Adaptation of a thermodynamic EAF model for stainless steelmaking

V. Nitelet[1], A. Mégret[1], J-C. Pierret[2], V. Vitry[1]

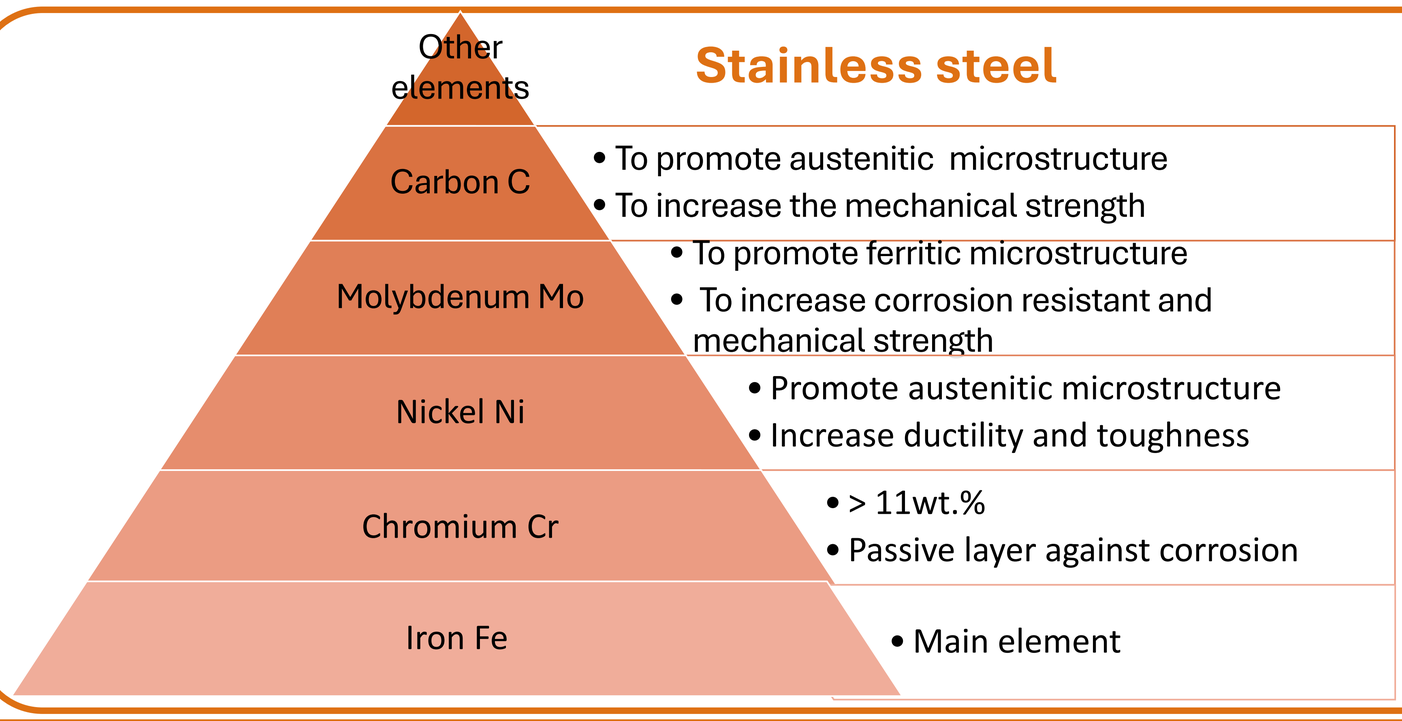
Introduction

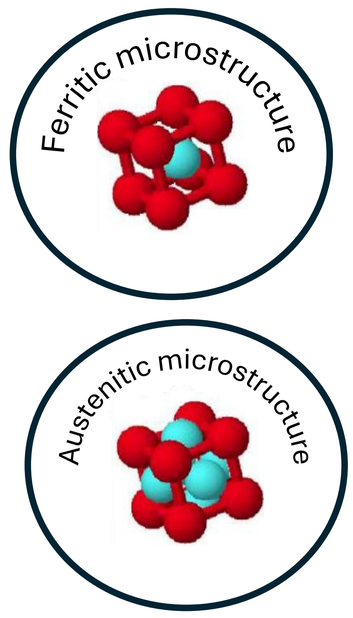
Nowadays, stainless steel is used everywhere (construction, transport, etc.).

With time, stainless steelmaking evolves but the equilibriums during the melting part are not well known.

This project consists in adapting an electric arc furnace model for carbon steel to stainless steel.

