
- * + pure solids 116
- suppress duplicates
- * - custom selection species: 167

Composition target
 Element Ni - FSstel-LIQU
 Estimate ALPHA:
 Mass(g):

Solution species

| * | + | Base-Phase | Full Name |
|---|---|--------------|--------------------------|
| | C | FSstel-LIQU | LIQUID |
| | + | FSstel-FCC1 | FCC_A1 |
| | + | FSstel-BCC1 | BCC_A2 |
| | I | FToxid-SLAGA | ASlag-liq all oxides + S |
| | I | FToxid-SPINA | ASpinel |
| | I | FToxid-MeO_A | AMonoxide |
| | + | FToxid-cPyrA | AClinopyroxene |
| | + | FToxid-oPyr | Orthopyroxene |

Legend
 I - immiscible 4 Show all selected
 C - cc
 - ele

Selection of solutions

Custom Solutions

- fixed activities
- ideal solutions
- activity coefficients
-

Pseudonyms

apply

include molar volumes

Total Species (max 1500) 584
 Total Solutions (max 40) 16

Final Conditions

| <A> | | T(C) | P(atm) | Delta H(J) |
|-----|-----|------|--------|------------|
| | | 1600 | 1 | |

10 steps Table

Equilibrium

- normal normal + transitions
- transitions only
- open
-

FactSage 6.3 C:\...\EquiReactor_Composition_Target-10Ni-No1-a.DAT

Menu Window – Composition Target

The screenshot displays the FactSage software interface. The main window is titled "Menu - Equilib: comments" and shows a list of reactants (14) and a table of base-phases. The "Composition Target" dialog box is open, showing the "Solution ST53-LIQU" and the "Element" dropdown menu set to "Ni". The "Values" section shows the mass fraction for Ni as 0.25 (25%).

Menu - Equilib: comments

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants [14]

Solution FSstel-LIQU

- clear
- all species
- * - custom select species
- m - merge dilute solution from
- solution properties
- + - single phase
- I - possible 2-phase immiscibility
- J - possible 3-phase immiscibility
- standard stable phase
- ! - dormant (metastable) phase
- F - formation target phase
- P - precipitate target phase
- S - Scheil cooling target phase
- D - solidification calculation ...
- C - composition target ...**

| | Base-Phase |
|---|--------------|
| C | FSstel-LIQU |
| + | FSstel-FCC1 |
| + | FSstel-BCC1 |
| I | FToxid-SLAGA |
| I | FToxid-SPINA |
| I | FToxid-MeO_A |
| + | FToxid-cPyrA |
| + | FToxid-oPyr |

Composition Target

Solution ST53-LIQU

Variable

- species composition
- log10 (species composition)
- element composition
- log10 (element composition)
- species activity
- log10(species activity)
- none (removes targets) -

Species

Code numbers (568-586)
Fe, C, Co, ...

568 [Fe]

Element

Elements: C O Mg Al Si Ca Cr Mn Fe Co Ni

Element: [Ni]

Values

Enter a single value - or enter a range of values 'first last step'

Element Ni [0.25] [] []

mass fraction: (25%)

Cancel Help OK

Results Window - Laterite + Char at 1600°C

Results - Equilib 1600 C **A=0.0381**

Output Edit Show Pages

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

FactSage 6.3

```
(gram) 8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +  
(500,1,s-FactPS,#1) (500,1,s1-FToxid,#1) (500,1,s1-FToxid,#1) (500,1,s4-FTox  
(gram) 16.8 MgO + 2.3 NiO + <4.8A> Al2O3 + <14A> SiO2 +  
(500,1,s-FToxid,#1) (500,1,s-FToxid,#1) (100,1,s4-FToxid,#2) (100,1,s1-FToxi  
(gram) <81.2A> C + 0.1 CaO + 0.1 CoO + 0.8 Cr2O3 +  
(100,1,s1-FactPS,#2) (500,1,s-FToxid,#1) (500,1,s-FToxid,#1) (500,1,s-FToxid  
(gram) 0.6 MnO2 + 0.3 Na2O =  
(500,1,s-FToxid,#1) (500,1,s1-FToxid,#1)
```

0.25752 mol gas_ideal
(7.3988 gram, 0.25752 mol, 39.583 litre, 1.8692E-04 gram/cm3)
(1600 C, 1 atm, a=1.0000)

| | | |
|--------------|------|--------|
| (0.95496 | CO | FactPS |
| + 4.4912E-02 | CO2 | FactPS |
| + 6.1427E-05 | Fe | FactPS |
| + 3.8497E-05 | Na | FactPS |
| + 2.1527E-05 | SiO | FactPS |
| + 6.9777E-06 | Ni | FactPS |
| + 1.2003E-06 | Mg | FactPS |
| + 5.0642E-07 | Mn | FactPS |
| + 2.3065E-07 | Co | FactPS |
| + 1.6261E-07 | FeO | FactPS |
| + 1.0555E-07 | Cr | FactPS |
| + 3.7393E-08 | SiO2 | FactPS |
| + 1.9781E-08 | CrO | FactPS |
| + 4.5947E-09 | O | FactPS |
| + 3.0436E-09 | CrO2 | FactPS |
| + 1.4467E-09 | NiO | FactPS |
| + 3.8185E-10 | O2 | FactPS |
| ... | ... | ... |

Laterite 100 g vs Char 0.0381 g
Laterite 1 ton vs Char 0.381 kg

Effect of change of Char - Laterite + Char at 1600°C

Menu - Equilib: change of Ni with adding Char

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants [14]

| | | | | | |
|--------------------|---------------------|---------------------|---------------------|--------------------|----------------------|
| (gram) 8.1 FeO | + 20.9 Fe2O3 | + 43.8 SiO2 | + 6.4 Al2O3 | + 16.8 MgO | + (500C,s-FToxid,#1) |
| (500C,s-FactPS,#1) | (500C,s1-FToxid,#1) | (500C,s1-FToxid,#1) | (500C,s4-FToxid,#1) | (500C,s-FToxid,#1) | (500C,s-FToxid,#1) |

Products

Compound species: 51 (gas ideal real), 0 (aqueous), 0 (pure liquids), 116 (pure solids). suppress duplicates: apply. species: 167.

Solution species

| * | + | Base Phase | Full Name |
|---|---|--------------|--------------------------|
| | + | FSstel-LIQU | LIQUID |
| | + | FSstel-FCC1 | FCC_A1 |
| | + | FSstel-BCC1 | BCC_A2 |
| | | FToxid-SLAGA | ASlag-liq all oxides + S |
| | | FToxid-SPINA | ASpinel |
| | | FToxid-MeO_A | AMonoxide |
| | + | FToxid-cPyrA | AClinopyroxene |
| | + | FToxid-oPyr | Orthopyroxene |

Legend: | - immiscible 4, + - selected 8. Show all selected. species: 417, solutions: 16. Select.

Custom Solutions: 0 fixed activities, 0 ideal solutions, 0 activity coefficients. Details...

Pseudonyms: apply List... include molar volumes. Total Species (max 1500) 584, Total Solutions (max 40) 16. Default.

Final Conditions

| <A> | | T(C) | P(atm) | Delta H(J) |
|-----|-----|-------|--------|------------|
| 0 | 0.1 | 0.005 | 1600 | 1 |

10 steps Table 21 calculations

Equilibrium

normal normal + transitions, transitions only, open. Calculate >>

FactSage 6.3 C:\...\EquiNo6-Fe-Ni_effect_on_Co_and_Cr_composition.DAT

**Change of Char from 0 to 0.1g based on 100g Laterite
Laterite 1 ton vs change of Char from 0 to 1 kg**

Effect of change of Char - Laterite + Char at 1600°C

Results - Equilib A=0 (page 1/21)

Output Edit Show Pages

Save or Print ▶ T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Plot ▶ Plot Results ...

Equilib Results file ▶ Repeat Plot - gram vs Alpha ... =0.045 | A=0.05 | A=0.055 |

Stream File ▶

Format ▶

Fact-XML ▶

Fact-Optimal ▶

Fact-Function-Builder ▶

Refresh ...

8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +

Results Processor: C:\FactSage\Equi0.res

| Axes | Variables | Minimum | Maximum |
|------|---------------|-------------|-------------|
| | activity | 0 | 104.58 |
| | mole | 0 | 2.5887 |
| | mole fract. | 0 | 0.999983 |
| | gram | 0 | 99.429 |
| | weight % | 0 | 99.998 |
| | Alpha | 0 | 0.1 |
| | T(C) | 1600. | 1600. |
| | P(atm) | 1. | 1. |
| | Delta Cp(J) | 19.62 | 82.696 |
| | Delta G(J) | -3.8924E+05 | -2.7358E+05 |
| | Vol(litre) | 0 | 0 |
| | Delta H(J) | 1.7769E+05 | 3.1154E+05 |
| | Delta V(litr) | 3.702 | 101.96 |
| | Delta S(J) | 152.43 | 277.68 |
| | - page - | 1. | 21. |

8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +

Y-axis: weight %

X-axis: Alpha

maximum: 100

minimum: 0

tick every: 5

maximum: 0.1

minimum: 0

tick every: 0.01

Cancel Refresh OK

0 selected

0 selected

Select

Graph

Labels

size: 9 no: 4

chemical

integer #

Display

color full screen

reactants Viewer

file name Figure

Plot >>

FactSage 6.3 C:\FactSage\Equi0.res 6Feb13 21 sets

Effect of change of Char - Laterite + Char at 1600°C

Species Selection - EQUILIB Results: gram vs Alpha

| + | # | Species | Gram (min) | Gram (max) | Wt.% (min) | Wt.% (max) | Activity (min) | Activity (max) |
|---|---------------------|------------|------------|------------|------------|------------|----------------|----------------|
| | 48 | Co(g) | 5.6271E-11 | 4.5397E-06 | 7.3018E-09 | 8.9375E-05 | 3.9645E-11 | 4.5347E-07 |
| | 49 | Ni(g) | 2.4118E-08 | 2.3166E-04 | 3.1296E-06 | 5.3523E-03 | 1.7062E-08 | 3.2792E-05 |
| | 50 | NiO(g) | 2.0065E-10 | 1.1828E-06 | 1.0782E-09 | 4.2251E-05 | 4.0498E-12 | 2.3422E-07 |
| | 51 | Ni(CO)4(g) | 0 | 1.5441E-15 | 0 | 3.0551E-14 | 0 | 5.3505E-17 |
| | FSstel- LIQU | | | | | | | |
| | 52 | Fe(LIQU) | 0 | 20.715 | 2.225 | | | |
| | 53 | C(LIQU) | 0 | 0.172327 | 0 | | | |
| | 54 | Co(LIQU) | 0 | 7.8630E-02 | 0.214 | | | |
| | 55 | Cr(LIQU) | 0 | 0.384669 | 3.429 | | | |
| | 56 | Al(LIQU) | 0 | 5.1829E-05 | 2.307 | | | |
| | 57 | Mn(LIQU) | 0 | 3.8302E-02 | 4.711 | | | |
| + | 58 | Ni(LIQU) | 0 | 1.8073 | 7.319 | | | |
| | 59 | Si(LIQU) | 0 | 1.4944 | 1.375 | | | |
| | 60 | Mg(LIQU) | 0 | 9.3987E-07 | 6.518 | | | |
| | 61 | O(LIQU) | 0 | 9.6386E-03 | 4.271 | | | |
| | 62 | AlO(LIQU) | 0 | 1.6660E-06 | 3.131 | | | |
| | 63 | Al2O(LIQU) | 0 | 1.4529E-09 | 2.600 | | | |
| | 64 | CrO(LIQU) | 0 | 3.5027E-04 | 3.473 | | | |

Results Processor: C:\FactSage\Equi0.res

8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +

| Axes | Variables | Minimum | Maximum |
|------|---------------|-------------|-------------|
| | activity | 0 | 104.58 |
| | mole | 0 | 2.5887 |
| | mole fract. | 0 | 0.999983 |
| | gram | 0 | 99.429 |
| | weight % | 0 | 99.998 |
| | Alpha | 0 | 0.1 |
| | T(C) | 1600. | 1600. |
| | P(atm) | 1. | 1. |
| | Delta Cp(J) | 19.62 | 82.696 |
| | Delta G(J) | -3.8924E+05 | -2.7358E+05 |
| | Vol(litre) | 0 | 0 |
| | Delta H(J) | 1.7769E+05 | 3.1154E+05 |
| | Delta V(litr) | 3.702 | 101.96 |
| | Delta S(J) | 152.43 | 277.68 |
| | - page - | 1. | 21. |

Mass
 source
 [page]
 mole
 gram

Clear

21 pages

Click on the '+' column to add or remove species.

0 selected

0 selected

Select

Graph
 Labels
 size: 9 no: 4
 chemical
 integer #

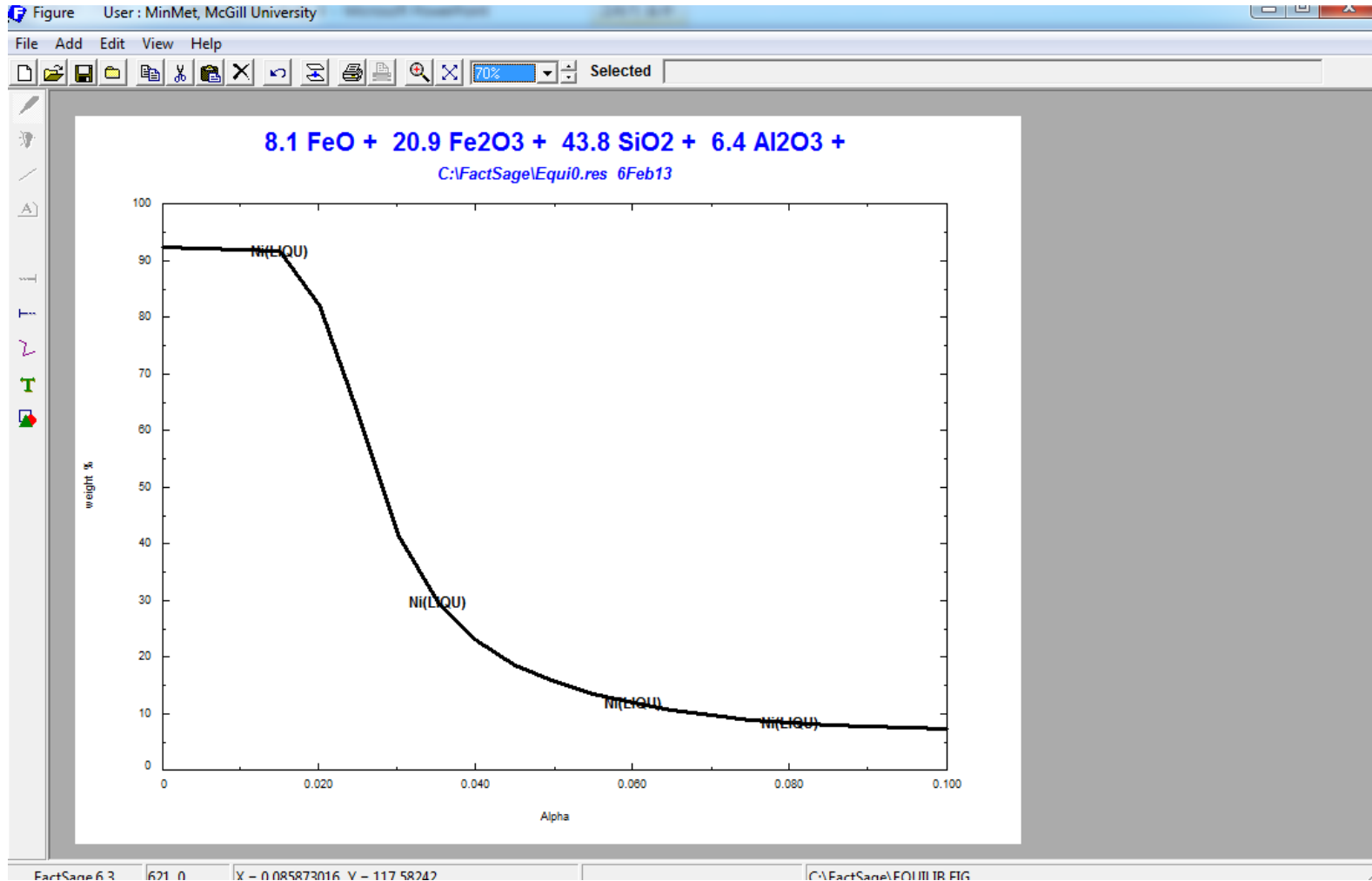
Display
 color
 full screen
 reactants
 Viewer
 file name
 Figure

Plot >>

Select species and phases to be plotted.

