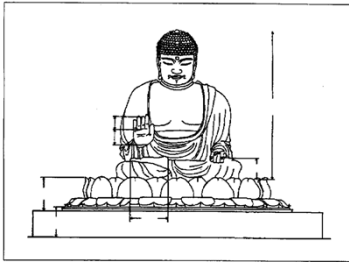


Casting Processing, MH2252, 6 credits



Lecture 1-2 Introduction. Component casting and Cast House Processes

Lect.1-2-1

Goals

The aim of the course is:

- To give an overview of both component casting and processes such as ingot casting, continuous casting and direct casting
- Describe and explain the problems that can arise during casting of metals, solidification and cooling.

Lect.1-2-2

Intended learning outcomes

After passing the course the student should be able to:

- Give example of and justify for the use of common casting processes for manufacturing of components, as well as blanks (work pieces) (TEN2)
- Apply and calculate fluid dynamic processes for metal flow at tapping and filling of a casting system for manufacturing of components, as well as blanks (TEN2)
- Explain principles and justify adopted models for heat transport at the moulding and solidification of metals (TEN2)
- Explain and justify for structure and structure formation in casted materials and the appearance of micro and macro segregations during solidification (TEN2)
- Explain the origin of casting defects such as shrinkage, gas porosity, slags, secondary phases and cracks and methods and processes to control and minimize these (TEN2)
- Dimension and simulate a casting system with the purpose of minimizing casting defects and maximizing yield, and present this in a scientific context (PRA1)
- Describe and give examples of the complexity of a real industrial process chain for casting of components or blanks and present this during a seminar (STU1)

Lect.1-2-3

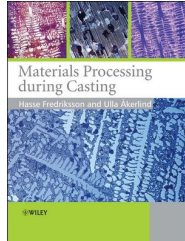
Literature

Pdf of lecture notes found in Canvas

The text book:

Materials Processing during Casting.
Hasse Fredriksson, Ulla Åkerlind,
Wiley, March 2006, ISBN: 0-470-
01514-4

You can **buy it** from an internet
reseller and/or use the freely
available **electronic version** from
Wiley Online Library (link in Canvas)
and/or **download the pdf** version (link
in Canvas).



Lect.1-2-4

Examination parts

PRA1 – Assignment/Lab, 1.5 credits, grade scale: P, F

STU1 – Study visit, 0.5 credits, grade scale: PF

TEN2 - Examination, 4.0 credits, grade scale: AF

Requirements for final grade:

Written examination (TEN2)

Computer assignment/Lab work (PRA1)

Study visit/seminar (STU1)

Examiner:

Anders Eliasson, anderse@kth.se

Lect.1-2-5

Lectures, excercises and study visit

Lectures, exercises/HA and exam (TEN1)

The aim of the lectures/HA in the course is to
highlight vital parts of the course. The major part
of the material is to be studied individually.

Lecturer: Anders Eliasson, anderse@kth.se



Anders Eliasson

The exercises/HA will give you an opportunity to
learn applications of theory and to solve
problems. Problem solving should be done by the
students and will be valued and commented by
the assistant.

Assistant: Surbhi Shivaji Jogdand, jogdand@kth.se



Surbhi Shivaji
Jogdand

Lect.1-2-6

Study visit and Computer assignment

Study visit (STU1)

A mandatory study visit is planned to a foundry. The students are requested to in groups prepare questions, write a visit report and present it at a seminar. Note: for H22 it might be cancelled or replaced, due to the still present Covid-19 pandemic.

Responsible: Anders Eliasson, anderse@kth.se



Anders
Eliasson

Computer assignment (PRA1):

A computer assignment should be solved by help of the industrial numerical simulation program MagmaSoft.

Responsible: Surbhi Shivaji Jogdand, jogdand@kth.se



Surbhi Shivaji
Jogdand
Lect.1-2-7

Written examination – TEN2

The examination is in two parts. The first part is answered without any aids, while during the second part the use of course material is allowed.

This means that only the course material are allowed, no personal notes.

Note: for H22 the written Campus exam might be replaced by a digital distance examination, due to the present Covid-19 pandemic.

Old campus exams are found at the course page in Canvas.