Stainless steel





Stainless steelmaking: Electric arc furnace (EAF)

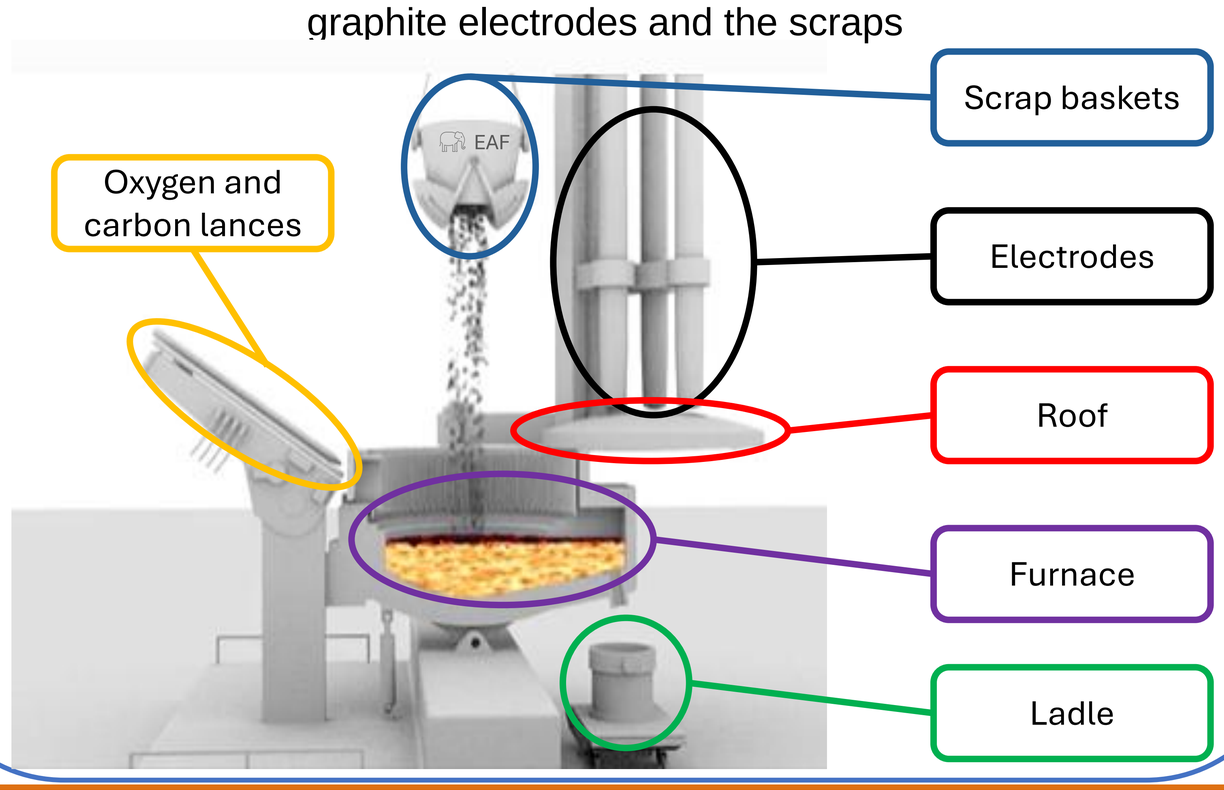
Input

Natural gas and oxygen
- ❖ Used as burner to homogenize the heat distribution (cold points due to the electrodes position)
- ❖ Pre-refining by oxygen addition

Addition elements
- ❖ Ferroalloy: to reach a specific composition according to the grade required
- ❖ Oxide to make the slag and remove impurities from the steel
- ❖ Carbon: To reduce metal from slag

Scraps
- ❖ Internal from the process - merchant

Basket of scraps and slag former are melted by electric arcs between graphite electrodes and the scraps