FactSage 6.3 C:\FactSage\Equi0.res 6Feb13 21 sets

Effect of change of Char - Laterite + Char at 1600°C



**With addition of Change the contents of Ni dissolved in liquid iron decrease.
If then, what are amounts of Fe-Ni and Slag after each process?**

Effect of change of Char - Laterite + Char at 1600°C

Results - Equilib A=0 (page 1/21)

Output Edit Show Pages

Save or Print ▶ T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Plot ▶ Plot Results ...

Equilib Results file ▶ Repeat Plot - gram vs Alpha ... =0.045 | A=0.05 | A=0.055 |

Stream File ▶

Format ▶

Fact-XML ▶

Fact-Optimal ▶

Fact-Function-Builder ▶

Refresh ...

8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +

Results Processor: C:\FactSage\Equi0.res

| Axes | Variables | Minimum | Maximum |
|------|---------------|-------------|-------------|
| | activity | 0 | 104.58 |
| | mole | 0 | 2.5887 |
| | mole fract. | 0 | 0.999983 |
| | gram | 0 | 99.429 |
| | weight % | 0 | 99.998 |
| | Alpha | 0 | 0.1 |
| | T(C) | 1600. | 1600. |
| | P(atm) | 1. | 1. |
| | Delta Cp(J) | 19.62 | 82.696 |
| | Delta G(J) | -3.8924E+05 | -2.7358E+05 |
| | Vol(litre) | 0 | 0 |
| | Delta H(J) | 1.7769E+05 | 3.1154E+05 |
| | Delta V(litr) | 3.702 | 101.96 |
| | Delta S(J) | 152.43 | 277.68 |
| | - page - | 1. | 21. |

Y-axis: gram

X-axis: Alpha

maximum 100 minimum 0 tick every 5

maximum 0.1 minimum 0 tick every 0.01

Cancel Refresh OK

0 selected 0 selected

Graph Labels size: 9 no: 4

Display color full screen reactants Viewer file name Figure

Plot >>

FactSage 6.3 C:\FactSage\Equi0.res 6Feb13 21 sets

Effect of change of Char - Laterite + Char at 1600°C

Species Selection - EQUILIB Results: gram vs Alpha

File Show Select

| + | # | Species | Gram (min) | Gram (max) | Wt.% (min) | Wt.% (max) | Activity (min) | Activity (max) |
|------------------|-----|---------|------------|------------|------------|------------|----------------|----------------|
| SOLUTIONS | | | | | | | | |
| | 585 | GAS | 0.770643 | 18.611 | 0 | 0 | 1. | 1. |
| + | 586 | LIQU | 0 | 24.691 | 0 | 0 | 3.9934E-03 | 1. |
| | 587 | FCC1 | 0 | 0 | 0 | 0 | 1.2990E-04 | 0.947531 |
| | 588 | BCC1 | 0 | 0 | 0 | 0 | | |
| + | 589 | SLAGA#1 | 66.898 | 99.429 | 0 | 0 | | |
| | 590 | SLAGA#2 | 0 | 0 | 0 | 0 | | |
| | 591 | SPINA#1 | 0 | 0 | 0 | 0 | | |
| | 592 | SPINA#2 | 0 | 0 | 0 | 0 | | |
| | 593 | MeO_A#1 | 0 | 0 | 0 | 0 | | |
| | 594 | MeO_A#2 | 0 | 0 | 0 | 0 | | |
| | 595 | cPyrA | 0 | 0 | 0 | 0 | | |
| | 596 | oPyr | 0 | 0 | 0 | 0 | | |
| | 597 | pPyrA | 0 | 0 | 0 | 0 | | |
| | 598 | OlivA | 0 | 0 | 0 | 0 | | |
| | 599 | MulF | 0 | 0 | 0 | 0 | | |
| | 600 | CORU#1 | 0 | 0 | 0 | 0 | | |
| | 601 | CORU#2 | 0 | 0 | 0 | 0 | | |

Results Processor: C:\FactSage\Equi0.res

File Help

8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +

| Axes | Variables | Minimum | Maximum |
|------|---------------|-------------|-------------|
| | activity | 0 | 104.58 |
| | mole | 0 | 2.5887 |
| | mole fract. | 0 | 0.999983 |
| | gram | 0 | 99.429 |
| | weight % | 0 | 99.998 |
| | Alpha | 0 | 0.1 |
| | T(C) | 1600. | 1600. |
| | P(atm) | 1. | 1. |
| | Delta Cp(J) | 19.62 | 82.696 |
| | Delta G(J) | -3.8924E+05 | -2.7358E+05 |
| | Vol(litre) | 0 | 0 |
| | Delta H(J) | 1.7769E+05 | 3.1154E+05 |
| | Delta V(litr) | 3.702 | 101.96 |
| | Delta S(J) | 152.43 | 277.68 |
| | - page - | 1. | 21. |

source Mass mole gram

[page] 21 pages

Clear

Click on the '+' column to add or remove species.

0 selected

0 selected

Select

Graph

Labels

size: 9 no: 4

chemical integer #

Display

color full screen

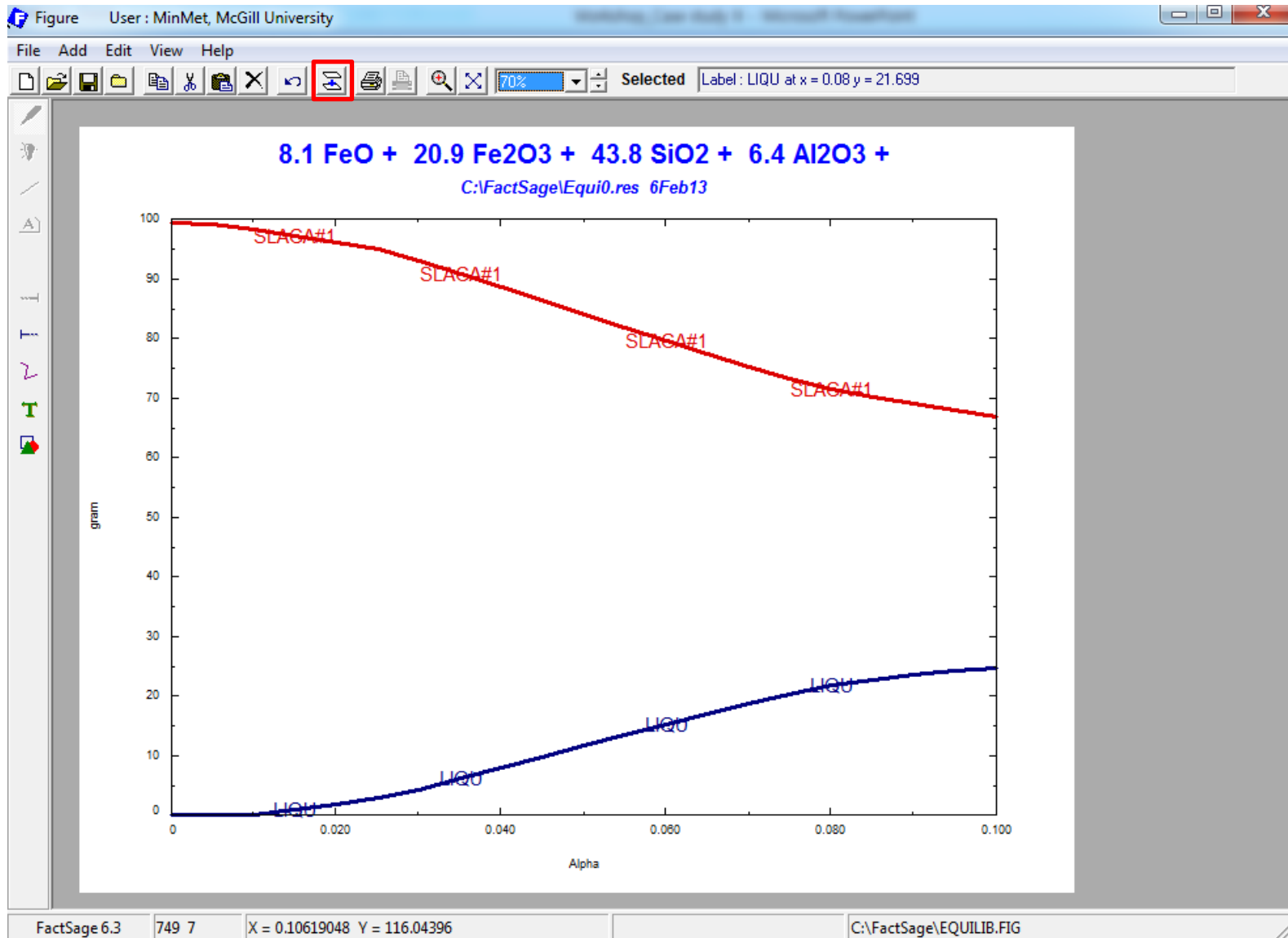
reactants Viewer

file name Figure

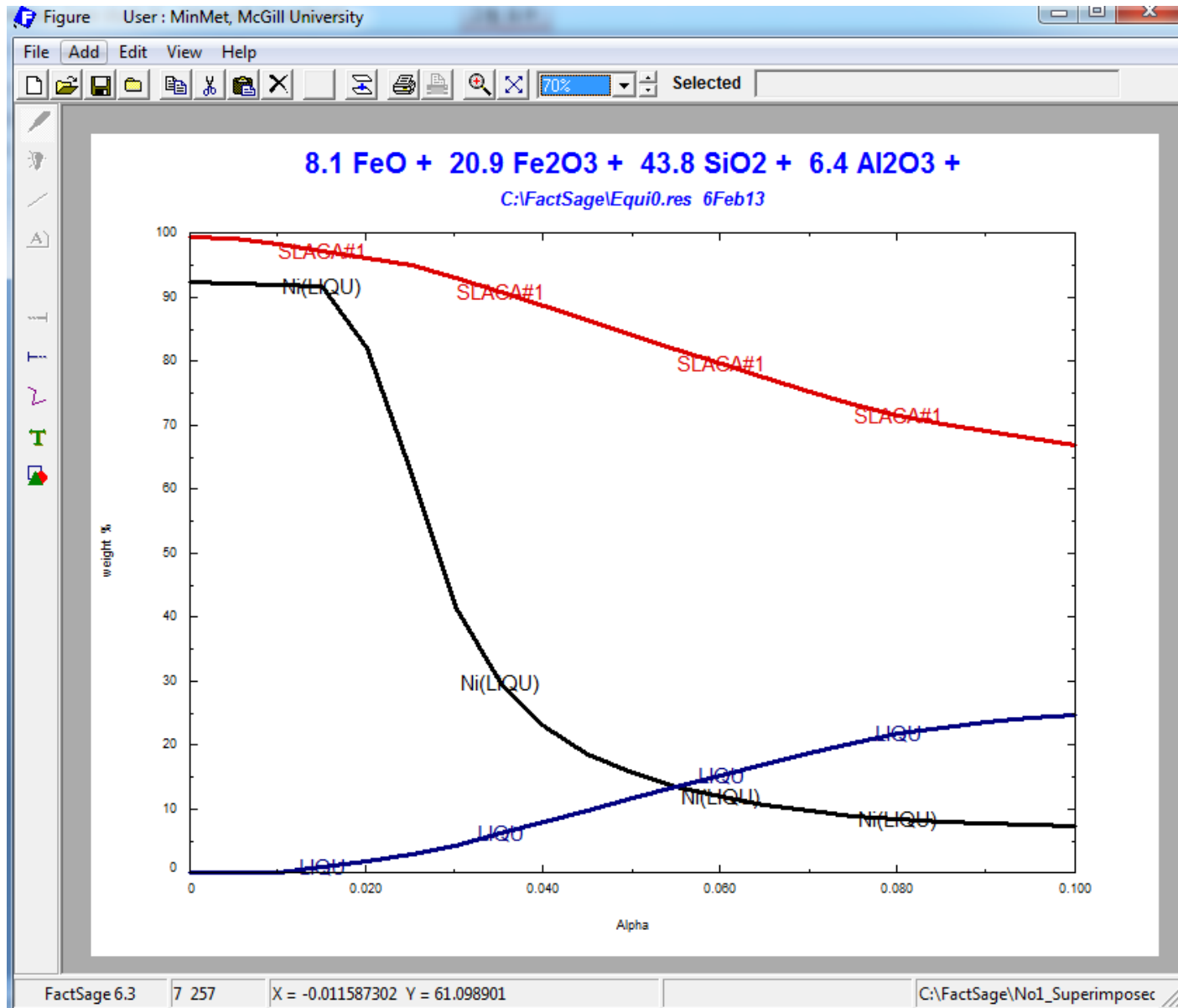
Plot >>

FactSage 6.3 C:\FactSage\Equi0.res 6Feb13 21 sets

Effect of change of Char - Laterite + Char at 1600°C



Effect of change of Char - Laterite + Char at 1600°C



Determine the liquidus temperatures of slag and alloy (Fe-25wt% Ni)

Stream / Precipitate Target

Liquidus Temp. of Alloy – Creating Stream file

The screenshot shows the FactSage 6.3 interface. The main window title is "Results - Equilib 1600 C, A=0.0015". The "Output" menu is open, and the "Stream File" option is selected, opening a sub-menu. In this sub-menu, "Save stream file" is selected, opening another sub-menu. In this second sub-menu, "Save gas phase ..." is selected, opening a third sub-menu. In this third sub-menu, "FSstel-LIQU LIQUID" is highlighted with a red box. Below the menu, a table of solutions is visible, with "FToxid-SLAGA#1 ASlag-liq" highlighted.

| T(C) | P(atm) | Energy(J) | Mass(g) | Vol(litre) |
|------|--------|-----------|------------|------------|
| 1600 | 1 | 1.3989 | 1.8501E-04 | 1.0000 |

| Solution | Phase |
|------------------------------|--------|
| FSstel-LIQU LIQUID | FactPS |
| FSstel-FCC1 FCC_A1 | FactPS |
| FSstel-BCC1 BCC_A2 | FactPS |
| FToxid-SLAGA#1 ASlag-liq | FactPS |
| FToxid-SLAGA#2 ASlag-liq | FactPS |
| FToxid-SPINA#1 ASpinel | FactPS |
| FToxid-SPINA#2 ASpinel | FactPS |
| FToxid-MeO_A#1 AMonoxide | FactPS |
| FToxid-MeO_A#2 AMonoxide | FactPS |
| FToxid-cPyrA ACLinopyroxene | FactPS |
| FToxid-oPyr Orthopyroxene | FactPS |
| FToxid-pPyrA AProtopyroxene | FactPS |
| FToxid-OlivA AOLivine | FactPS |
| FToxid-MulF Mullite | FactPS |
| FToxid-CORU#1 M2O3(Corundum) | FactPS |
| FToxid-CORU#2 M2O3(Corundum) | FactPS |

Liquidus Temp. of Slag – Creating Stream file

The screenshot shows the FactSage 6.3 interface. The main window title is 'Results - Equilib 1600 C, A=0.0015'. The 'Output' menu is open, showing options like 'Save or Print', 'Plot', 'Equilib Results file', 'Stream File', 'Format', 'Fact-XML', 'Fact-Optimal', 'Fact-Function-Builder', and 'Refresh ...'. The 'Stream File' sub-menu is also open, showing 'Recycle all streams ...', 'Save stream file', 'Stream file properties ...', 'Summary of streams', and 'Directory (C:\FactSage\ ...)'. The 'Save stream file' option is selected, opening a further sub-menu with 'Save gas phase ...', 'Save pure liquids ...', 'Save aqueous ...', 'Save pure solids ...', and 'Save solutions'. The 'Save solutions' option is selected, opening a list of solutions. The solution 'FToxid-SLAGA#1 ASlag-liq' is highlighted with a red box.

