



Casting Processing, MH2252, 6hp H22

Aim

The course gives an overview over both component casting and processes such as ingot casting, continuous casting and direct casting and describe and explain the problems that can arise during metal casting, solidification and cooling.

Intended learning outcomes

After passing the course the student should be able to:

- LM1 Give example of and justify for the use of common casting processes for manufacturing of components, as well as blanks (TEN2)
- LM2 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)
- LM3 Explain principles and justify adopted models for heat transport at the moulding and solidification of metals (TEN2)
- LM4 Explain and justify for structure and structure formation in casted materials and the appearance of micro and macro segregations during solidification (TEN2)
- LM5 Explain the origin of casting defects such as shrinkage, gas porosity, slags, secondary phases and cracks and methods and processes to control and minimise these (TEN2)
- LM6 Dimension and simulate a casting system with the purpose of minimising casting defects and maximising yield, and present this in a scientific context (PRA1)
- LM7 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)

Specific prerequisites

- Good knowledge of the production process for casting of metals corresponding to the course MH1024 Fundamentals of Materials Science - Metallic Materials, or the equivalent
- Good knowledge in fluid dynamics of melts corresponding to the course MH1018 Transport Phenomena, or the equivalent.

Literature

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

Examination

PRA1 - Practical training, 1.5 credits, Grading scale: P, F

STU1 - Study visit, 0.5 credits, Grading scale: P, F

TEN2 - Written exam, 4.0 credits, Grading scale: A, B, C, D, E, FX, F

Examiner:

Anders Eliasson

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Lectures and exercises/home assignments

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

Lecturer: Anders Eliasson, anderse@kth.se

The exercises/home assignments will give 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. The students are recommended to solve and hand in solutions to the exercises noted in the Home assignment list.

Assistant: Surbhi Shivaji Jogdand, jogdand@kth.se

Computer assignment (PRA1: 1,5 credits)

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

Assistant: Surbhi Shivaji Jogdand, jogdand@kth.se

Study visit (STU1: 0,5 credits)

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.

Responsible: Anders Eliasson, anderse@kth.se

Isak Hollinger, isak.hollinger@scania.com, Jessica Elfsberg, jessica.elfsberg@scania.com

Examination (TEN2: 4,0 credits)

The examination is in two parts. The first part is answered without any aids, while during the second part the use of handed out course material (Summary pages) is allowed. This means that only the Summary pages/course material are allowed, no personal notes.

Responsible: Anders Eliasson, anderse@kth.se

Course schedule H22

Date	Time	Place	#	Topic	Chapter
30/8	15-17	Blå	L1-2	Information and introduction. Component casting. Cast house processes. Chapter 1-2	1.1-1.2 2.1-2.6
31/8	15-17	Blå	L3	Casting hydrodynamics. Chapter 3.	3.1-3.7
5/9	08.00	Canvas	HA1	Component casting. Cast house processes. Casting hydrodynamics.	Chapter 1-3
8/9	10-12	Blå	L4a+b	Heat transport at Sand mould casting - good contact Chapter 4-5	4.1-4.4 5.1-5.7
12/9	08.00	Canvas	HA2	Heat transport at component casting.	Chapter 4-5
13/9	15-17	Blå	L4c	Heat transport at component casting - poor contact. Chapter 4-5	4.1-4.4 5.1-5.7
15/9	09-12	M102	CL1	Computer lab – Introduction to MagmaSoft	
19/9	08.00	Canvas	HA3	Heat transport at component casting - poor contact.	Chapter 4-5
20/9	15-17	Blå	L5+6	Structure and structure formation in cast materials. Micro-segregation and solidification processes in alloys. Macro-segregations. Chapter 6, 7, 11.	6.1-6.11 7.1-7.9 11.1-11.9
22/9	09-12	M102	CL2	Computer lab – Introduction to Assignment	
26/9	08.00	Canvas	HA4	Structure and structure formation in cast materials. Microsegregation and solidification processes.	Chapter 6-7, 11
28/9	15-18	M102	CL3	Computer lab – Work with Assignment	
29/9	10-12	Blå	L7a+b	Precipitation of pores and slag inclusions at casting processes. Chapter 9.	9.1-9.9
3/10	08.00	Canvas	HA5	Reaction kinetics and precipitation of gas pores and non-metallic phases during solidification.	Chapter 9
4/10	13-15	Blå	L8a+b	Solidification and cooling shrinkage of metals. Chapter 10 Information about the study visit.	10.1-10.7
6/10	09-12	M102	CL4	Computer lab – Final work with Assignment	
10/10	08.00	Canvas	HA6	Solidification and cooling shrinkage.	Chapter 10
11/10	10-12	Blå	L9	Repetition: Casting and solidification. Information about the exam.	
12/10	13-17	Scania	Field trip	Study Visit at Scania AB, Södertälje. Note, Preliminary!	
13/10	10-12	Blå	E7	Repetition	
14/10	10-12	Blå	Sem	Seminar – Presentations of Study visit groups	
28/10	08-13	B1	TEN2	Examination.	
20/12	08-13	D35	TEN2	Re-examination	

