

Goals

The course provides knowledge of:

- how a sustainable production of metal in a modern industry is part of the circular economy in a society
- the production of metals based on both ore and recirculated metal exemplified with the production of steel, copper and aluminium as well as the production of metal powders
- how simplified thermodynamic calculations relevant for the production of metals can be carried out
- the integrated parts of an industrial process for metal production production of metals based on a visit to a metallurgical plant

After passing the course, the student should be able to fulfill the following learning goals:

- LG1: Explain current methods to produce base metals from natural ores and recycled materials, which are most relevant for the Swedish steel industry as well as explain how a sustainable metal production is part of a circular economy
- LG2: Explain and apply basic kinetic and thermodynamic theories to evaluate metal production processes
- LG3: Explain the integrated parts of an industrial process for metal production

Examinator:

Christopher Hulme, chrihs@kth.se

Teachers:

Christopher Hulme, chrihs@kth.se

Björn Glaser, bjoerng@kth.se

Pär Jönsson, parj@kth.se

Jesse Franklin White, jfwhite@kth.se

Andrey Karasev, karasev@kth.se

Rutger Gyllenram, rutger.gyllenram@kobilde.com

Wenjing Wei, wenjing@kobilde.com

Peter Samuelsson, petersam@kth.se

Assistants:

Konstantinos Rigas, krig@kth.se, thermodynamics

Sudanshu Kuthe, kuthe@kth.se, kinetics

Course requirements:

- LAB1 – Assignment, 1,0 hp, grading: P, F
- STU1 - Study visit, 0,5 hp, grading: P, F
- PRO1 – Projekt/Project, 6,0 hp, grading: A, B, C, D, E, Fx, F

Note, that PRO1 will be examined in the following manner:

- Thermodynamics – home assignment and seminar, 2,0 p
- Kinetics- home assignment and seminar, 2,0 p
- Basic principles of production of iron, steel, copper, aluminium and metal powders – written exam, 2,0 p

Literature:

The following course material will be available in CANVAS:

- Circular economy
- Basic principles of production of iron, steel, copper, aluminium and metal powders
- Thermodynamics relevant for metal production
- Kinetics relevant for metal production

Period: 1 1

Student office, ITM

Brinellvägen 68

100 44 Stockholm

Phone: 08-7908200

e-mail: expnord@itm.kth.se

Lecture and exercise schedule

All lectures will be held in room U61, if not specified differently.

Thermodynamics

Mo Aug 28 13.15 – 15.00

Lecture: Chemical reactions (dG, K, a, f, Ellingham diagram) applied to metals and oxides –
Jesse White

Tu Aug 29 10.15 – 12.00

Lecture: Phase equilibrium (PSDs) applied to metals and slags – Jesse White

Th Aug 31 10.15 – 12.00

Recitation: Chemical reactions (dG, K, a, f, Ellingham diagram); applied to metals and oxides
– Konstantinos Rigas

Mo Sep 4 10.15 – 12.00

Recitation: Phase equilibrium (PSDs) applied to metals and slags – Konstantinos Rigas

Th Sep 7 13.15 – 15.00

Lecture: Binary and multicomponent phase diagrams applied to metals and oxides – Jesse
White

Fr Sep 8 13.15 – 15.00

Recitation: Binary and multicomponent phase diagrams applied to metals and oxides –
Konstantinos Rigas

Processes

Mo Sep 11 13.15 – 15.00

Lecture: Methods for producing steel from ore – Peter Samuelsson

We Sep 13 13.15 – 15.00, **Note, room L21**

Lecture: Steelmaking from scrap and ladle treatment – Pär Jönsson

Fr Sep 15 13.15 – 15.00, **Note, room E36**

Lecture: Circular economy – Rutger Gyllenram

Mo Sep 18 13.15 – 15.00

Lecture: Ladle treatment + casting – Pär Jönsson

We Sep 20 – Visit to Alleima in Sandviken

Lectures about steelmaking of stainless steel with a focus on EAF and AOD

Th Sep 21 13.15 – 15.00

Lecture: Copper making from ore and scrap – Pär Jönsson

Fr Sep 22 13.15 – 15.00 **Note, room D3**
Lecture: Aluminum making from ore and scrap – Pär Jönsson

We Sep 27 10.15 – 12.00
Lecture: Production of metal powder – Chris Hulme-Smith

Kinetics

Mo Oct 2 10.15 – 12.00
Lecture: Homogenous Chemical Reactions – Björn Glaser

Mo Oct 2 13.15 – 15.00
Lecture: Gas-Solid and Gas-Liquid Interfacial Reactions – Björn Glaser

We Oct 4 08.15 – 12.00 Seminar in circular economy

Th Oct 5 08.15 – 10.00
Lecture: Mass diffusion – Sudanshu Kuthe

Th Oct 5 13.15 – 15.00
Lecture: Exercise – Sudanshu Kuthe

Th Oct 12 Visit to SSAB in Oxelösund. Examination of thermodynamics and kinetics.

Fr Oct 13 Visit to Gränges and Hydro in Finspång

October 23 Seminar kinetics

9.00 – 10.30 Seminar kinetics group 1
10.30 – 12.00 Seminar kinetics group 2
13.00 – 14.30 Seminar kinetics group 3

October 27 14.00 – 16.00 V11

Written examination (part of PRO1, 2 p): Basic principles of production of iron, steel, copper, aluminium and metal powders

December 18 8.00 – 10.00 L31

Re-examination (part of PRO1, 2 p): Basic principles of production of iron, steel, copper, aluminium and metal powders