Output

Save or Print ▶ T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Plot ▶

Equilib Results file ▶

Stream File ▶

Format ▶

Fact-XML ▶

Fact-Optimal ▶

Fact-Function-Builder ▶

Refresh ...

Recycle all streams ...

Save stream file ▶

Stream file properties ...

Summary of streams ▶

Directory (C:\FactSage\ ...) ▶

Save gas phase ...

Save pure liquids ...

Save aqueous ...

Save pure solids ...

Save solutions ▶

ALL solutions

FSstel-LIQU LIQUID

FSstel-FCC1 FCC_A1

FSstel-BCC1 BCC_A2

FToxid-SLAGA#1 ASlag-liq

FToxid-SLAGA#2 ASlag-liq

FToxid-SPINA#1 ASpinel

FToxid-SPINA#2 ASpinel

FToxid-MeO_A#1 AMonoxide

FToxid-MeO_A#2 AMonoxide

FToxid-cPyrA ACLinopyroxene

FToxid-oPyr Orthopyroxene

FToxid-pPyrA AProtopyroxene

FToxid-OlivA AOLivine

FToxid-MulF Mullite

FToxid-CORU#1 M2O3(Corundum)

FToxid-CORU#2 M2O3(Corundum)

al

3 mol, 1.3989 litre, 1.8501E-04 gram/cm3

a=1.0000)

| | | |
|--------------|------|--------|
| (0.97332 | CO | FactPS |
| + 2.6511E-02 | CO2 | FactPS |
| + 7.4349E-05 | Fe | FactPS |
| + 4.6063E-05 | Na | FactPS |
| + 4.2801E-05 | SiO | FactPS |
| + 2.6804E-06 | Ni | FactPS |
| + 2.0202E-06 | Mg | FactPS |
| + 8.5857E-07 | Mn | FactPS |
| + 2.0347E-07 | Cr | FactPS |
| + 1.1399E-07 | FeO | FactPS |
| + 8.7497E-08 | Co | FactPS |
| + 4.3057E-08 | SiO2 | FactPS |
| + 2.2085E-08 | CrO | FactPS |
| + 2.6610E-09 | O | FactPS |
| + 1.9679E-09 | CrO2 | FactPS |
| + 3.2184E-10 | NiO | FactPS |
| + 1.4791E-10 | MgO | FactPS |

Liquidus Temp. of Alloy – Import Stream file

The screenshot shows the 'Reactants - Equilib' window in FactSage 6.3. The 'File' menu is open, and the 'Mixtures and Streams' sub-menu is selected. Within this sub-menu, 'Import a stream (or single-line mixture)' is highlighted. The main window contains a table with columns for Energy(J), Mass(g), and Vol(litre). A list of 25 stream options is displayed on the right, with '3 FSstel-LIQU LIQUID stream' highlighted at the top.

| Energy(J) | Mass(g) | Vol(litre) |
|-----------|---------|------------|
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- 3 FSstel-LIQU LIQUID stream
- 4 FToxide Slag stream
- 5 Slag with A=12.12 stream
- 6 Slag with A=12.62 stream
- 7 Slag with A=13.12 stream
- 8 Slag with A=13.62 stream
- 9 Slag with A=14.12 stream
- 10 Slag with A=14.62 stream
- 11 Slag with A=15.12 stream
- 12 Slag with A=16.12 stream
- 13 Slag with A=16.62 stream
- 14 Slag with A=17.12 stream
- 15 Slag with A=18.12 stream
- 16 Slag with A=19.12 stream
- 17 Slag with A=20.12 stream
- 18 Slag with A=21.12 stream
- 19 Slag with A=22.12 stream
- 20 Slag with A=23.12 stream
- 21 Slag with A=24.12 stream
- 22 Slag with A=25.12 stream
- 23 Slag with A=26.12 stream
- 24 Slag with A=27.12 stream
- 25 Slag with A=28.12 stream

FactSage 6.3 Compound: 3/19 databases Solution: 2/19 databases

Liquidus Temp. of Alloy – Precipitate Target

Reactants - Equilib

File Edit Table Units Data Search Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

1-1

| Mass(g) | Species | Phase | T(C) | P(total)** | Stream# | Data |
|---------|--------------------|----------|------|------------|---------|------|
| 100% | [FSstel-LIQU_LIQU] | [Stream] | 1600 | 1 | 1 | |

Initial Conditions

Next >>

Liquidus Temp. of Alloy – Precipitate Target

Menu - Equilib: Steel Cooling

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants (1)

(gram) 100% [FSstel-LIQU_LIQUID]
(1600C_liq.#1)

Products

Compound species

- + gas ideal real 48
- aqueous 0
- pure liquids 0
- + pure solids 109
- suppress

Legend

P - precipitate target
+ - selected 2

Species: 55
Solutions: 3

Click mouse-right button to open Selection Window for FSstel-FCC1

Solution FSstel-LIQU

- clear
- all species
- * - custom select species
- m - merge dilute solution from
- solution properties
- + - single phase
- I - possible 2-phase immiscibility
- J - possible 3-phase immiscibility
- standard stable phase
- ! - dormant (metastable) phase
- F - formation target phase
- P - precipitate target phase**
- S - Scheil cooling target phase
- D - solidification calculation ...
- C - composition target ...
- Help ...

Precipitate Target

FSstel-LIQU

Estimate T(C): 1000

Mass(g): 0

Final Conditions

<A> **T(C)** P(atm) Delta H(J)

10 steps Table 1 calculation

FactSage 6.3 C:\FactSage\EquiSteel-cooling-No2-b.DAT

Liquidus Temp. of Alloy – Precipitate Target

Results - Equilib **1599.96 C**

Output Edit Show Pages

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

FactSage 6.3

```
(gram) 100% [FSstel-LIQU_LIQUID] =  
(1600,1,liq,#1)  
  
0      mol  gas_ideal  
(1599.96 C, 1 atm, a=1.0000)  
( 0.95499      CO      FactPS  
+ 4.4922E-02   CO2     FactPS  
+ 6.1399E-05   Fe       FactPS  
+ 2.1523E-05   SiO      FactPS  
+ 6.9743E-06   Ni       FactPS  
+ 1.2001E-06   Mg       FactPS  
+ 5.0627E-07   Mn       FactPS  
+ 2.3054E-07   Co       FactPS  
+ 1.6255E-07   FeO      FactPS  
+ 1.0550E-07   Cr       FactPS  
+ 3.7390E-08   SiO2     FactPS  
+ 1.9775E-08   CrO      FactPS  
+ 4.5926E-09   O        FactPS  
+ 3.0432E-09   CrO2     FactPS  
+ 1.4459E-09   NiO      FactPS  
+ 3.8173E-10   O2       FactPS  
+ 1.5170E-10   MgO      FactPS  
+ 1.3795E-12   CrO3     FactPS  
+ 1.0866E-12   Si       FactPS  
+ 8.4551E-13   Al       FactPS  
+ 7.5318E-13   AlO      FactPS  
+ 4.7334E-13   C2O      FactPS  
+ 3.4142E-13   Ca       FactPS  
+ 1.7660E-13   C3O2     FactPS  
+ .....     -        -
```

Liquidus Temp. of Slag – Import Stream file

The screenshot shows the FactSage software interface. The window title is "Reactants - Equilib". The menu bar includes "File", "Edit", "Table", "Units", "Data Search", and "Help". The "File" menu is open, showing options like "Add a new Reactant", "Insert new reactant before ...", "Delete reactant ...", "Delete all blank reactants", "Mixtures and Streams", "Re-order the reactants", "Export list of reactants", "Import list of reactants", "Clear", and "Example". The "Mixtures and Streams" option is expanded, showing "Import a mixture", "Import a stream (or single-line mixture)", "Edit a mixture or stream", and "Directory (C:\FactSage\ ...)". The "Import a stream (or single-line mixture)" option is highlighted with a red box. To the right, a list of stream options is displayed, with "4 FToxide Slag stream" highlighted in red. The list includes options 3 through 25, such as "3 FSstel-LIQU LIQUID stream", "5 Slag with A=12.12 stream", "7 Slag with A=13.12 stream", "9 Slag with A=14.12 stream", "11 Slag with A=15.12 stream", "13 Slag with A=16.62 stream", "15 Slag with A=18.12 stream", "17 Slag with A=20.12 stream", "19 Slag with A=22.12 stream", "21 Slag with A=24.12 stream", "23 Slag with A=26.12 stream", and "25 Slag with A=28.12 stream". The "Initial Con" checkbox is checked. The "Next >>" button is visible at the bottom. The status bar shows "FactSage 6.3", "Compound: 3/19 databases", and "Solution: 2/19 databases".

Liquidus Temp. of Slag – Precipitate Target

Reactants - Equilib

File Edit Table Units Data Search Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

1 - 1

| Mass(g) | Species | Phase | T(C) | P(total)** | Stream# | Data |
|---------|----------------|----------|------|------------|---------|------|
| 100% | [FToxide_Slag] | [Stream] | 1600 | 1 | 1 | |

Initial Conditions

Next >>

Liquidus Temp. of Slag – Precipitate Target

The screenshot shows the FactSage software interface for an equilibrium calculation. The main window is titled "Menu - Equilib: Slag cooling". The "Reactants (1)" section contains a text box with "(gram) 100% [FToxide_Slag] (1600C,#1)". The "Products" section is divided into "Compound species" and "Solution species". The "Compound species" table has columns for phase type and count, with "pure solids" highlighted in red. The "Solution species" table has columns for Base-Phase, Full Name, and count, with the first row highlighted in red. A "Precipitate Target" section shows "FToxid-SLAGA" and "Estimate T(C): 1000". A "Legend" section defines symbols for immiscible, precipitate target, and selected phases. The "Final Conditions" section shows "T(C)" highlighted in red. A context menu is open over the "Solution species" table, with the "P - precipitate target phase" option highlighted in red. The "Calculate >>" button is visible at the bottom right.

Menu - Equilib: Slag cooling

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants (1)

(gram) 100% [FToxide_Slag]
(1600C,#1)

Products

Compound species

| | |
|--------------------|-----|
| * + gas ideal real | 34 |
| aqueous | 0 |
| pure liquids | 0 |
| * + pure solids | 114 |

suppress duplicates apply

* - custom selection
species: 148

"*" denotes custom selection - not all the species have been selected.

Solution species

| | + | Base-Phase | Full Name |
|---|----|--------------|--------------------------|
| * | IP | FToxid-SLAGA | ASlag-liq all oxides + S |
| | I | FToxid-SPINA | ASpinel |
| | I | FToxid-MeO_A | AMonoxide |
| | I | FToxid-cPyrA | AClinopyroxene |
| | + | FToxid-oPyr | Orthopyroxene |
| | + | FToxid-pPyrA | AProtopyroxene |

Precipitate Target
FToxid-SLAGA
Estimate T(C): 1000
Mass(g): 0

Legend
I - immiscible 7
P - precipitate target
+ - selected 2

Show all selected

species: 440
solutions: 16 Select

Final Conditions

| | | | | |
|-----|-------|------|--------|------------|
| <A> | | T(C) | P(atm) | Delta H(J) |
| 10 | steps | | 1 | |

1 calculation

Solution FToxid-SLAGA

- clear
- all species
- * - custom select species
- m - merge dilute solution from
- solution properties
- + - single phase
- I - possible 2-phase immiscibility
- J - possible 3-phase immiscibility
- standard stable phase
- ! - dormant (metastable) phase
- F - formation target phase
- P - precipitate target phase
- S - Scheil cooling target phase
- D - solidification calculation ...
- C - composition target ...

Help ...

