TCFE3: TCS Steel and Fe-alloys Database

TCFE3 is the successor of the well-known TCFE2 (i.e., TCFE-2000 or TCFE2K) thermodynamic database for steels and Fe-alloys. A number of improvements have been made in order to increase the predictive capability of the TCFE3 database.

Some of the major improvements are:

- Improved data for the important σ-phase in stainless steels.
- Addition of data for the binary Nb-Ni system.
- Improved data for the ternary Fe-Cr-Mo system.
- Improved data for the ternary Cr-Mo-Ni system.
- Improved data for the fcc Ti(C,N) carbonitride.

Additionally, some minor improvements on data for other systems have been made.

One of the major improvements in the TCFE3 database is the improved data for the important α phase in stainless steels. Figure 1 shows a comparison between calculations using the TCFE3, TCFE2 and the SSOL databases for a duplex stainless steel.

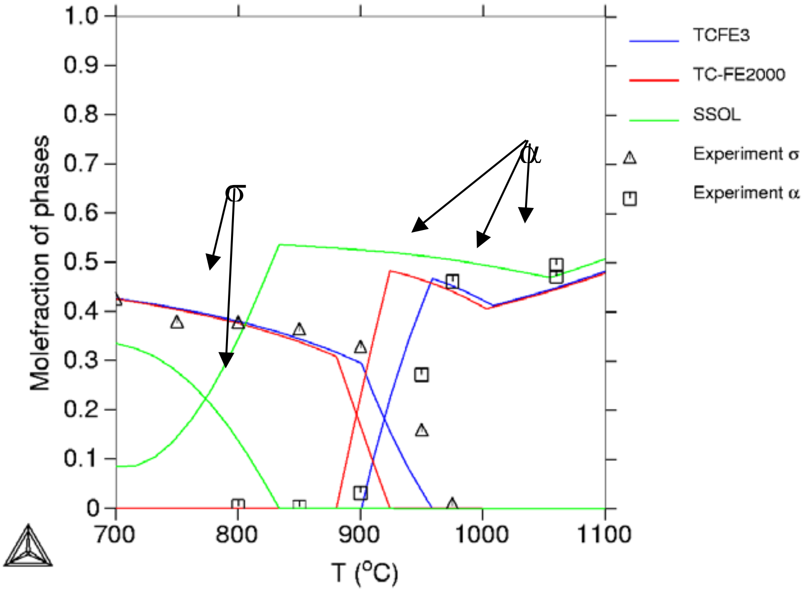

Figure 1. Calculated and experimental equilibrium fractions of ferrite and α-phase for a duplex stainless steel as a function of temperature. The calculations were performed with three different thermodynamic databases, TCFE3, TCFE2 and SSOL. The experimental data were taken from Nilsson [2000].

Figures 2 and 3 below show how TCFE3 can be used for predicting liquidus and solidus temperatures for different types of steels.