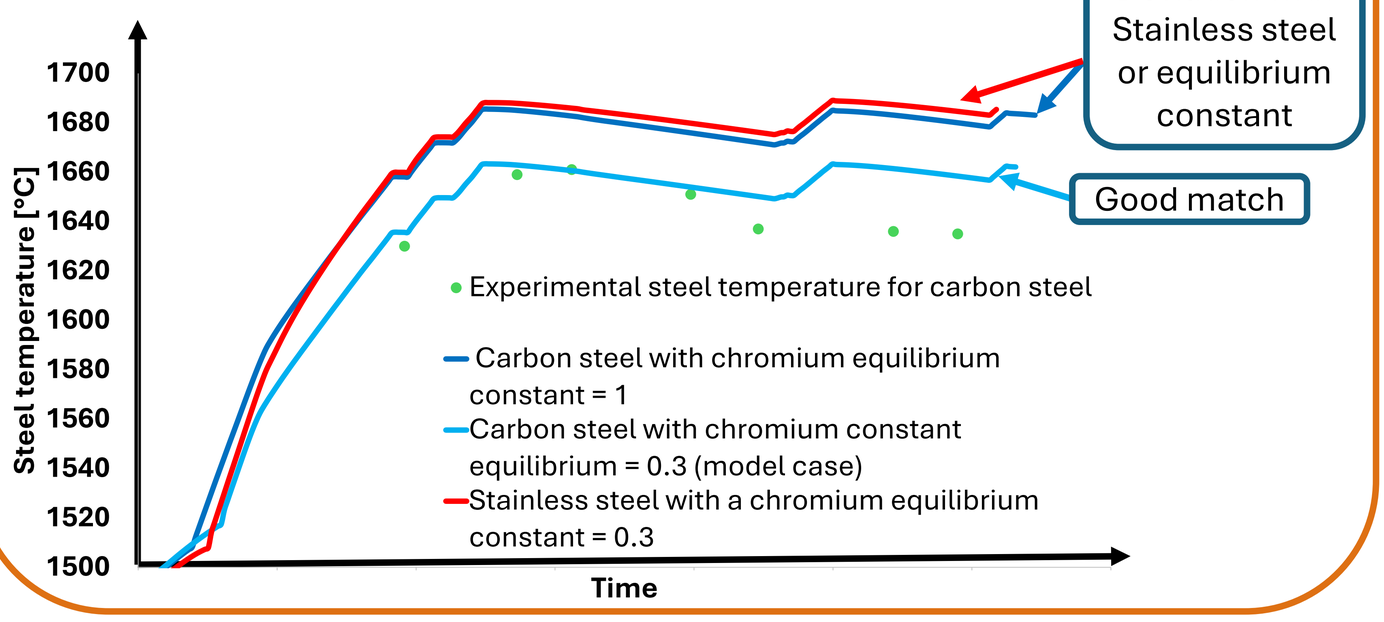
Output

Stainless crude steel
- ❖ Not the final product
- ❖ Ready for the next step: Argon Oxygen Decarburised (AOD) to be refined

Slag
- ❖ Mix of oxides from refining step, refractories degradation
- ❖ Recycled in concrete and railway ballast

Off gas
- ❖ A treatment is required
- ❖ Try to recover heat energy

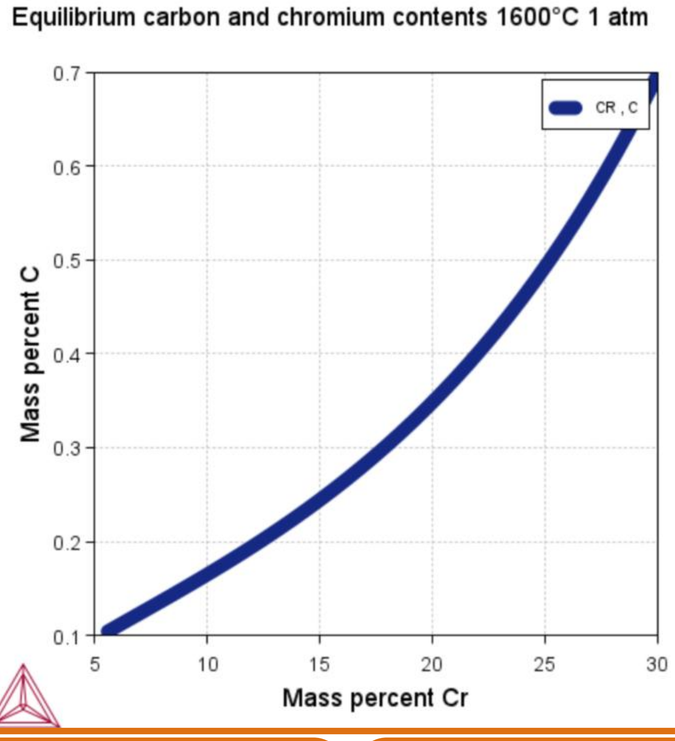
Model from the « centre de Recherche métallurgique » (CRM)



Thermocalc

Calculate the equilibrium steel - slag → K=f(composition, basicity, temperature) → Add in the model → Verification with experimental data (APERAM)

Equilibrium carbon and chromium contents 1600°C 1 atm



Conclusion

- ➢ The model from the CRM is valid for carbon steel with low amount of alloy elements
- ➢ For stainless steel, the model needs to be adapted by the modification of equilibrium formula

Perspectives

- ➢ Determination of a methodology to calculate the steel – slag equilibrium for some elements (**e.g.** Fe, Cr, Ni, C, O, Mo)
- ➢ Experimental trials to validate the model adaptation

Acknowledge

I want to thank the CRM for the model and the Walloon region for the funding (Convention: 8948)

Contacts

[1] Metallurgy Department, Faculty of Engineering, UMONS-University of Mons, Belgium
[2]Centre de Recherche Métallurgique, Liège