Calculate >>

FactSage 6.3 C:\FactSage\EquiSlag-cooling-No2-a.DAT

Liquidus Temp. of Slag – Precipitate Target

Results - Equilib 1380.48 C

Output Edit Show Pages

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

| Element | Amount | Amount |
|---------|------------|------------|
| Ni | 3.8207E-05 | 9.9884E-05 |
| Co | 2.7385E-05 | 7.1886E-05 |
| Fe | 7.0139E-02 | 0.17447 |
| Mn | 1.7320E-03 | 4.2383E-03 |
| Cr | 2.6261E-03 | 6.0820E-03 |
| Ca | 4.4773E-04 | 7.9926E-04 |
| Si | 0.18525 | 0.23174 |
| Al | 3.2420E-02 | 3.8963E-02 |
| Mg | 0.10466 | 0.11330 |
| Na | 2.4281E-03 | 2.4864E-03 |
| O | 0.60023 | 0.42775 |

+ 0

gram AOlivine#1
(1380.48 C, 1 atm, a=1.0000)

| Amount | Phase | Phase |
|--------------|------------------|--------|
| - 37.299 | wt.% MgMgSi104 | FToxid |
| + 5.1126 | wt.% Fe1Fe1Si104 | FToxid |
| + 12.725 | wt.% Mg1Fe1Si104 | FToxid |
| + 23.821 | wt.% Fe1Mg1Si104 | FToxid |
| + 3.5553E-10 | wt.% Ca1Ca1Si104 | FToxid |
| + 1.1064E-03 | wt.% Ca1Fe1Si104 | FToxid |
| + 1.6546E-06 | wt.% Fe1Ca1Si104 | FToxid |
| + 5.0756E-03 | wt.% Ca1Mg1Si104 | FToxid |
| + 4.0547E-06 | wt.% Mg1Ca1Si104 | FToxid |
| + 1.4338E-03 | wt.% Mn1Mn1Si104 | FToxid |
| + 3.5096E-08 | wt.% Mn1Ca1Si104 | FToxid |
| + 1.4617E-05 | wt.% Ca1Mn1Si104 | FToxid |
| + 7.6010E-07 | wt.% Co1Co1Si104 | FToxid |
| + 1.1247E-05 | wt.% Co1Mn1Si104 | FToxid |
| + 9.6934E-05 | wt.% Mn1Co1Si104 | FToxid |
| + 1.1400E-02 | wt.% Mg1Co1Si104 | FToxid |
| + 3.9755E-03 | wt.% Co1Mg1Si104 | FToxid |

Show the impact of the SiO_2/MgO (in the range of 1 to 4) ratio on the liquidus temperature of the slag (Primary crystallization phase)
Stream / Precipitate Target

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

**Addition of 0.381 kg of Char
with 1 tone of Laterite
SiO₂+MgO = 60.6 wt%**

Reactants - Equilib

File Edit Table Units Data Search Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

1 - 10 | 11 - 14

| Mass(g) | Species | Phase | T(C) | P(total)** | Stream# | Data |
|------------|--------------------------------|-------------------------|------|------------|---------|--------|
| 8.1 | FeO | solid-FactPS wustite | 500 | 1 | 1 | FactPS |
| + 20.9 | Fe ₂ O ₃ | solid-1-FToxid hematit | 500 | 1 | 1 | FToxid |
| + <60.6-A> | SiO ₂ | solid-1-FToxid quartz{l | 500 | 1 | 1 | FToxid |
| + 6.4 | Al ₂ O ₃ | solid-4-FToxid corund | 500 | 1 | 1 | FToxid |
| + <A> | MgO | solid-FToxid periclase | 500 | 1 | 1 | FToxid |
| + 2.3 | NiO | solid-FToxid | 500 | 1 | 1 | FToxid |
| + <4.8B> | Al ₂ O ₃ | solid-4-FToxid corund | 100 | 1 | 2 | FToxid |
| + <14B> | SiO ₂ | solid-2-FToxid quartz{l | 100 | 1 | 2 | FToxid |
| + <81.2B> | C | solid-1-FactPS graphit | 100 | 1 | 2 | FactPS |
| + 0.1 | CaO | solid-FToxid lime | 500 | 1 | 1 | FToxid |

Initial Conditions

Next >>

FactSage 6.2 Compound: 2/19 database Solution: 2/19 database

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

MgO = 12.12 to 30.3 wt%
SiO₂/MgO = 1 to 4 ratio

Menu - Equilib: 37 Calculations

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants [14]

<60.6-A> SiO2 + 6.4 Al2O3 + <A> MgO + 2.3 NiO + <4.8B> Al2O3 + <

(500C,s1-FToxid,#1) (500C,s4-FToxid,#1) (500C,s-FToxid,#1) (500C,s-FToxid,#1) (100C,s4-FToxid,#2) (100C

Products

Compound species

- gas ideal real 51
- aqueous 0
- pure liquids 0
- pure solids 116

suppress duplicates apply

* - custom selection species: 167

Target

- none -

Estimate T(C): 1000

Mass(g): 0

Solution species

| | Base-Phase | Full Name |
|-------------------------------------|--------------|--------------------------|
| <input checked="" type="checkbox"/> | FSstel-LIQU | LIQUID |
| <input checked="" type="checkbox"/> | FSstel-FCC1 | FCC_A1 |
| <input checked="" type="checkbox"/> | FSstel-BCC1 | BCC_A2 |
| <input type="checkbox"/> | FToxid-SLAGA | ASlag-liq all oxides + S |
| <input type="checkbox"/> | FToxid-SPINA | ASpinel |
| <input type="checkbox"/> | FToxid-MeO_A | AMonoxide |
| <input checked="" type="checkbox"/> | FToxid-cPyrA | AClinopyroxene |
| <input checked="" type="checkbox"/> | FToxid-oPyr | Orthopyroxene |

Legend

- immiscible 4
- selected 8

species: 417 solutions: 16 Select

Custom Solutions

- fixed activities
- ideal solutions
- activity coefficients

Details ...

Pseudonyms

apply List ...

include molar volumes

Total Species (max 1500) 584

Total Solutions (max 40) 16

Default

Final Conditions

| <A> | | T(C) | P(atm) | Delta H(J) |
|----------------|--------|------|--------|------------|
| 12.12 30.3 0.5 | 0.0015 | 1600 | 1 | |

10 steps Table 37 calculations

Equilibrium

- normal
- normal + transitions
- transitions only
- open

Calculate >>

FactSage 6.3 C:\FactSage\EquiSiO2-MgO_ratio-No3-a.DAT

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

37 different Slags and Alloys are formed with change of SiO₂/MgO at 1600°C.

Results - Equilib A=12.12 (page 1/38)

Output Edit Show Pages

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

A=24.12

A=18.12 | A=18.62 | A=19.12 | A=19.62 | A=20.12 | A=20.62 | A=21.12 | A=21.62 | A=22.12 | A=22.62 | A=23.12 | A=23.62

A=12.12 | A=12.62 | A=13.12 | A=13.62 | A=14.12 | A=14.62 | A=15.12 | A=15.62 | A=16.12 | A=16.62 | A=17.12 | A=17.62

FactSage 6.3

(gram) 20.9 Fe + 8.1 Fe₂O₃ + <60.6-A> SiO₂ + 6.4 Al₂O₃ +
(500,1,s2-FSsteel,#1) (500,1,s1-FToxid,#1) (500,1,s1-FToxid,#1) (500,1,s4-FTo
(gram) <A> MgO + 2.3 NiO + <4.8(0.0015)> Al₂O₃ + <14(0.0015)> SiO₂ +
(500,1,s-FToxid,#1) (500,1,s-FToxid,#1) (100,1,s4-FToxid,#2) (100,1,s2-FToxi
(gram) <81.2(0.0015)> C + 0.1 CaO + 0.1 CoO + 0.8 Cr₂O₃ +
(100,1,s1-FactPS,#2) (500,1,s-FToxid,#1) (500,1,s-FToxid,#1) (500,1,s-FToxid
(gram) 0.6 MnO₂ + 0.3 Na₂O =
(500,1,s-FToxid,#1) (500,1,s1-FToxid,#1)

9.2135E-03 mol gas_ideal
(0.26153 gram, 9.2135E-03 mol, 1.4162 litre, 1.8467E-04 gram/cm3)
(1600 C, 1 atm, a=1.0000)

| | | |
|--------------|------------------|--------|
| (0.97654 | CO | FactPS |
| + 2.3284E-02 | CO ₂ | FactPS |
| + 7.4306E-05 | Fe | FactPS |
| + 6.5345E-05 | SiO | FactPS |
| + 3.1435E-05 | Na | FactPS |
| + 2.6810E-06 | Ni | FactPS |
| + 1.3820E-06 | Mg | FactPS |
| + 8.1622E-07 | Mn | FactPS |
| + 2.1625E-07 | Cr | FactPS |
| + 9.9725E-08 | FeO | FactPS |
| + 8.7642E-08 | Co | FactPS |
| + 5.7545E-08 | SiO ₂ | FactPS |
| + 2.0547E-08 | CrO | FactPS |
| + 2.3294E-09 | O | FactPS |
| + 1.6028E-09 | CrO ₂ | FactPS |

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

The screenshot shows the FactSage 6.3 software interface. The title bar reads 'Results - Equilib A=12.12 (page 1/38)'. The 'Output' menu is open, and the 'Save or Print As ...' option is highlighted with a red rectangle. Other menu options include 'Save or Print', 'Plot', 'Equilib Results file', 'Stream File', 'Format', 'Fact-XML', 'Fact-Optimal', 'Fact-Function-Builder', and 'Refresh ...'. The main window displays the chemical composition of the slag phase, including the following text:

```
3 + <60.6-A> SiO2 + 6.4 Al2O3 +  
,1,s1-FToxid,#1) (500,1,s1-FToxid,#1) (500,1,s4-FTo  
+ <4.8(0.0015)> Al2O3 + <14(0.0015)> SiO2 +  
1,s-FToxid,#1) (100,1,s4-FToxid,#2) (100,1,s2-FToxi  
0.1 CaO + 0.1 CoO + 0.8 Cr2O3 +  
,1,s-FToxid,#1) (500,1,s-FToxid,#1) (500,1,s-FToxid  
0 =  
1,s1-FToxid,#1)
```

Below the chemical composition, the following data is shown:

```
9.2135E-03 mol gas_ideal  
(0.26153 gram, 9.2135E-03 mol, 1.4162 litre, 1.8467E-04 gram/cm3)  
(1600 C, 1 atm, a=1.0000)  
( 0.97654 CO FactPS  
+ 2.3284E-02 CO2 FactPS  
+ 7.4306E-05 Fe FactPS  
+ 6.5345E-05 SiO FactPS  
+ 3.1435E-05 Na FactPS  
+ 2.6810E-06 Ni FactPS  
+ 1.3820E-06 Mg FactPS  
+ 8.1622E-07 Mn FactPS  
+ 2.1625E-07 Cr FactPS  
+ 9.9725E-08 FeO FactPS  
+ 8.7642E-08 Co FactPS  
+ 5.7545E-08 SiO2 FactPS  
+ 2.0547E-08 CrO FactPS  
+ 2.3294E-09 O FactPS  
+ 1.6028E-09 CrO2 FactPS
```

To export wt% of SiO₂ and MgO in Slag phase

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

Output

Page Range

- All 38 pages
- Current page 1

Type of Output

- Printer
- Text file (*.txt)
- Equilib Results File (Equi*.res)
- Xml file (*.xml)
- Excel Spreadsheet
- Open Text Spreadsheet
- Save Text Spreadsheet
- Swap rows & columns

Spreadsheet - Equilib Page 38/38 : T(C) = 1600, P(atm) = 1, Alpha = 30.3

File Edit Show

Selected: 2/502 Spreadsheet Species

Page 38/38 : T(C) = 1600, P(atm) = 1, Alpha = 30.3 [min = 12.12 at p. 1; max = 30.3 at p. 38]

| + Code | Species | Data | Phase | T | V | Activity | Minimum | Maximum |
|--------|--------------|--------|--------------|---|---|------------|-----------------|-----------------|
| 1050 | Na2O(SLAGA) | FToxid | FToxid-SLAGA | | | 1.8600E-10 | 1.6164E-12 [1] | 1.8600E-10 [38] |
| 1051 | Al2O3(SLAGA) | FToxid | FToxid-SLAGA | | | 3.3995E-03 | 2.9345E-04 [3] | 3.3995E-03 [38] |
| + 1052 | SiO2(SLAGA) | FToxid | FToxid-SLAGA | | | 6.8588E-02 | 6.8588E-02 [38] | 0.8134 [1] |
| 1053 | Na4O2(SLAGA) | FToxid | FToxid-SLAGA | | | 6.1134E-05 | 1.6602E-06 [1] | 6.1134E-05 [38] |
| 1054 | CaO(SLAGA) | FToxid | FToxid-SLAGA | | | 8.5125E-06 | 3.7994E-07 [1] | 8.5125E-06 [38] |
| 1055 | FeO(SLAGA) | FToxid | FToxid-SLAGA | | | 0.2781 | 0.1157 [1] | 0.2781 [38] |
| 1056 | Fe2O3(SLAGA) | FToxid | FToxid-SLAGA | | | 4.4248E-05 | 3.1854E-06 [1] | 4.4248E-05 [38] |
| + 1057 | MgO(SLAGA) | FToxid | FToxid-SLAGA | | | 8.0697E-02 | 9.2915E-03 [1] | 8.0697E-02 [38] |
| 1058 | CoO(SLAGA) | FToxid | FToxid-SLAGA | | | 3.2034E-05 | 1.3708E-05 [1] | 3.2034E-05 [38] |
| 1059 | NiO(SLAGA) | FToxid | FToxid-SLAGA | | | 1.1994E-04 | 5.0847E-05 [1] | 1.1994E-04 [38] |
| 1060 | MnO(SLAGA) | FToxid | FToxid-SLAGA | | | 2.1544E-03 | 5.9400E-04 [1] | 2.1544E-03 [38] |
| 1061 | CrO(SLAGA) | FToxid | FToxid-SLAGA | | | 1.4742E-02 | 9.8533E-03 [1] | 1.4973E-02 [36] |
| 1062 | Cr2O3(SLAGA) | FToxid | FToxid-SLAGA | | | 9.9823E-04 | 1.8610E-04 [1] | 9.9920E-04 [37] |
| 1063 | Mn2O3(SLAGA) | FToxid | FToxid-SLAGA | | | 3.7091E-10 | 1.1765E-11 [1] | 3.7091E-10 [38] |

'+' denotes all the Species Properties as defined in the Spreadsheet Setup.

Spreadsheet Setup

System Properties

Property columns 2

| | | |
|-----------|-------|-------|
| Column: | - 1 - | - 2 - |
| Variable: | Alpha | T(C) |

Species Properties

Columns per species 1 order species order props.

