Reduction of iron ore by hydrogen

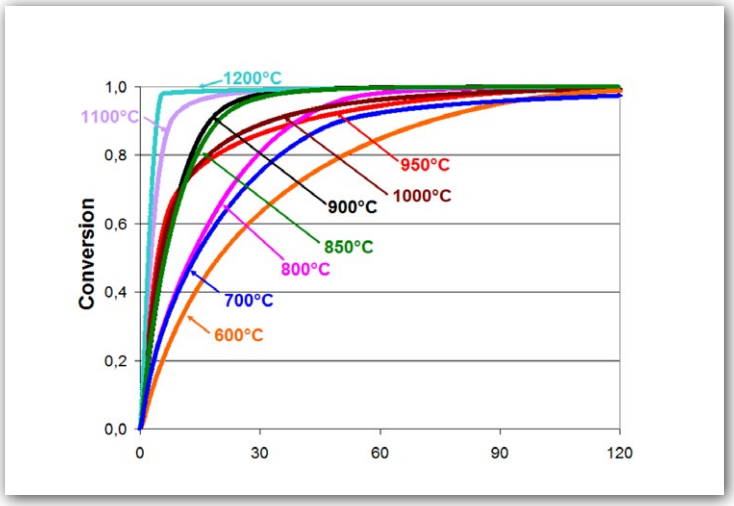
INTRODUCTION

Traditional steelmaking processes generate large amounts of CO2, corresponding to 7% of global human emissions. To reduce greenhouse gas releases, cleaner processes are being considered, such as the use of hydrogen instead of coal for iron ore reduction. This approach has the advantage of generating H2O instead of CO2 as a by-product. Thermogravimetric analysis is an ideal tool to study such a gas-solid reaction under realistic conditions, and to characterize its efficiency and speed.

EXPERIMENT

THEMYS H2 TGA was used to characterize the mass change against time of iron ore when reacting with hydrogen.

- Samples: iron ore pellets (95-96% hematite), about 2.5g.
- Reducing gas used: 2 L/min H2–He (40–60 vol.%).
- Test temperatures ranging from 600 to 1200°C.



RESULTS AND CONCLUSION

The conversion data were calculated from the mass loss vs. time signals measured by the THEMYS H2 TGA. From 600 to 900 °C, and from 1100 to 1200 °C, increasing temperature accelerates the reaction kinetics. But between 900 and 1100 °C, it was observed that the reaction rate decreases from about 70% conversion. It was found to be due to kinetics-limiting step in the hydrogenation process. This specific behavior may of course have an impact on the performance of the industrial furnaces.

Reference : Fabrice Patisson, Olivier Mirgaux, Jean-Pierre Birat, Hydrogen steelmaking. Part 1: Physical chemistry and process metallurgy, Matériaux & Techniques 109, 303 (2021)

INSTRUMENT

THEMYS H2

ULTRA-HIGH TEMPERATURE CAPABILITY
to 1750°C with a single furnace

MULTIPLE BUILT-IN SAFETY SYSTEMS
for instrument and user's secured operations
• up to 100% Hydrogen capacity

HIGH ACCURACY & VERSATILE
hang-down symmetrical beam balance specifically designed for TGA applications

EXTERNAL COUPLING CAPABILITY
to 1000 °C with Mass Spectrometers

ACCURATE AND SENSITIVE
Tri- Couple DTA and DSC technologies up to 1000°C