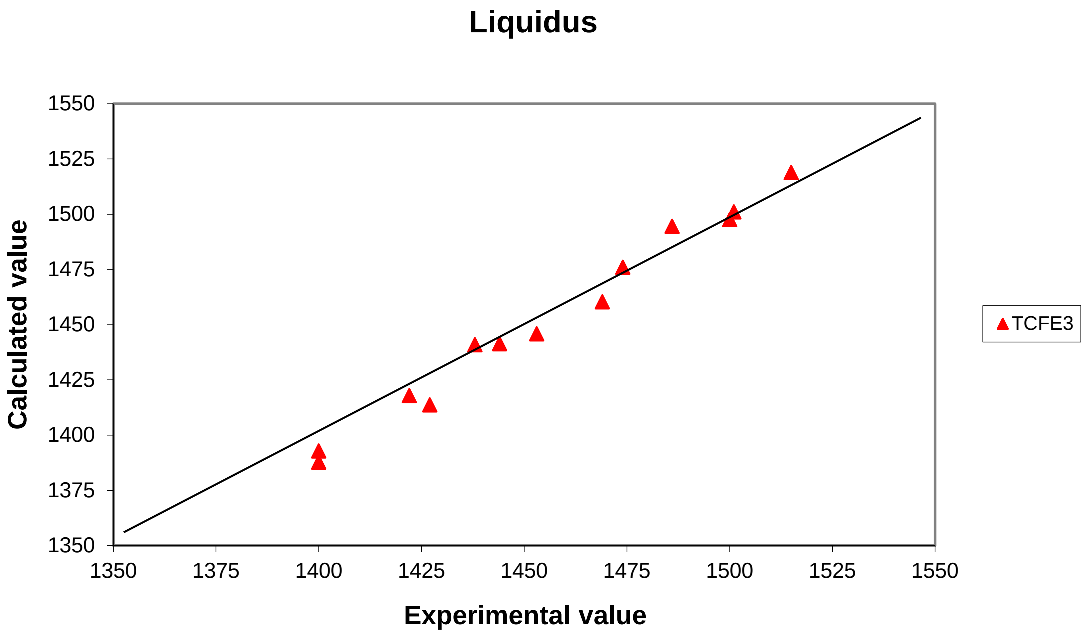

Figure 2. Calculated vs. experimental liquidus temperatures for some different low alloy steels, tool steels and stainless steels. The experimental data were taken from Jernkontoret [1977], where a cooling rate of 0.1 ℃/s was used.

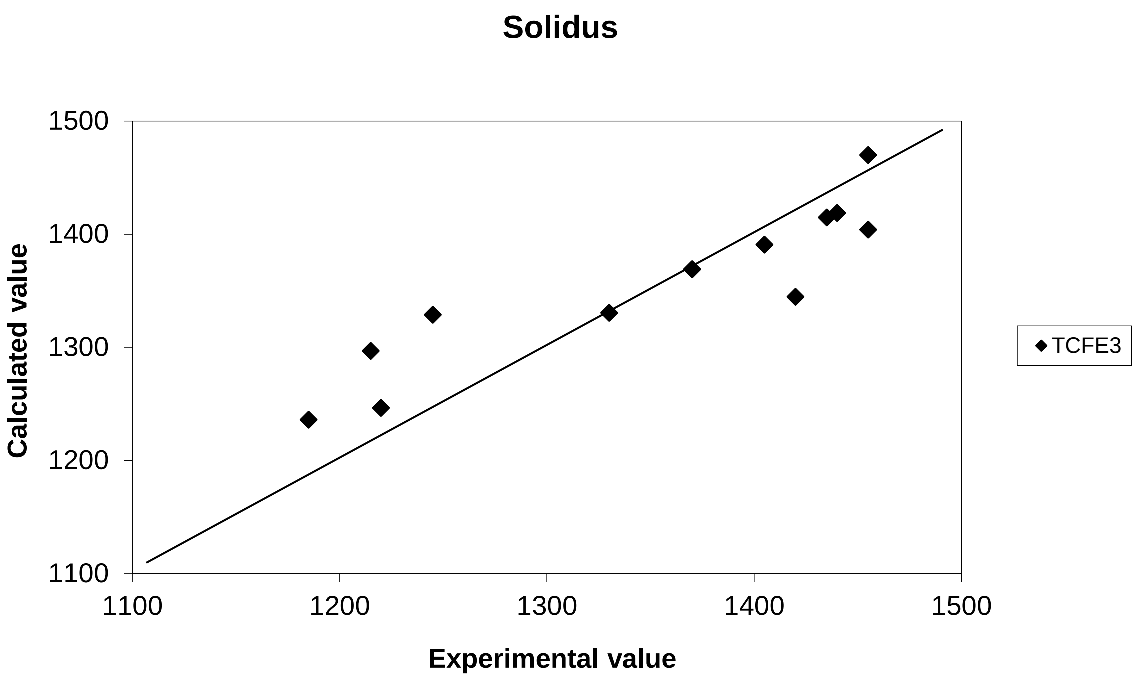

Figure 3. Calculated vs. experimental solidus temperatures for some different low alloy steels, tool steels and stainless steels. The experimental data were taken from Jernkontoret [1977], where a cooling rate of 0.1 ℃/s was used.

TCFE3 is of course also capable of predicting phase equilibria in the solid state. Figures 4 and 5 show calculated and experimental phase compositions for a number of different, ferritic-, austenitic- and duplex stainless steels.