| | |
|-----------|-------|
| Column: | - 1 - |
| Variable: | Wt% |

Species

Species: 2

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

Equilib Results

File Edit Swap rows and columns

| Alpha | T(C) | Wt%-SiO2(SLAGA#1) | Wt%-MgO(SLAGA#1) | Wt%-SiO2(SLAGA#2) | Wt%-MgO(SLAGA#2) |
|---------------|---------------|-------------------|------------------|-------------------|------------------|
| 1.2120000E+01 | 1.6000000E+03 | 5.9104840E+01 | 1.4772695E+01 | 5.9104840E+01 | 1.4772695E+01 |
| 1.2620000E+01 | 1.6000000E+03 | 5.8497349E+01 | 1.5382513E+01 | 5.8497349E+01 | 1.5382513E+01 |
| 1.3120000E+01 | 1.6000000E+03 | 5.7889996E+01 | 1.5992402E+01 | 5.7889996E+01 | 1.5992402E+01 |
| 1.3620000E+01 | 1.6000000E+03 | 5.7282768E+01 | 1.6602366E+01 | 5.7282768E+01 | 1.6602366E+01 |
| 1.4120000E+01 | 1.6000000E+03 | 5.6675654E+01 | 1.7212408E+01 | 5.6675654E+01 | 1.7212408E+01 |
| 1.4620000E+01 | 1.6000000E+03 | 5.6068642E+01 | 1.7822534E+01 | 5.6068642E+01 | 1.7822534E+01 |
| 1.5120000E+01 | 1.6000000E+03 | 5.5461721E+01 | 1.8432746E+01 | 5.5461721E+01 | 1.8432746E+01 |
| 1.5620000E+01 | 1.6000000E+03 | 5.4854884E+01 | 1.9043049E+01 | 5.4854884E+01 | 1.9043049E+01 |
| 1.6120000E+01 | 1.6000000E+03 | 5.4248124E+01 | 1.9653448E+01 | 5.4248124E+01 | 1.9653448E+01 |
| 1.6620000E+01 | 1.6000000E+03 | 5.3641436E+01 | 2.0263948E+01 | 5.3641436E+01 | 2.0263948E+01 |
| 1.7120000E+01 | 1.6000000E+03 | 5.3034815E+01 | 2.0874555E+01 | 5.3034815E+01 | 2.0874555E+01 |
| 1.7620000E+01 | 1.6000000E+03 | 5.2428259E+01 | 2.1485276E+01 | 5.2428259E+01 | 2.1485276E+01 |
| 1.8120000E+01 | 1.6000000E+03 | 5.1821769E+01 | 2.2096119E+01 | 5.1821769E+01 | 2.2096119E+01 |
| 1.8620000E+01 | 1.6000000E+03 | 5.1215345E+01 | 2.2707092E+01 | 5.1215345E+01 | 2.2707092E+01 |
| 1.9120000E+01 | 1.6000000E+03 | 5.0608990E+01 | 2.3318205E+01 | 5.0608990E+01 | 2.3318205E+01 |
| 1.9620000E+01 | 1.6000000E+03 | 5.0002708E+01 | 2.3929470E+01 | 5.0002708E+01 | 2.3929470E+01 |
| 2.0120000E+01 | 1.6000000E+03 | 4.9396507E+01 | 2.4540898E+01 | 4.9396507E+01 | 2.4540898E+01 |
| 2.0620000E+01 | 1.6000000E+03 | 4.8790393E+01 | 2.5152504E+01 | 4.8790393E+01 | 2.5152504E+01 |
| 2.1120000E+01 | 1.6000000E+03 | 4.8184375E+01 | 2.5764304E+01 | 4.8184375E+01 | 2.5764304E+01 |
| 2.1620000E+01 | 1.6000000E+03 | 4.7578465E+01 | 2.6376315E+01 | 4.7578465E+01 | 2.6376315E+01 |
| 2.2120000E+01 | 1.6000000E+03 | 4.6972673E+01 | 2.6988559E+01 | 4.6972673E+01 | 2.6988559E+01 |
| 2.2620000E+01 | 1.6000000E+03 | 4.6367012E+01 | 2.7601056E+01 | 4.6367012E+01 | 2.7601056E+01 |
| 2.3120000E+01 | 1.6000000E+03 | 4.5761495E+01 | 2.8213831E+01 | 4.5761495E+01 | 2.8213831E+01 |
| 2.3620000E+01 | 1.6000000E+03 | 4.5156135E+01 | 2.8826909E+01 | 4.5156135E+01 | 2.8826909E+01 |
| 2.4120000E+01 | 1.6000000E+03 | 4.4550942E+01 | 2.9440317E+01 | 4.4550942E+01 | 2.9440317E+01 |

Copy and paste in Excel file and then, you can calculate the ratio of SiO₂/MgO in Slag

Impossible to draw as a function of SiO₂/MgO in FactSage

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

Results - Equilib A=12.12 (page 1/38)

Output Edit Show Pages

Save or Print ▶ T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Plot ▶

Equilib Results file ▶ 9.62 | A=20.12 | A=20.62 | A=21.12 | A=21.62 | A=22.12 | A=22.62 | A=23.12 | A=23.62

Stream File ▶ A=16.12 | A=16.62 | A=17.12 | A=17.62

Format ▶

Fact-XML ▶

Fact-Optimal ▶

Fact-Function-Builder ▶

Refresh ...

Recycle all streams ...

Save stream file ▶

Stream file properties ...

Summary of streams ▶

Directory (C:\FactSage\ ...) ▶

Save gas phase ...

Save pure liquids ...

Save aqueous ...

Save pure solids ...

Save solutions ▶

ALL solutions

FSstel-LIQU LIQUID

FSstel-FCC1 FCC_A1

FSstel-BCC1 BCC_A2

FToxid-SLAGA#1 ASlag-liq

FToxid-SLAGA#2 ASlag-liq

FToxid-SPINA#1 ASpinel

FToxid-SPINA#2 ASpinel

FToxid-MeO_A#1 AMonoxide

FToxid-MeO_A#2 AMonoxide

FToxid-cPyrA AClinopyroxene

FToxid-oPyr Orthopyroxene

FToxid-pPyrA AProtopyroxene

FToxid-OlivA AOlivine

FToxid-MulF Mullite

FToxid-CORU#1 M2O3(Corundum)

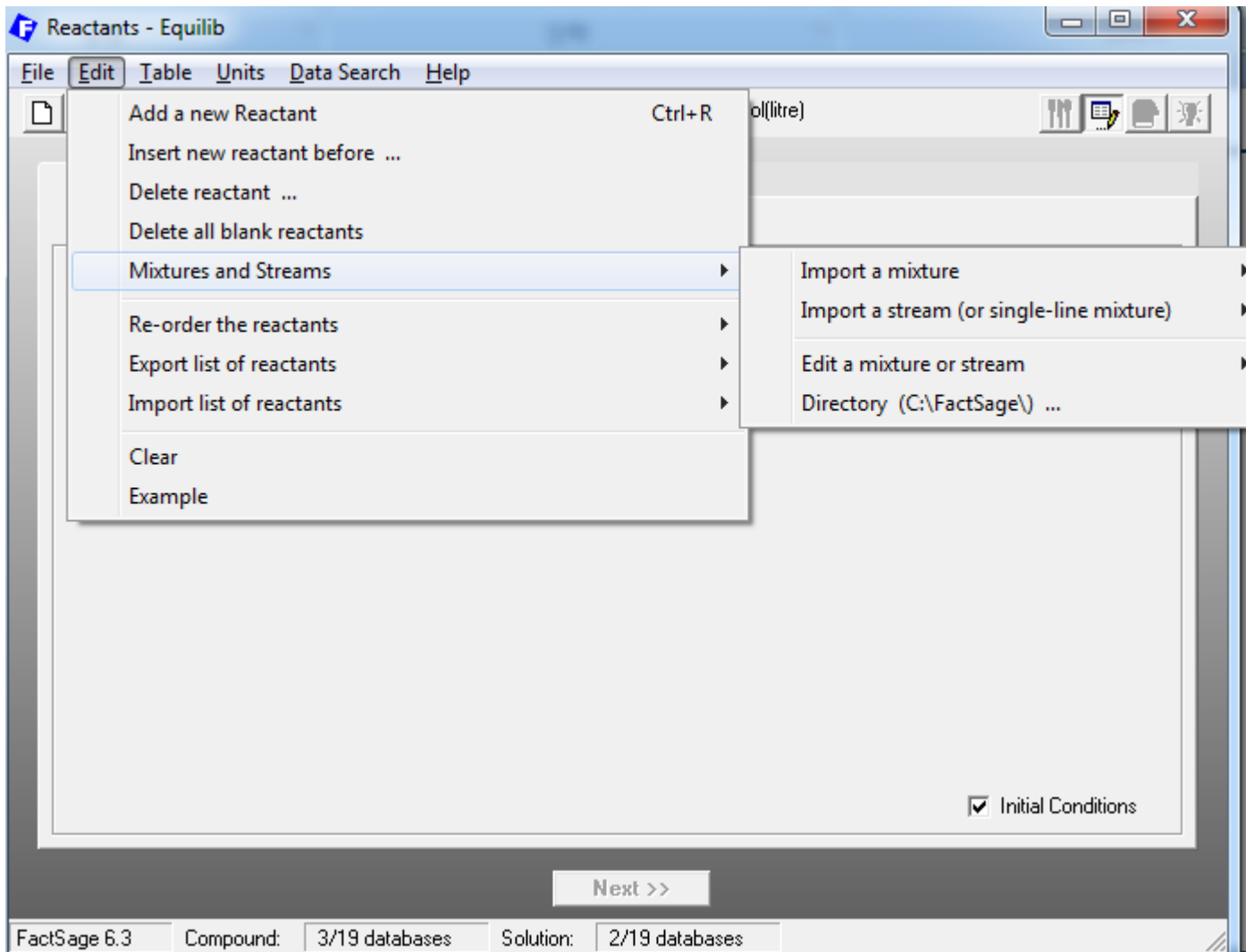
FToxid-CORU#2 M2O3(Corundum)

9.2135E-03 mol gas_ideal
(0.26153 gram, 9.2135E-03 mol, 1.4162 litre, 1.8467E-04 gram/cm3)
(1600 C, 1 atm, a=1.0000)

| | | |
|--------------|------|--------|
| 0.97654 | CO | FactPS |
| + 2.3284E-02 | CO2 | FactPS |
| + 7.4306E-05 | Fe | FactPS |
| + 6.5345E-05 | SiO | FactPS |
| + 3.1435E-05 | Na | FactPS |
| + 2.6810E-06 | Ni | FactPS |
| + 1.3820E-06 | Mg | FactPS |
| + 8.1622E-07 | Mn | FactPS |
| + 2.1625E-07 | Cr | FactPS |
| + 9.9725E-08 | FeO | FactPS |
| + 8.7642E-08 | Co | FactPS |
| + 5.7545E-08 | SiO2 | FactPS |
| + 2.0547E-08 | CrO | FactPS |
| + 2.3294E-09 | O | FactPS |
| + 1.6028E-09 | CrO2 | FactPS |

Create 37 stream files for Slag phases

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag



- 3 FSstel-LIQU LIQUID stream
- 4 FToxide Slag stream
- 5 Slag with A=12.12 stream
- 6 Slag with A=12.62 stream
- 7 Slag with A=13.12 stream
- 8 Slag with A=13.62 stream
- 9 Slag with A=14.12 stream
- 10 Slag with A=14.62 stream
- 11 Slag with A=15.12 stream
- 12 Slag with A=16.12 stream
- 13 Slag with A=16.62 stream
- 14 Slag with A=17.12 stream
- 15 Slag with A=18.12 stream
- 16 Slag with A=19.12 stream
- 17 Slag with A=20.12 stream
- 18 Slag with A=21.12 stream
- 19 Slag with A=22.12 stream
- 20 Slag with A=23.12 stream
- 21 Slag with A=24.12 stream
- 22 Slag with A=25.12 stream
- 23 Slag with A=26.12 stream
- 24 Slag with A=27.12 stream
- 25 Slag with A=28.12 stream
- 26 Slag with A=29.12 stream
- 27 Slag with A=30.12 stream
- 28 Slag with A=30.3 stream
- Slag FToxid-SLAGA#1 stream
- Steel FSstel-LIQU stream

Select each stream and calculate liquidus temp. using 'Precipitate Target'

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

Menu - Equilib: 37 calculations

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants (1)

Products

Compound species

- * + gas ideal real 34
- aqueous 0
- pure liquids 0
- * + pure sol 114
- suppress duplicates apply
- * - custom selection species: 148

Precipitate Target

FToxid-SLAGA

Estimate T(C): 1000

Mass(g): 0

Solution species

| * | + | Base-Phase | Full Name |
|---|---|--------------|--------------------------|
| * | + | FToxid-SLAGA | ASlag-liq all oxides + S |
| | + | FToxid-SPINA | ASpinel |
| | + | FToxid-Orth | Orthopyroxene |
| | + | FToxid-oPyr | Orthopyroxene |
| | + | FToxid-pPyrA | AProtopyroxene |
| | + | FToxid-OlivA | AOlivine |
| | + | FToxid-MulF | Mullite |

Legend

- I - immiscible 6
- P - precipitate target
- + - selected 3

Show all selected

species: 434 solutions: 15 **Select**

Custom Solutions

- fixed activities
- ideal solutions
- activity coefficients

Details ...

Pseudonyms

apply **List ...**

include molar volumes

Total Species (max 1500) 582

Total Solutions (max 40) 15

Default

Final Conditions

| <A> | | T(C) | P(atm) | Delta H(J) |
|-----|-----|------|--------|------------|
| | | | 1 | |

10 steps Table **1 calculation**

Equilibrium

- normal normal + transitions
- transitions only
- open

Calculate >>

FactSage 6.3 C:\FactSage\EquiNo3-a-Precipitate_Target.DAT

Effect of SiO₂/MgO ratio of Laterite on Liquidus Temp. of Slag

Results - Equilib 1468.09 C

Output Edit Show Pages

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

| Amount | Unit | Phase Name | Phase Type |
|--------------|-------|---|------------|
| + 29.353 | wt. % | Fe1Cr2O4 | FToxid |
| + 0.27335 | wt. % | Cr1Cr2O4 | FToxid |
| + 1.4574E-03 | wt. % | Cr1Fe2O4 | FToxid |
| + 9.0725E-02 | wt. % | Cr1Al2O4 | FToxid |
| + 2.5892E-03 | wt. % | Co1Al2O4 | FToxid |
| + 4.1180E-05 | wt. % | Co1Fe2O4 | FToxid |
| + 8.9999E-11 | wt. % | Co1Co2O4 | FToxid |
| + 3.4195E-07 | wt. % | Fe1Co2O4 | FToxid |
| + 3.1984E-03 | wt. % | Ni1Al2O4 | FToxid |
| + 5.0886E-05 | wt. % | Ni1Fe2O4 | FToxid |
| + 5.3608E-07 | wt. % | Mg1Co2O4 | FToxid |
| + 7.7316E-03 | wt. % | Co1Cr2O4 | FToxid |
| + 9.5535E-03 | wt. % | Ni1Cr2O4 | FToxid |
| + 1.1121E-10 | wt. % | Ni1Co2O4 | FToxid |
| + 3.1877E-09 | wt. % | Cr1Co2O4 | FToxid |
| + 0 | gram | SiO2_cristobalite(h) (1468.09 C, 1 atm, S6, a=1.0000) | FToxid |
| + 0 | gram | SiO2_tridymite(h) (1468.09 C, 1 atm, S4, a=0.99999) | FToxid |
| + 0 | gram | SiO2_quartz(h) (1468.09 C, 1 atm, S2, a=0.92034) | FToxid |
| + 0 | gram | MgSiO3_proto-enstatite (1468.09 C, 1 atm, S3, a=0.54841) | FToxid |
| + 0 | gram | MgSiO3_ortho-enstatite (1468.09 C, 1 atm, S2, a=0.54085) | FToxid |

Primary crystallization phase is SiO₂ (cristobalite)

Using **Macro function**, this kind of calculation can be carried out automatically.

Repeat to calculate the liquidus temp of each slag using '**Precipitate Target**'

The effect of SiO_2/MgO and FeO and Al_2O_3 in Slag on the liquidus temperature of the Slag

Phase Diagram / Equilib

Phase diagram of $\text{SiO}_2\text{-MgO-Al}_2\text{O}_3\text{-FeO-Fe}$

Actually, SiO_2/MgO of Laterite is almost same as that of the produced Slag
The main system of Slag is virtually $\text{SiO}_2\text{-MgO-Al}_2\text{O}_3\text{-FeO}$

Components - Phase Diagram

File Edit Units Data Search Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

1 - 5

Components

SiO₂

MgO

Al₂O₃

FeO

Fe

Note:
- on the phase diagram the units of mass will be g, but the chemical formulae of the components remain molar values.