Lect.1-2-8

Today's topics – Lecture 1-2

- Component Casting
 - History of Casting
 - Component Casting
- Cast House Processes
 - Ingot Casting
 - Continuous Casting
 - Near Net Shape Casting
 - The ESR Process

Lect.1-2-9

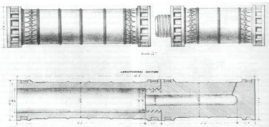
A Long Time Ago - Bronze



Melting and casting of copper, detail from grave in Thebe, Egypt about 1500 BC

Lect.1-2-10

The Middle Ages - Bronze and Cast Iron



Muhammad II cannon, cast in year 1464 AC



Bronze Pots from Belfast, cast 1560-70 (Ireland)



Cast drain pipes in Versailles, France, from the year 1664.

Copper alloys, bronzes (Cu+?=Sn, Zn, etc) were the most important metal for the manufacture of household, art objects and cannons.

Cast iron was first used in Europe around 1100-1200 AD. It was used for everyday objects, cannons/ cannon balls, weapons, and to pipes!

Lect.1-2-11

New times - 1800s

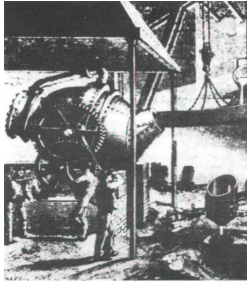


Small blast furnace from the 1800s for the production of pig iron.

Cast iron were made and converted at different processes to forgeable low carbon steel. The steel were used for weapons (90%) and everyday items (hammer, scissors, etc).

Lect.1-2-12

Industrialism – Steel



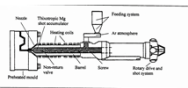
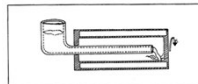
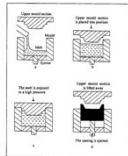
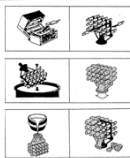
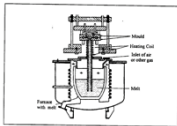
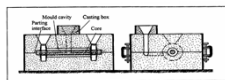
The Bessemer process
1860, Ebbw Vale, South
Wales, UK.

The Bessemer process produces a low-carbon, forgeable, steel and for the first time in history, large volumes of steel in be manufactured. The Industrial Revolution begins. The steel were used in machinery, railway tracks and weapons.

Lect.1-2-13

Industrial Casting – Component Casting

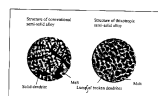
- Component Casting
 - Nonrecurrent Moulds
 - Permanent Moulds



Lect.1-2-14

Component Casting

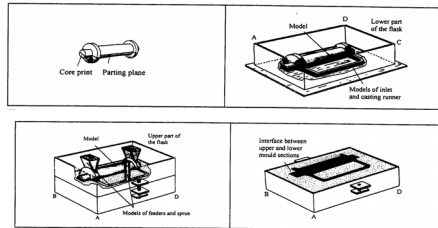
- Nonrecurrent Moulds
 - Sand moulding
 - Shell mould Casting
 - Investment Casting
- Permanent Moulds
 - High Pressure Die Castning
 - Low-Pressure Die Casting
 - Die Casting (gravity die casting)
 - Squeeze Casting
 - Centrifugal casting
- Thixomoulding/Rheocasting



