**Thermodynamics computer exercise 3**

**Lunar soil reduction by carbon and hydrogen**

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The purpose of this exercise was to simulate the reduction of metals in the lunar soil using solid carbon and hydrogen gas using the HSC software.

The composition of the lunar soil is given in table 1.

Table 1. Composition of lunar soil (100kg)

|  |  |  |
| --- | --- | --- |
| **Phases** | **Amount (Wt%)** | **Amount (kmol)** |
| SiO2 | 47.71 | 0.794 |
| TiO2 | 1.59 | 0.02 |
| Al2O3 | 15.02 | 0.147 |
| Fe2O3 | 3.44 | 0.022 |
| FeO | 7.35 | 0.102 |
| MgO | 9.01 | 0.224 |
| CaO | 10.42 | 0.186 |
| Na2O | 2.7 | 0.044 |
| K2O | 0.82 | 0.009 |
| MnO | 0.18 | 0.003 |
| P2O5 | 0.55 | 0.005 |

First, reduction with hydrogen was modelled. The composition of the slag, silicates, alloys, and reaction gasses in the end product was calculated with hydrogen input values between 1 and 8 kmol at 1900 °C The results are shown in figures 1-4. Figure 2 shows that adequate reduction was achieved with 4 kmol of hydrogen.

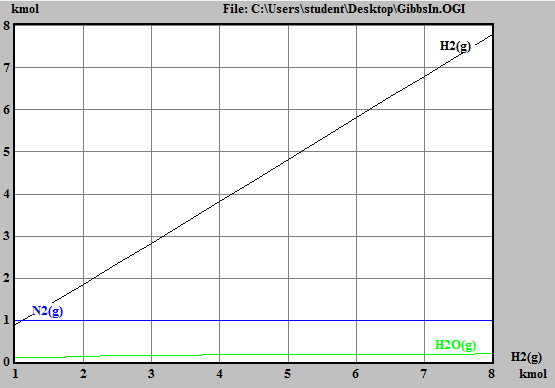


Fig. 1 Composition of reaction product gasses as function of hydrogen at 1900 °C

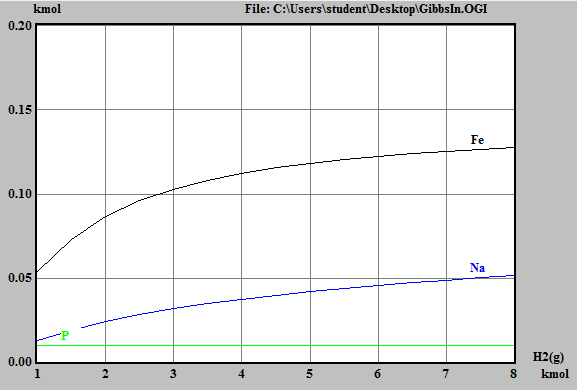


Fig. 2 Composition of reduction product alloy as function of hydrogen at 1900 °C

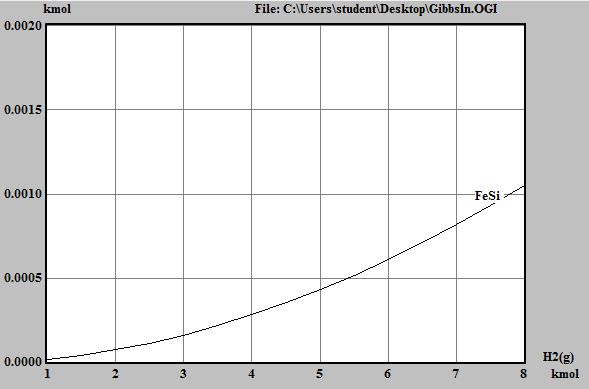


Fig. 3 Composition of reduction product silicates as function of hydrogen at 1900 °C

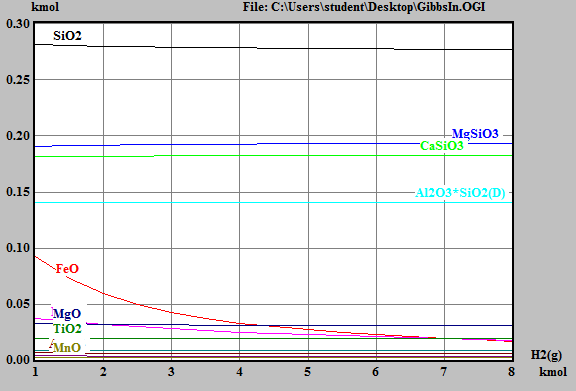


Fig. 4 Composition of reduction product slag as function of hydrogen at 1900 °C

Next, the effect of process temperature on the hydrogen reduction process was examined.