Fe-saturation condition

Eh - pH diagram

Next >>

FactSage 6.3 Compound: 2/19 databases Solution: 2/19 databases

Phase diagram of SiO₂-MgO-Al₂O₃-FeO-Fe

Select pure solid and liquid of Fe for Fe-saturation condition

Selection - Equilib - no results -

File Edit Show Sort

Selected: 41/68 **SOLID** Duplicates selected

| Code | Species | Data | Phase | T | V | Activity | Minimum | Maximum |
|------|----------|-------------|---------------|-----------|---|----------|---------|---------|
| 17 | Si(s) | FSstel | diamond_a4 | | o | | | |
| 18 | SiO2(s) | FSstel | quartz(l) | | v | | | |
| 19 | SiO2(s2) | FSstel | quartz(h) | | v | | | |
| 20 | SiO2(s3) | FSstel | tridymite(l) | | v | | | |
| 21 | SiO2(s4) | FSstel | tridymite(h) | | v | | | |
| 22 | SiO2(s5) | FSstel | crystalite(l) | | v | | | |
| 23 | SiO2(s6) | FSstel | crystalite(h) | | v | | | |
| + | 24 | Fe(s) | FSstel | bcc_a2 | | | | |
| + | 25 | Fe(s2) | FSstel | fcc_a1 | | | | |
| | 26 | Fe2O3(s) | FSstel | hematite | | v | | |
| | 27 | Fe3O4(s) | FSstel | magnetite | | v | | |
| | 28 | Fe3O4(s2) | FSstel | magnetite | | v | | |
| | 29 | Al5Fe2(s) | FSstel | al5fe2 | | o | | |
| | 30 | Al61Fe31(s) | FSstel | al2fe | | o | | |

Show Selected Select All Select/Clear... Clear OK

comments

Variables Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

(gram) SiO2 + FeO + MgO + Al2O3 + Fe

aqueous 0

* + pure liquids 1

* + pure solids 41

Solution species

| * | + | Base-Phase | Full Name |
|---|---|--------------|--------------------------|
| | l | FToxid-SLAGA | ASlag-liq all oxides + S |
| | l | FToxid-SPINA | ASpinel |
| | + | FToxid-MeO_A | AMonoxide |
| | + | FToxid-cPyrA | AClinopyroxene |
| | + | FToxid-oPyr | Orthopyroxene |
| | + | FToxid-pPyrA | AProtopyroxene |
| | + | FToxid-OlivA | AOlivine |
| | + | FToxid-MulF | Mullite |

Custom Solutions

- fixed activities
- ideal solutions
- activity coefficients

Details ...

Pseudonyms

apply List ...

include molar volumes

Total Species (max 1500) 178

Total Solutions (max 40) 12

Legend

l - immiscible 3

+ - selected 6

Show all selected

species: 136

solutions: 12

Select

Default

| FeO/(SiO2+FeO) | Al2O3/ | Fe/(SiO2+FeO) |
|----------------|--------|---------------|
| 0 1 | 0 | 0.000001 |

Phase Diagram

Calculate >>

sNo4-SiO2-MgO-Al2O3-SiO2-constant_1500C.DAT

Selection - Equilib - no results -

File Edit Show Sort

Selected: 1/10 **LIQUID** Duplicates selected

| Code | Species | Data | Phase | T | V | Activity | Minimum | Maximum |
|------|-----------|------------|--------|--------|---|----------|---------|---------|
| 3 | Mg(liq) | FSstel | liquid | | o | | | |
| 4 | MgO(liq) | FSstel | liquid | | | | | |
| 5 | Al(liq) | FSstel | liquid | | o | | | |
| 6 | Si(liq) | FSstel | liquid | | o | | | |
| 7 | SiO2(liq) | FSstel | liquid | | | | | |
| + | 8 | Fe(liq) | FSstel | liquid | | | | |
| | 9 | Fe3O4(liq) | FSstel | liquid | | | | |
| | 10 | MgO(liq) | FToxid | liquid | | | | |
| | 11 | Al2O3(liq) | FToxid | liquid | | | | |
| | 12 | SiO2(liq) | FToxid | liquid | | | | |

Show Selected Select All Select/Clear... Clear OK

Phase diagram of SiO₂-MgO-Al₂O₃-FeO-Fe

Variables: SiO₂-MgO-Al₂O₃-FeO-Fe composition #3. vs composition #1.

Variables
 Y X
 A
 B C
 Y steps: 10
 X steps: 10
 Next >>

T and P
 Temperature: T(C) constant 1500
 Pressure or Volume: P(atm) constant 1
 log P
 V(litre) 1
 log V

Energy(J) Mass(g) Vol(litre)

FeO + MgO + Al₂O₃ + Fe

Compositions (mass)
 #1. 1 SiO₂ + 0 MgO + 0 Al₂O₃ + 0 FeO + 0 Fe = 1 (max)
 1 SiO₂ + 1 MgO + 1 Al₂O₃ + 1 FeO + 1 Fe = 0
 Composition #1 max = 4

Cancel OK

| Phase | Full Name |
|-------|--------------------------|
| AGA | ASlag-liq all oxides + S |
| INA | ASpinel |
| O_A | AMonoxide |
| lyrA | AClinopyroxene |
| Pyr | Orthopyroxene |
| lyrA | AProtopyroxene |
| ivA | AOlivine |
| ulF | Mullite |

Custom Solutions
 fixed activities
 ideal solutions
 activity coefficients
 Details ...

Pseudonyms
 apply List ...

include molar volumes
 Total Species (max 1500) 178
 Total Solutions (max 40) 12

Show all selected
 species: 136
 solutions: 12
 Select

Default

Variables

| T(C) | SiO ₂ /(SiO ₂ +FeO) | FeO/(SiO ₂ +FeO) | Al ₂ O ₃ / | Fe/(SiO ₂ +FeO) |
|------|---|-----------------------------|----------------------------------|----------------------------|
| 1500 | 0.1 | 0.1 | 0 | 0.000001 |

A = SiO₂, B = MgO, C = FeO

Phase Diagram
 A
 B C
 Calculate >>

FactSage 6.3 C:\...\PhasNo4-SiO2-MgO-Al2O3-SiO2-constant_1500C.DAT

Phase diagram of $\text{SiO}_2\text{-MgO-Al}_2\text{O}_3\text{-FeO-Fe}$

Variables: SiO₂-FeO-MgO-Al₂O₃-Fe composition #1. vs composition #1.

Variables

compositions 4

log₁₀(a) 0

Y steps: 11

X steps: 11

Next >>

T and P

Temperature

T(C) constant 1500

Pressure or Volume

P(atm) constant 1

log P

V(litre) 1

log V

Compositions (mass)

#1. 1 SiO₂ + 0 FeO + 0 MgO + 0 Al₂O₃ + 0 Fe

1 SiO₂ + 1 FeO + 1 MgO + 0 Al₂O₃ + 0 Fe

Composition # #1 max = 5

Cancel

**Ternary phase diagram
of FeO-MgO-SiO₂
at constant Al₂O₃
with Fe-saturation**

**Add small
amount of Fe**

Variables: SiO₂-MgO-Al₂O₃-FeO-Fe composition #3. vs composition #1.

Variables

compositions 4

log₁₀(a) 0

Y steps: 10

X steps: 10

Next >>

T and P

Temperature

T(C) constant 1500

Pressure or Volume

P(atm) constant 1

log P

V(litre) 1

log V

Compositions (mass)

#4. 0 SiO₂ + 0 MgO + 0 Al₂O₃ + 0 FeO + 1 Fe

1 SiO₂ + 1 MgO + 1 Al₂O₃ + 1 FeO + 1 Fe

Composition # #4 max = 4

constant 0.0001

Cancel

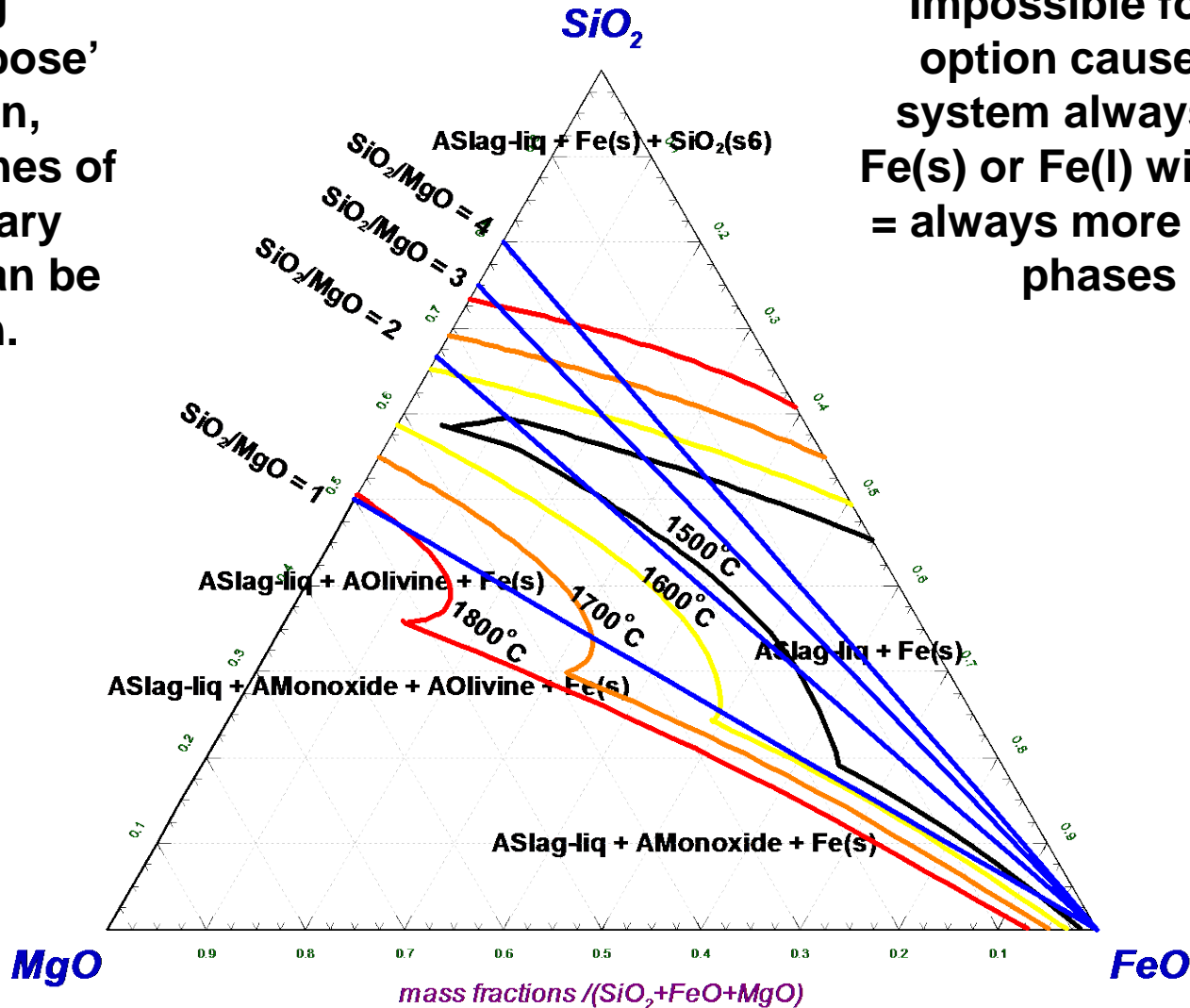
OK

Phase diagram of $\text{SiO}_2\text{-MgO-Al}_2\text{O}_3\text{-FeO-Fe}$

Using 'superimpose' function, liquidus lines of the ternary system can be drawn.

$\text{SiO}_2 - \text{FeO} - \text{MgO} - \text{Al}_2\text{O}_3 - \text{Fe}$
 $\text{Al}_2\text{O}_3/\text{Z} \text{ (g/g)} = 0, \text{ Fe/Z (g/g)} = 0.00001,$
 $\text{Z} = (\text{SiO}_2 + \text{FeO} + \text{MgO}),$

Impossible for 'O' option cause the system always has Fe(s) or Fe(l) with slag = always more than 2 phases



Phase diagram of SiO₂-MgO-Al₂O₃-FeO-Fe

Variables: SiO₂-FeO-MgO-Al₂O₃-Fe T(C) vs composition #1.

Variables

Y-axis: Y-axis
X-axis: X-axis

compositions: 4

log10(a): 0

Y steps: 11
X steps: 11

Next >>

T and P

Temperature: T(C) 1/TK
Y-axis: Y-axis
Max: 2000
Min: 1000

Pressure or Volume: P(atm) log P V(litre) log V
constant
1

Compositions (mass)

#1. SiO₂ + FeO + MgO + Al₂O₃ + Fe = constant

SiO₂ + FeO + MgO + Al₂O₃ + Fe =

Composition # max = 4

Cancel OK

With change 0 to 8 wt% of Al₂O₃ at constant SiO₂/MgO=1 under Fe-saturation

composition #1.

Temperature: Y-axis
Max: 2000
Min: 1000

Pressure or Volume: P(atm) log P V(litre) log V
constant
1

#3. SiO₂ + FeO + MgO + Al₂O₃ + Fe = constant

SiO₂ + FeO + MgO + Al₂O₃ + Fe =

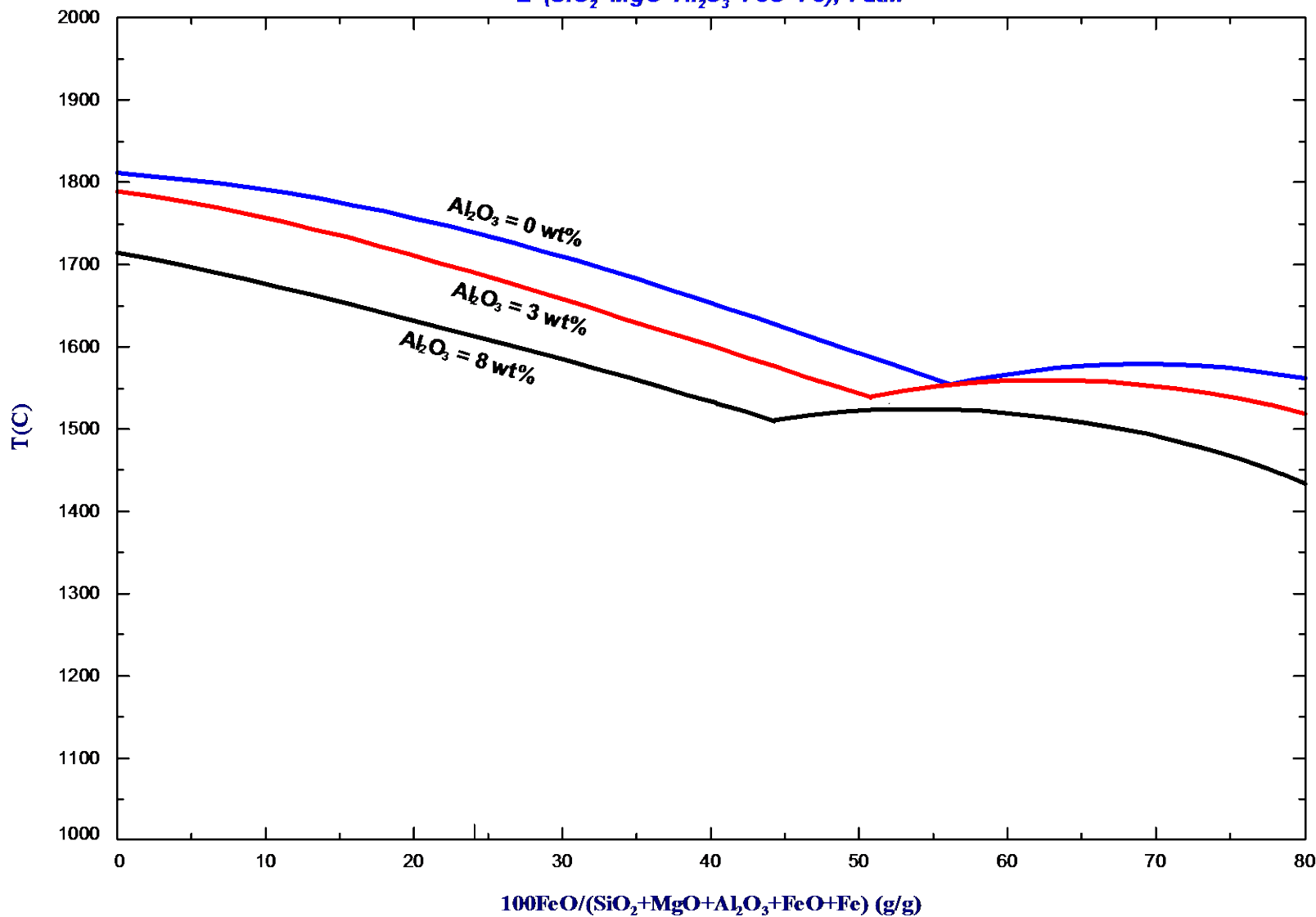
Composition # max = 4

Cancel OK

Phase diagram of SiO_2 - MgO - Al_2O_3 - FeO - Fe

SiO_2 - MgO - Al_2O_3 - FeO - Fe

SiO_2 - $1\text{MgO}/Z$ (g/g) = 0, $100\text{Al}_2\text{O}_3/Z$ (g/g) = 0, $100\text{Fe}/Z$ (g/g) = 1,
 $Z=(\text{SiO}_2+\text{MgO}+\text{Al}_2\text{O}_3+\text{FeO}+\text{Fe})$, 1 atm