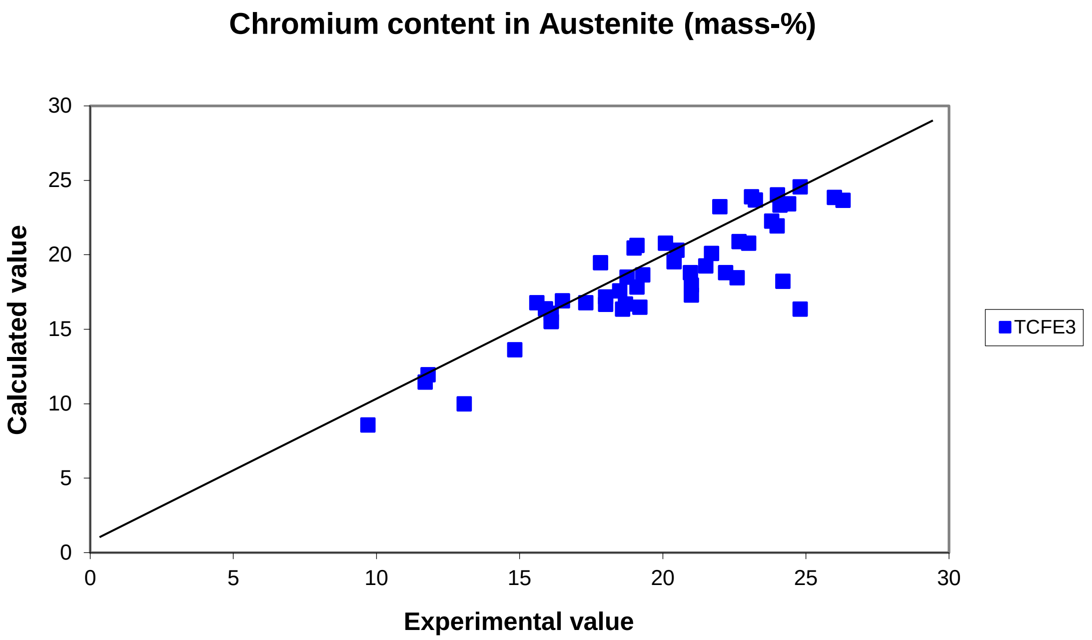

Figure 4. Calculated vs. experimental equilibrium austenite composition in different multicomponent, multiphase stainless steels. The experimental data were taken from Jernkontoret [1977].

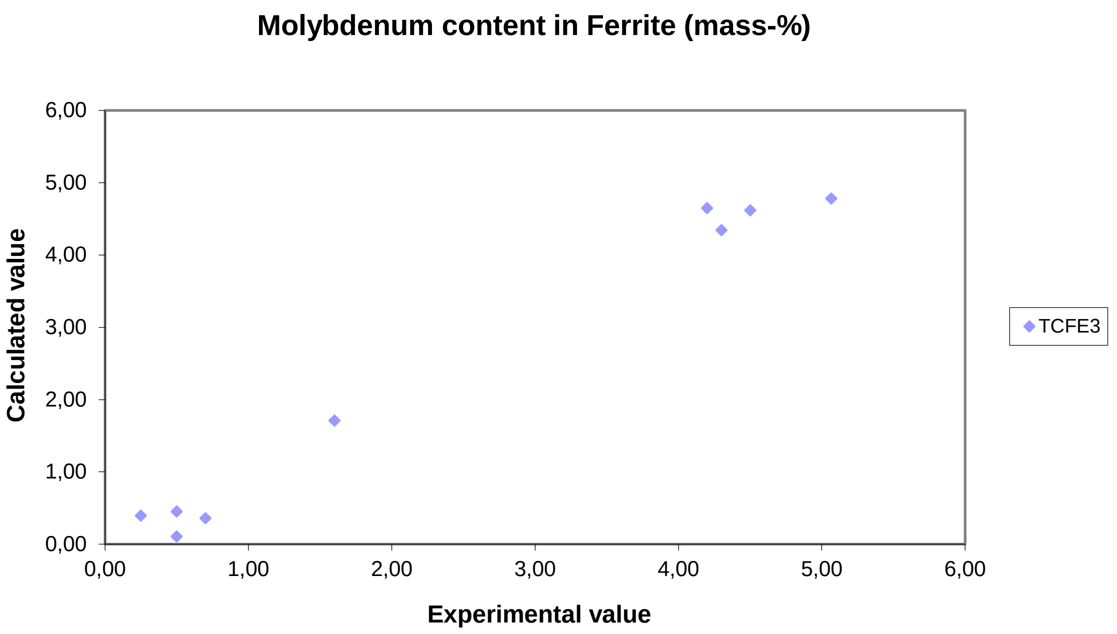

Figure 5. Calculated vs. experimental equilibrium austenite composition in different multicomponent, multiphase stainless steels. The experimental data were taken from Wessman et al.

References

[1977, Jernkontoret] Jernkontoret, *Guide to Solidification of Steels* (Ljungberg Tryckeri AB, Stockholm, Sweden, 1977).

[2000, Nilsson] J.-O. Nilsson, P. Kangas, A. Wilson, T. Karlsson, Mechanical properties, microstructural stability and kinetics of σ-phase formation in 29Cr-6Ni-2Mo-0.38N superduplex stainless steel. Metall. Mater. Trans. A. 31, 35–45 (2000).

[Wessman] S. M. Wessman *et al.*, "Technical Steel Research, Report EUR 20315."