Lect.1-2-15

Casting in Sand Mould – Handforming-I

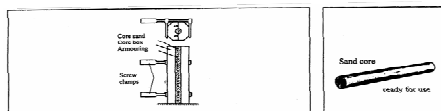
1. Mould preparation



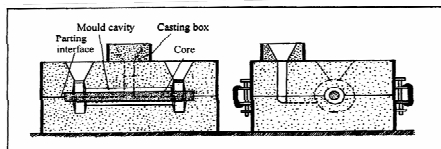
Lect.1-2-16

Casting in Sand Mould – Handforming-II

2. Core preparation



3. Casting of Cast Iron Tube



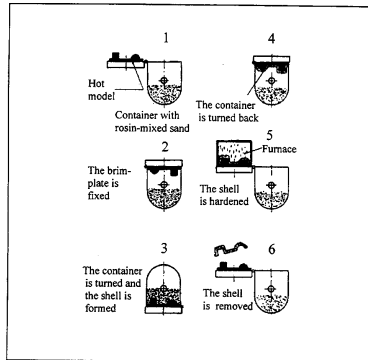
Lect.1-2-17

Casting in Sand Mould - Handforming



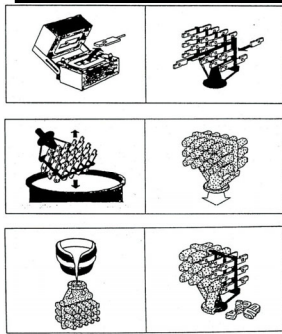
Lect.3-18

Shell Mould Casting



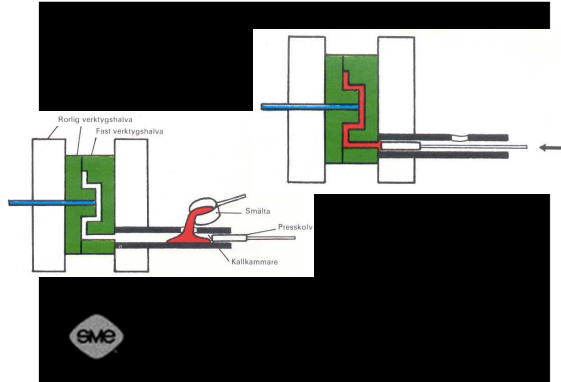
Lect.1-2-19

Investment Casting – Lost Wax Casting

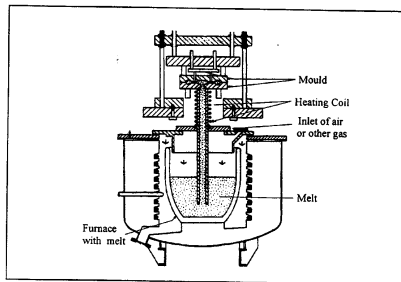


1. Wax patterns are cast in a special tool
2. A cluster is built of the wax patterns
3. The cluster is dipped into ceramic slurry
4. The wax is melted away and the mould is burnt in an oven
5. Casting is performed directly into the hot mould
6. The ceramic mould is knocked out after casting and solidification

High Pressure Die Casting



Low Pressure Die Casting



Less turbulence- Al-alloys

Lect.1-2-22

Gravity Die Casting



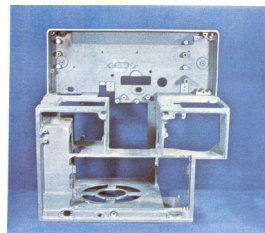
Manual casting – Al-alloys

Lect.1-2-23

Low and High Pressure Die Castings



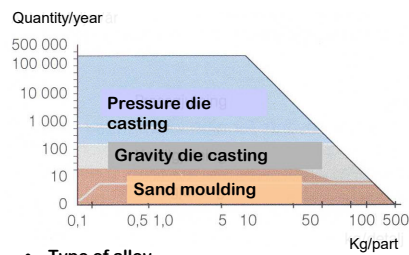
Rims on tires



Chassis

Lect.1-2-24

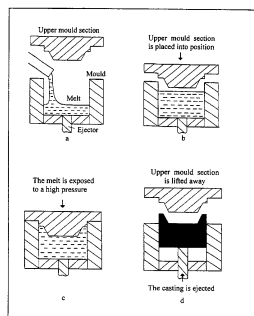
How to choose casting method?



- Type of alloy.
 - High or low melting temperature?
- Number of components.
 - Only some few or many?
- Size/weight.
 - How large, heavy, complex?

Lect.1-2-25

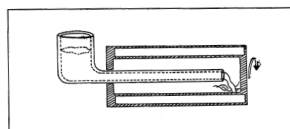
Squeeze Casting



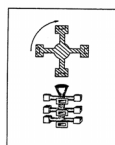
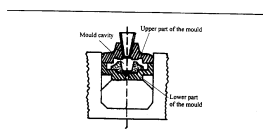
Pressure on casting