Show the liquidus temperature of the alloy as a function of Fe-Ni grades

Precipitate target / Phase diagram

Liquidus Temp of Alloy as a function of Fe-Ni grades

The alloy mainly contains Fe and Ni with small amounts of Co or Cr
Virtually, it is a binary Fe-Ni system

Reactants - Equilib

File Edit Table Units Data Search Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

1 - 2

| Mass(g) | Species | Phase | T(C) | P(total)** | Stream# | Data |
|---------|---------|-------|------|------------|---------|------|
| <100-A> | Fe | | | | 1 | |
| + <A> | Ni | | | | 1 | |

Initial Conditions

Next >>

FactSage 6.3 Compound: 3/19 databases Solution: 2/19 databases

Liquidus Temp of Alloy as a function of Fe-Ni grades

Menu - Equilib: NO5-Liquidus of Fe-Ni

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants (2)

(gram) <A> Fe + <A> Ni

Products

Compound species

- gas ideal real 2
- aqueous 0
- pure liquids 0
- pure solids 6
- suppress duplicates

species: 8

Precipitate Target

FSstel-LIQU

Estimate T(C): 1000

Mass(g): 0

Solution species

| | + | Base-Phase | Full Name |
|--|---|-------------|-----------|
| | P | FSstel-LIQU | LIQUID |
| | + | FSstel-FCC1 | FCC_A1 |
| | + | FSstel-BCC1 | BCC_A2 |

Legend

P - precipitate target
+ - selected 2

Show all selected

species: 6
solutions: 3

Custom Solutions

- fixed activities
- ideal solutions
- activity coefficients

Pseudonyms

apply

include molar volumes

Total Species (max 1500) 14
Total Solutions (max 40) 3

Final Conditions

| <A> | | T(C) | P(atm) | Product H(J) |
|-----|-----|------|--------|--------------|
| 0 | 50 | 1 | | |

10 steps Table 51 calculations

Equilibrium

- normal normal + transitions
- transitions only
- open

FactSage 6.3 C:\FactSage\EquiNO5-Liquidus_of_Fe-Ni.DAT

Liquidus Temp of Alloy as a function of Fe-Ni grades

Results - Equilib 1537.81 C, A=0 (page 1/51)

Output Edit Show Pages

Save or Print Plot Equilib Results file Stream File Format Fact-XML Fact-Optimal Fact-Function-Builder Refresh ...

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Plot Results ... Repeat Plot - T(C) vs Alpha ...

1500.72 C, A=14 | 1498.68 C, A=15 | 1512.78 C, A=8 | 1510.81 C, A=9 | 1508.086 C, A=2 | 1527.08 C, A=3 | 1523.1

Results Processor: C:\FactSage\Equi0.res

File Help

<100-A> Fe + <A> Ni

| Axes | Variables | Minimum | Maximum |
|------|-------------|-------------|-------------|
| | activity | 0 | 1. |
| | mole | 0 | 1.7907 |
| | mole fract. | 0 | 1. |
| | gram | 0 | 100. |
| | weight % | 0 | 100. |
| | Alpha | 0 | 50. |
| | T(C) | 1445.9 | 1537.8 |
| | P(atm) | 1. | 1. |
| | Cp(J) | 75.575 | 82.369 |
| | G(J) | -1.9775E+05 | -1.9378E+05 |
| | Vol(litre) | 0 | 0 |
| | H(J) | 1.0825E+05 | 1.2976E+05 |
| | V(litre) | 0 | 0 |
| | S(J) | 176.13 | 180.43 |
| | - page - | 1. | 51. |

System component Mole fraction Mass fraction

Fe 1.0000 1.0000

gram BCC_A2 (1537.81 C, 1 atm, a=1.0000) (100.00 wt.% Fe1Va3)

gram FCC_A1 (1537.81 C, 1 atm, a=0.99446) (100.00 wt.% Fe1Va1)

gram Fe_bcc_a2 (1537.81 C, 1 atm, S1, a=1.0000)

0 selected 0 selected

Select

Graph

Labels size: 9 no: 4

chemical integer # none

Display

color reactants file name full screen Viewer Figure

Plot >>

FactSage 6.3 C:\FactSage\Equi0.res 5Feb13 51 sets

Liquidus Temp of Alloy as a function of Fe-Ni grades

Species Selection - EQUILIB Results: vs

File Show Select

| + | # | Species | Mole (min) | Mole (max) | Fraction (min) | Fraction (max) | Activity (min) | Activity (max) |
|---|----|---------------------|------------|------------|----------------|----------------|----------------|----------------|
| | | Gas Phase | | | | | | |
| | 1 | Fe(g) | 0 | 0 | 0.751736 | 1. | 4.5471E-06 | 3.6413E-05 |
| | 2 | Ni(g) | 0 | 0 | 0 | 0.248264 | 0 | 1.5017E-06 |
| | | FSstel- LIQU | | | | | | |
| | 3 | Fe(LIQU) | 0.895335 | 1.7907 | 0.512434 | 1. | 0.473324 | 1. |
| | 4 | Ni(LIQU) | 0 | 0.851885 | 0 | 0.487566 | 0 | 0.398546 |
| | | FSstel- FCC1 | | | | | | |
| | 5 | Fe1Va1(FCC1) | 0 | 0 | 0.518534 | 1. | | |
| | 6 | Ni1Va1(FCC1) | 0 | 0 | 0 | 0.481466 | | |
| | | FSstel- BCC1 | | | | | | |
| | 7 | Fe1Va3(BCC1) | 0 | 0 | 0.598803 | 1. | | |
| | 8 | Ni1Va3(BCC1) | 0 | 0 | 0 | 0.401197 | | |
| | | Pure Solids | | | | | | |
| | 9 | Fe(s) | 0 | 0 | 0 | 0 | | |
| | 10 | Fe(s2) | 0 | 0 | 0 | 0 | | |
| | 11 | Ni(s) | 0 | 0 | 0 | 0 | | |
| | 12 | Fe(s) | 0 | 0 | 0 | 0 | | |
| | 13 | Fe(s2) | 0 | 0 | 0 | 0 | | |

source **Mass** mole **Order** integer #
 [page] gram mass (max) fraction (max)
 activity (max)

Clear 51 pages Select

Click on the '+' column to add or remove species.

Results Processor: C:\FactSage\Equi0.res

File Help

<100-A> Fe + <A> Ni

| Axes | Variables | Minimum | Maximum |
|------|-----------|---------|---------|
| | activity | 0 | 1. |
| | mole | 0 | 1.7907 |

Axis: T(C) vs Alpha

Y-variable X-variable Swap Axes

Y-axis: **T(C)**

maximum: 1540
minimum: 1445
tick every: 5

X-axis: **Alpha**

maximum: 50
minimum: 0
tick every: 5

Cancel Refresh OK

0 selected

Axes

Repeat

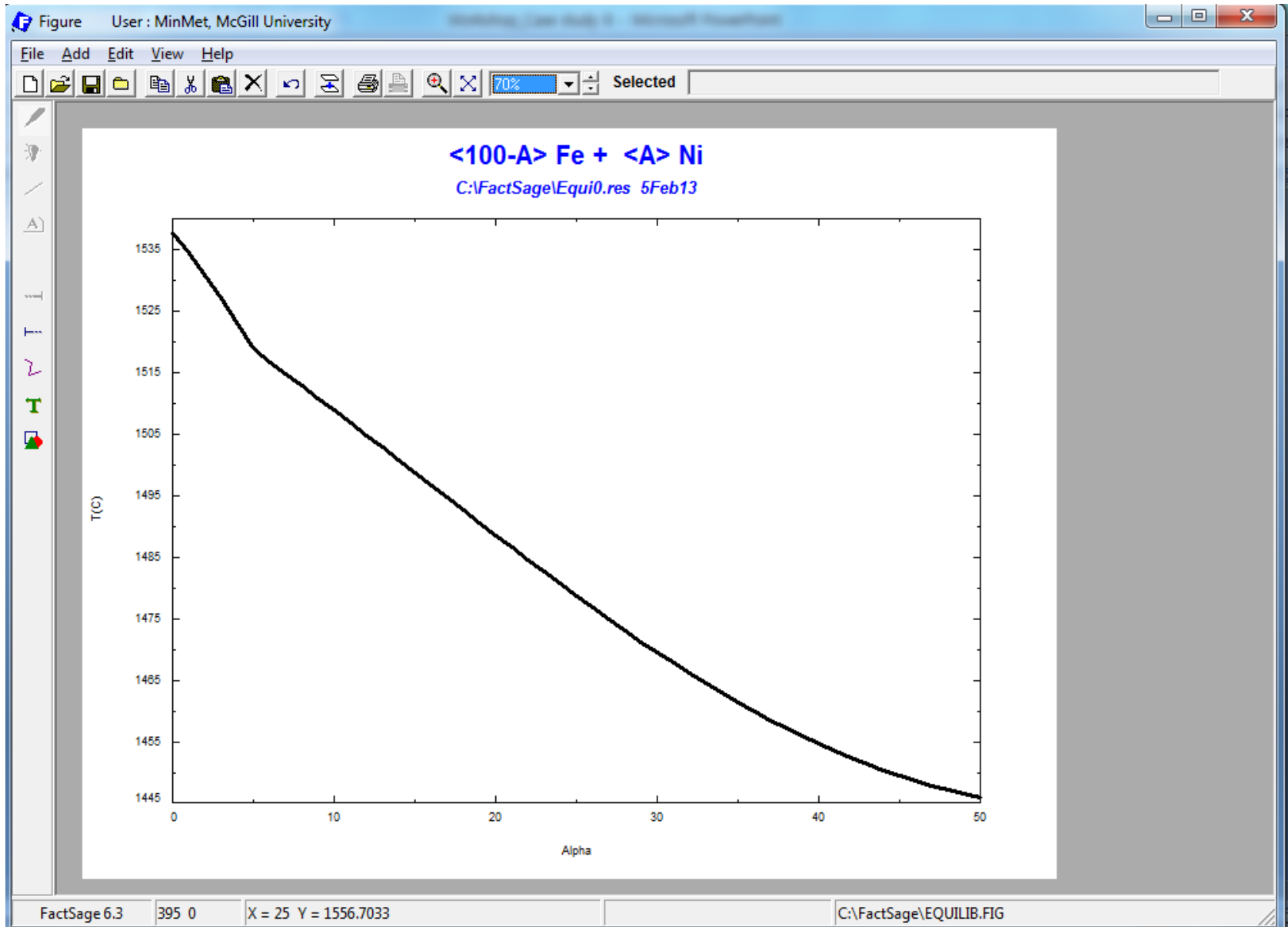
size: 9 no: 4

chemical reactants Viewer
 integer # file name Figure
 none

Plot >>

FactSage 6.3 C:\FactSage\Equi0.res 5Feb13 51 sets

Liquidus Temp of Alloy as a function of Fe-Ni grades



The effect of Fe-Ni grades on the concentration of Co and Cr in the liquid alloy

Equilib Calculation

The effect of Fe-Ni grades on the solubility of Co and Cr

Reactants - Equilib

File Edit Table Units Data Search Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

1 - 10 | 11 - 14 |

| Mass(g) | Species | Phase | T(C) | P(total)** | Stream# | Data |
|-----------|---------|-------------------------|------|------------|---------|--------|
| 8.1 | FeO | solid-FactPS wustite | 500 | 1 | 1 | FactPS |
| + 20.9 | Fe2O3 | solid-1-FToxid hematit | 500 | 1 | 1 | FToxid |
| + 43.8 | SiO2 | solid-1-FToxid quartz(l | 500 | 1 | 1 | FToxid |
| + 6.4 | Al2O3 | solid-4-FToxid corund | 500 | 1 | 1 | FToxid |
| + 16.8 | MgO | solid-FToxid periclase | 500 | 1 | 1 | FToxid |
| + 2.3 | NiO | solid-FToxid | 500 | 1 | 1 | FToxid |
| + <4.8A> | Al2O3 | solid-4-FToxid corund | 100 | 1 | 2 | FToxid |
| + <14A> | SiO2 | solid-1-FToxid quartz(l | 100 | 1 | 2 | FToxid |
| + <81.2A> | C | solid-1-FactPS graphit | 100 | 1 | 2 | FactPS |
| + 0.1 | CaO | solid-FToxid lime | 500 | 1 | 1 | FToxid |

Initial Conditions

Next >>

FactSage 6.3 Compound: 3/19 databases Solution: 2/19 databases

The effect of Fe-Ni grades on the solubility of Co and Cr

Menu - Equilib: change of Ni with adding Char

File Units Parameters Help

T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Reactants [14]

| | | | | | | | | | | | | | | | |
|----------------|---|------------|---|-----------|---|-----------|---|----------|---|--------------------|---------------------|---------------------|---------------------|--------------------|---------------------|
| (gram) 8.1 FeO | + | 20.9 Fe2O3 | + | 43.8 SiO2 | + | 6.4 Al2O3 | + | 16.8 MgO | + | (500C,s-FactPS,#1) | (500C,s1-FToxid,#1) | (500C,s1-FToxid,#1) | (500C,s4-FToxid,#1) | (500C,s-FToxid,#1) | (500C,s4-FToxid,#1) |
|----------------|---|------------|---|-----------|---|-----------|---|----------|---|--------------------|---------------------|---------------------|---------------------|--------------------|---------------------|

Products

Compound species

- gas ideal real 51
- aqueous 0
- pure liquids 0
- pure solids 116
- suppress duplicates
- * - custom selection species: 167

Target

- none -

Estimate ALPHA:

Mass(g):

Solution species

| * | + | Base-Phase | Full Name |
|---|---|--------------|--------------------------|
| | + | FSstel-LIQU | LIQUID |
| | + | FSstel-FCC1 | FCC_A1 |
| | + | FSstel-BCC1 | BCC_A2 |
| | | FToxid-SLAGA | ASlag-liq all oxides + S |
| | | FToxid-SPINA | ASpinel |
| | | FToxid-MeO_A | AMonoxide |
| | + | FToxid-cPyrA | AClinopyroxene |
| | + | FToxid-oPyr | Orthopyroxene |

Legend

| - immiscible 4

+ - selected 8

Show all selected

species: 417

solutions: 16

Custom Solutions

- fixed activities
- ideal solutions
- activity coefficients

Pseudonyms

apply

include molar volumes

Total Species (max 1500) 584

Total Solutions (max 40) 16

Final Conditions

| <A> | | T(C) | P(atm) | Delta H(J) |
|-----|-------|-------|--------|------------|
| 0 | 0.1 | 0.005 | | |
| 10 | steps | | | |

Table

21 calculations

Equilibrium

- normal
- normal + transitions
- transitions only
- open

FactSage 6.3 C:\...\EquiNo6-Fe-Ni_effect_on_Co_and_Cr_composition.DAT

With change of Char, Fe-Ni grade will be changed. The effect of Fe-Ni grades on the solubility of Co and Cr can be calculated with change of Char.

