

COURSE SYLLABUS

Liquid Metal and Solidification Processing, 7.5 credits*Smältning och stelningsprocesser, 7.5 högskolepoäng*

Course Code:	TSPS25	Education Cycle:	Second-cycle level
Confirmed:	Feb 01, 2025	Disciplinary domain:	Technology
Valid From:	Sep 01, 2025	Subject group:	Materials Technology
		Specialised in:	A1F Second cycle, has second-cycle course/s as entry requirements
		Main field of study:	Product Development

Intended Learning Outcomes (ILO)

On completion of the course the student shall:

Knowledge and understanding

- display knowledge of the common impurities and tramp elements in aluminium melt and their removal for a sustainable circular material recycling
- demonstrate comprehension of the industrial treatments and quality assessment of aluminium alloy melts
- display a fundamental understanding of microstructure development during solidification
- demonstrate comprehension of microstructural control and management through composition, cooling rate and treatment

Skills and abilities

- demonstrate the ability to select a suitable treatment and casting process for a specific aluminium alloy using thermodynamics and kinetics for the intended reactions and process steps
- demonstrate the ability to calculate and discuss in detail the formation of various solidification microstructures in relation to the phase diagram

Judgment and approach

- demonstrate the ability to assess the liquid and solidification treatment according to the required outcome
- demonstrate the ability to suggest methods to improve the microstructure and performance of cast metals

Content

The critical content is related to preparing aluminium alloys, including light metal scrap recycling technologies, melt refining, and impurity control to enable the sustainable management of circular materials. The fundamental mechanisms of solidification and different conditions for the formation of microstructure during solidification and casting defects will be taught. Finally, microstructural engineering, such as grain refinement and microstructural modification for desired properties, will be discussed.

The course includes the following elements:

- The effect of dissolved impurities and inclusions on the mechanical properties of metal products
- Thermodynamics and transport properties relevant for the removal of dissolved elements and inclusions from molten metals and the addition of alloying elements
- Industrial melt management practice for aluminium alloys and sustainable circular materials management

- Solidification and refining
- Microstructure formation through homogeneous and heterogeneous nucleation for grain refinement
- Primary phase growth and morphological control with Interface stability and constitutional undercooling
- Multiphase reactions such as eutectics and peritectic and modification
- Mushy zone characteristics and their importance for casting defect formation

Type of instruction

Lectures, assignments and laboration.

Language of instruction is in English.

Entry requirements

Passed courses of at least 150 credits in the program Industrial Product Realisation, or passed courses of at least 90 credits in Materials and Manufacturing, Materials Engineering, Mechanical Engineering, Chemical Engineering, Product Development, Engineering Physics or the equivalent. The bachelor's degree should comprise a minimum of 15 credits in Mathematics. Taken course in Chemical Thermodynamics, 7,5 credits, or the equivalent. Proof of English proficiency is required.

Examination and grades

The course is graded 5, 4, 3 or U.

Registration of examination:

Name of the Test	Value	Grading
Assignments	3.5 credits	G/U
Laboratory	1 credit	G/U
Examination	3 credits	5/4/3/U

Course literature

Please note that changes may be made to the reading list up until eight weeks before the start of the course.

Liquid Metal Processing, Anders E. W. Jarfors

Phase Transformations in Metals and Alloys, 3rd edition, David A. Porter, Kenneth E. Easterling, and Mohammed Y. Sherif (Chapter 4)