Lect.1-2-26

Centrifugal Casting



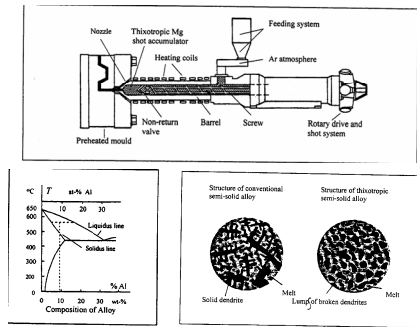
Cast iron tubes



Centrifugal force – tubes, ring-shaped components

Lect.1-2-27

Thixomoulding

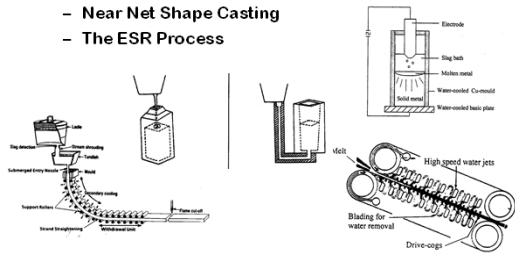


Semi-solid metal casting – Mg-alloys

Lect.1-2-28

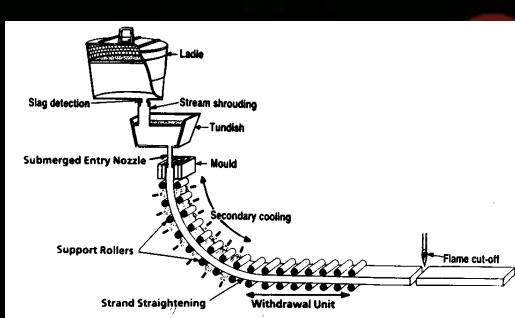
Industrial Casting - semi-finished products

- Cast House Processes (for plastic forming)
 - Continuous Casting
 - Ingot Casting
 - Near Net Shape Casting
 - The ESR Process

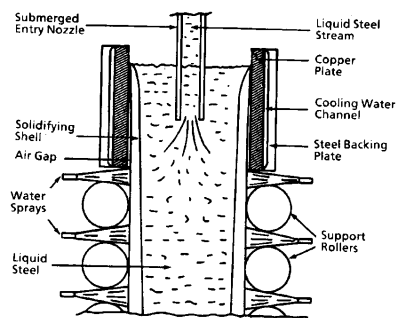


Lect.1-2-29

Continuous Casting



Continuous Casting - SEN



Lect.1-2-31

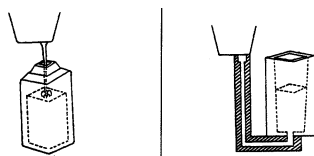
Continuous Casting - Castings



Billet, Bloom, Slab and Rounds

Lect.1-2-32

Ingot Casting

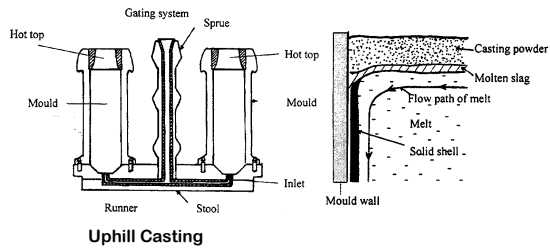


Downhill Casting

Uphill Casting

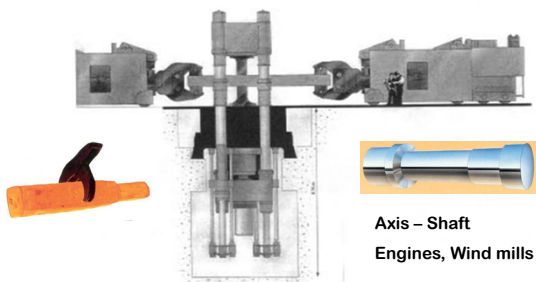
Lect.1-2-33

Ingot Casting - Uphill



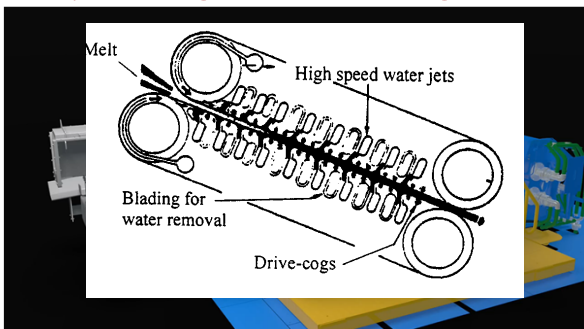
Lect.1-2-34

Ingot Casting – Castings - Components

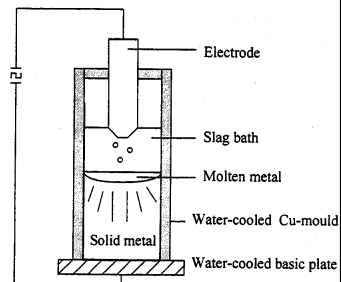


Lect.1-2-35

Some Other Casting Methods - Near Net Shape Casting - Hazelett Casting Machine



Some Other Casting Methods - ESR - Electro Slag Remelting



Refining of Ingots

Recommended reading in “Materials Processing during Casting”, by Hasse Fredriksson and Ulla Åkerlind

Chapter:

- ☐ 1.1 – 1.2
- ☐ 2.1 – 2.6

Lect.1-2-38