The effect of Fe-Ni grades on the solubility of Co and Cr

Results - Equilib A=0 (page 1/21)

Output Edit Show Pages

Save or Print ▶ T(C) P(atm) Energy(J) Mass(g) Vol(litre)

Plot ▶ Plot Results ...

Equilib Results file ▶ Repeat Plot - gram vs Alpha ... =0.045 | A=0.05 | A=0.055 |

Stream File ▶

Format ▶

Fact-XML ▶

Fact-Optimal ▶

Fact-Function-Builder ▶

Refresh ...

Results Processor: C:\FactSage\Equi0.res

File Help

8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +

| Axes | Variables | Minimum | Maximum |
|------|---------------|-------------|-------------|
| | activity | 0 | 104.58 |
| | mole | 0 | 2.5887 |
| | mole fract. | 0 | 0.999983 |
| | gram | 0 | 99.429 |
| | weight % | 0 | 99.998 |
| | Alpha | 0 | 0.1 |
| | T(C) | 1600. | 1600. |
| | P(atm) | 1. | 1. |
| | Delta Cp(J) | 19.62 | 82.696 |
| | Delta G(J) | -3.8924E+05 | -2.7358E+05 |
| | Vol(litre) | 0 | 0 |
| | Delta H(J) | 1.7769E+05 | 3.1154E+05 |
| | Delta V(litr) | 3.702 | 101.96 |
| | Delta S(J) | 152.43 | 277.68 |
| | - page - | 1. | 21. |

Y-axis X-variable Swap Axes

Y-axis: weight %

X-axis: Alpha

maximum 100 minimum 0 tick every 5

maximum 0.1 minimum 0 tick every 0.01

Cancel Refresh OK

Axes: 0 selected Species: 0 selected

Graph: Labels size: 9 no: 4

Display: color full screen reactants Viewer file name Figure

Plot >>

FactSage 6.3 C:\FactSage\Equi0.res 6Feb13 21 sets

The effect of Fe-Ni grades on the solubility of Co and Cr

Species Selection - EQUILIB Results: weight % vs Alpha

| # | Species | Gram (min) | Gram (max) | Wt.% (min) | Wt.% (max) | Activity (min) | Activity (max) |
|----|------------|------------|------------|------------|------------|----------------|----------------|
| 53 | C(LIQU) | 0 | 0.172327 | 0 | 0.697922 | 0 | 7.3983E-04 |
| 54 | Co(LIQU) | 0 | 7.8630E-02 | 0.214421 | 1.4707 | 1.2119E-06 | 1.3862E-02 |
| 55 | Cr(LIQU) | 0 | 0.384669 | 3.4297E-05 | 1.5579 | 7.7175E-11 | 1.3032E-02 |
| 56 | Al(LIQU) | 0 | 5.1829E-05 | 2.3078E-05 | 4.7114E-05 | 0 | 0 |
| 57 | Mn(LIQU) | 0 | 3.8302E-02 | 4.7114E-02 | 7.3194E-02 | 0 | 0 |
| 58 | Ni(LIQU) | 0 | 1.8073 | 7.3194E-02 | 1.3751E-01 | 0 | 0 |
| 59 | Si(LIQU) | 0 | 1.4944 | 1.3751E-01 | 6.5185E-01 | 0 | 0 |
| 60 | Mg(LIQU) | 0 | 9.3987E-07 | 6.5185E-07 | 4.2719E-07 | 0 | 0 |
| 61 | O(LIQU) | 0 | 9.6386E-03 | 4.2719E-03 | 3.1311E-03 | 0 | 0 |
| 62 | AlO(LIQU) | 0 | 1.6660E-06 | 3.1311E-06 | 2.6009E-06 | 0 | 0 |
| 63 | Al2O(LIQU) | 0 | 1.4529E-09 | 2.6009E-09 | 3.4732E-09 | 0 | 0 |
| 64 | CrO(LIQU) | 0 | 3.5027E-04 | 3.4732E-04 | 1.8417E-04 | 0 | 0 |
| 65 | Cr2O(LIQU) | 0 | 2.0450E-05 | 1.8417E-05 | 3.7368E-05 | 0 | 0 |
| 66 | MnO(LIQU) | 0 | 1.5796E-06 | 3.7368E-06 | 7.5982E-06 | 0 | 0 |
| 67 | SiO(LIQU) | 0 | 3.5940E-04 | 7.5982E-04 | 6.3853E-04 | 0 | 0 |
| 68 | MgO(LIQU) | 0 | 2.3304E-05 | 6.3853E-05 | 2.5967E-05 | 0 | 0 |
| 69 | Ca(LIQU) | 0 | 1.0102E-12 | 2.5967E-12 | 2.2890E-12 | 0 | 0 |
| 70 | CaO(LIQU) | 0 | 8.9324E-10 | 2.2890E-10 | | | |

Results Processor: C:\FactSage\Equi0.res

8.1 FeO + 20.9 Fe2O3 + 43.8 SiO2 + 6.4 Al2O3 +

| Axes | Variables | Minimum | Maximum |
|------|---------------|-------------|-------------|
| | activity | 0 | 104.58 |
| | mole | 0 | 2.5887 |
| | mole fract. | 0 | 0.999983 |
| | gram | 0 | 99.429 |
| | weight % | 0 | 99.998 |
| | Alpha | 0 | 0.1 |
| | T(C) | 1600. | 1600. |
| | P(atm) | 1. | 1. |
| | Delta Cp(J) | 19.62 | 82.696 |
| | Delta G(J) | -3.8924E+05 | -2.7358E+05 |
| | Vol(litre) | 0 | 0 |
| | Delta H(J) | 1.7769E+05 | 3.1154E+05 |
| | Delta V(litr) | 3.702 | 101.96 |
| | Delta S(J) | 152.43 | 277.68 |
| | - page - | 1. | 21. |

Mass: source mole gram

21 pages

Click on the '+' column to add or remove species.

0 selected Species 0 selected

Select

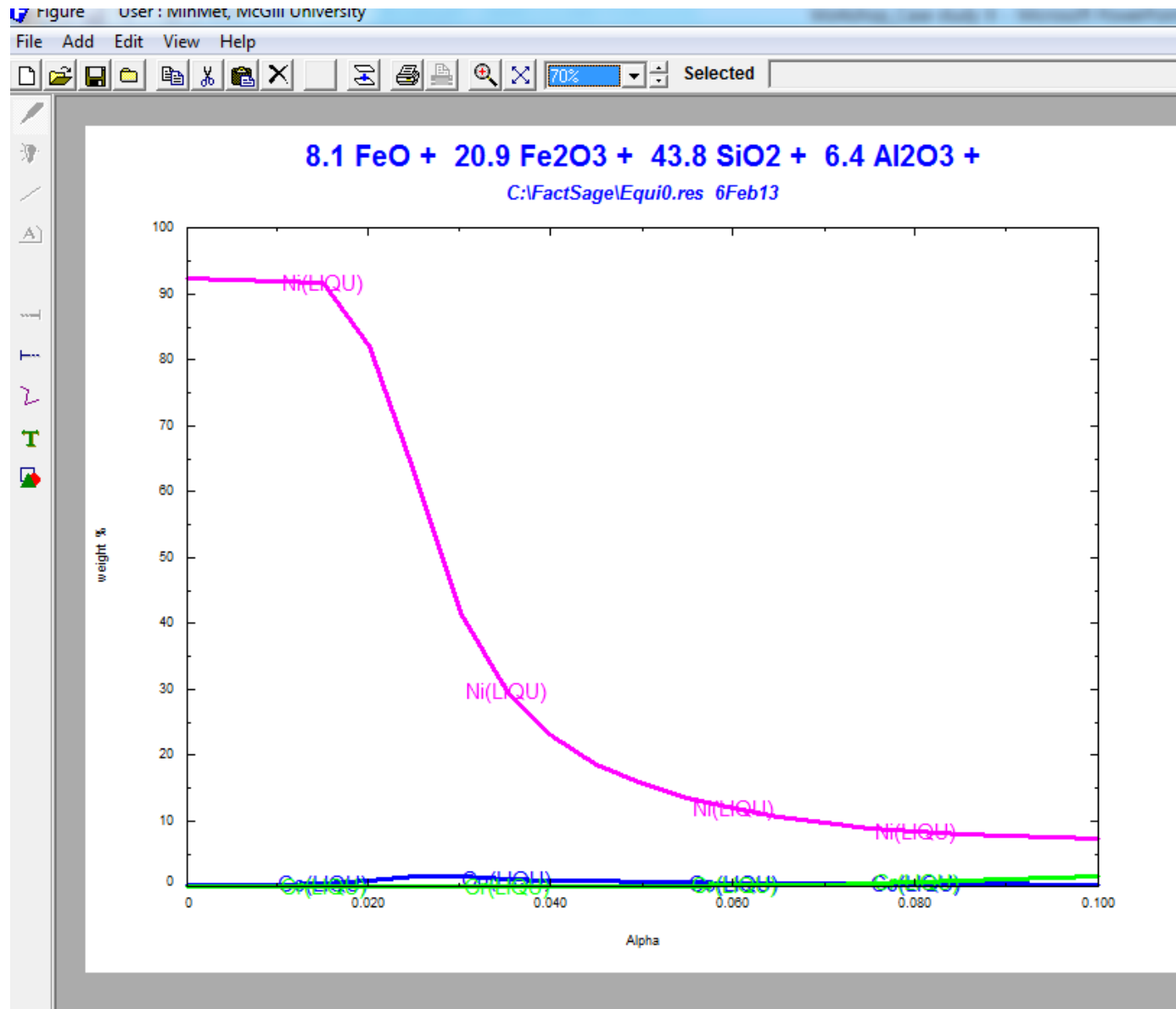
Graph: Labels size: 9 no: 4 chemical integer #

Display: color full screen reactants Viewer file name Figure

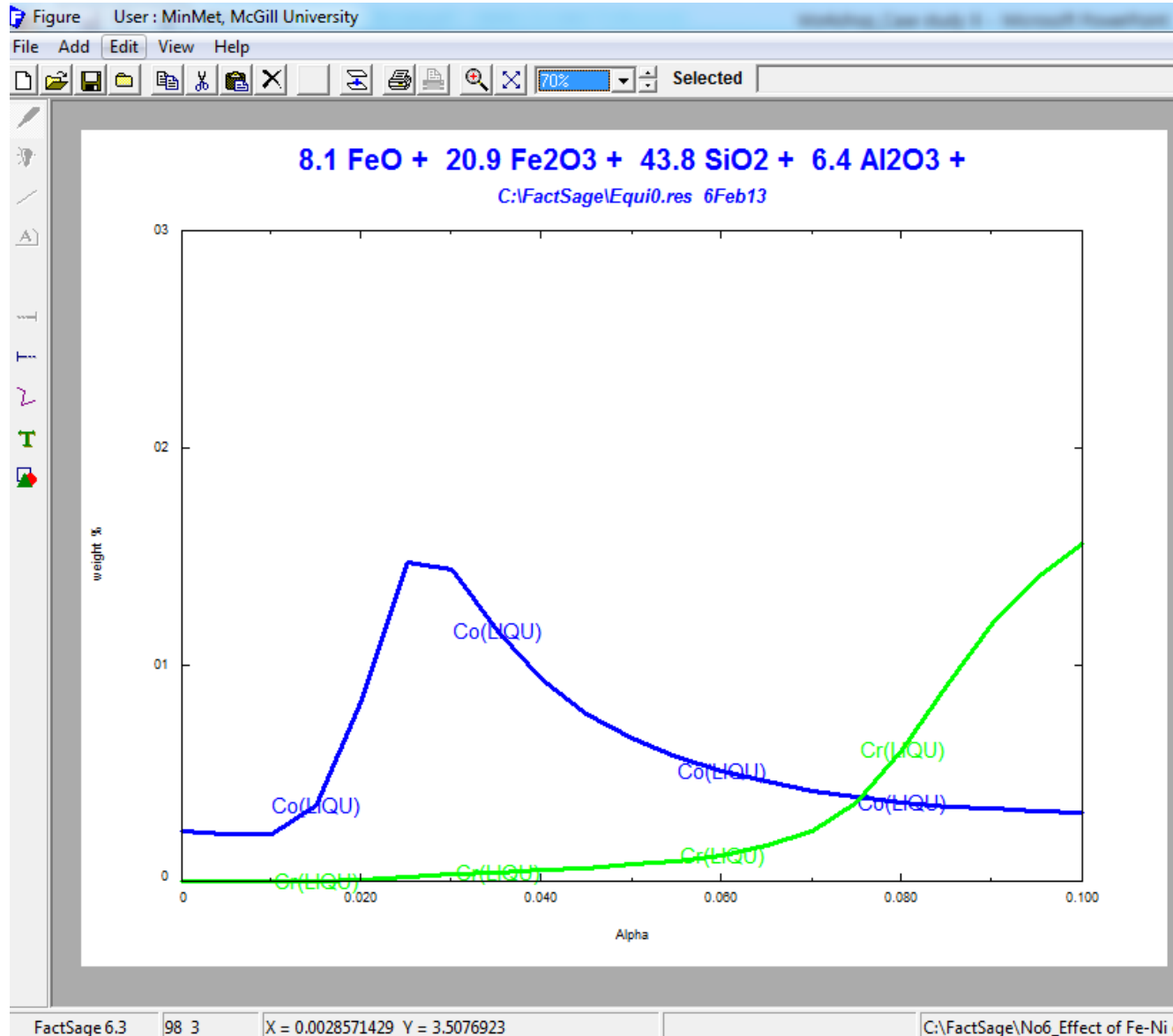
Plot >>

FactSage 6.3 C:\FactSage\Equi0.res 6Feb13 21 sets

The effect of Fe-Ni grades on the solubility of Co and Cr



The effect of Fe-Ni grades on the solubility of Co and Cr



Blow-up Scale of the solubility of Co and Cr with change of Char and Fe-Ni grade.