Literature: Materials Processing during Casting by Hasse Fredriksson and Ulla Åkerlind

<u>Chapter</u>	<u>Chapter</u>	<u>Activity</u>	<u>Exercises</u>		
1. Component Casting	Whole chapter	Carefully	-	-	
2. Cast House Processes	2.1 – 2.4	Carefully	-	-	
	2.5 – 2.6	Browse			
3. Casting Hydrodynamics	3.1 - 3.3.2	Carefully	3-1	3-6	
	3.3.3 - 3.3.4	Browse	3-2	3-7	
	3.4	Carefully	3-3	3-8	
	3.5	Browse	3-4	3-9	
	3.6 - 3.7	Carefully	3-5	3-10	
4. Heat Transport during Component Casting	Whole chapter	Carefully	4-1	4-7	
			4-2	4-8	
			4-3	4-9	
			4-4	4-10	
			4-5	4-11	
			4-6		
5. Heat Transport in Cast House Processes	5.1 - 5.3	Carefully	5-1	5-7	
	5.4	Browse	5-2	5-8	
	5.5	Carefully	5-3	5-9	
	5.6	Browse	5-4	5-10	
	5.7	Carefully	5-5	5-11	
	5.8	Browse	5-6	5-12	
6. Structure and Structure Formation in Cast Materials	6.1 - 6.4	Carefully	6-1	6-6	
	6.5 - 6.6	Browse	6-2	6-7	
	6.7 - 6.9	Carefully	6-3	6-8	
	6.10 - 6.11	Browse	6-4	6-9	
7. Microsegregation in Alloys – Peritectic Reactions and Transformations	7.1-7.3	Carefully	6-5	6-10	
			7.4	7-1	7-6
			7.5	7-2	7-7
			7.6-7.9	7-3	7-8
				7-4	7-9
8. Heat Treatment and Plastic Forming	8.1 – 8.4	Browse	7-5		
	8.5	Carefully	8-1	8-6	
	8.6	Browse	8-2	8-7	
			8-3	8-8	
9. Precipitation of Pores and Slag Inclusions during Casting Processes	9.1-9.7.5	Carefully	8-4	8-9	
	9.7.6-9.7	Browse	8-5	8-10	
	9.8	Carefully	9-1	9-6	
	9.9	Browse	9-2	9-7	
			9-3	9-8	
10. Solidification and Cooling Shrinkage of Metals and Alloys	10.1-10.5.1	Carefully	9-4	9-9	
	10.5.2-10.6	Some Browse	9-5	9-10	
	10.7	Browse	10-1	10-6	
			10-2	10-7	
Macrosegregation in Alloys	11.1 – 11.5	Browse	10-3	10-8	
			10-4	10-9	
			-	10-5	10-10
			11-1	11-6	
			11-2	11-7	
11.6 – 11.9	Carefully	11-3	11-8		
		11-4	11-9		
		11-5			

Bold: recommended/mandatory exercises.