



ITM/MSE

Casting Processing, MH2252, 6hp H19

Goals

The aim of the course is to give insight in and knowledge of the problems arising during casting of metals and understanding how the processes can be controlled to minimize errors and maximize yield. The course gives an overview of both component casting and cast house processes such as ingot casting, continuous casting and direct casting

Content

After completing the course the student will have knowledge of:

- Solidification processes (thermal conductivity).
- Structure formation.
- Influence of shrinkage on solidification processes as pipe formation in ingots.
- Formation of macro- and micro segregation.
- Precipitation of secondary phases during solidification.
- Structural changes at heating, forming and homogenisation.
- Metallic melts properties related to casting properties.
- Solubility of gases in melts and precipitation of gas during solidification.
- Forced and natural convection at casting and solidification.
- Surface tension gas/liquid and its importance in casting processes.
- Nucleation and inoculation in melts.
- Analytical and numerical modelling of solidification and casting processes.
- Thermal stresses and crack formation at casting of metals.
- Process control and optimization of casting processes.

Eligibility

A BSc degree within Materials science and engineering or equivalent (180 credits).

Literature

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

Examination

LAB1 – Study visit, 0.7 credits, grade scale: P, F

TEN1 - Examination, 3.8 credits, grade scale: A, B, C, D, E, FX, F

ÖVN1 - Assignment, 1.5 credits, grade scale: P, F

Requirements for final grade:

Written examination (TEN1), Computer assignment (ÖVN1), Lab work and study visit (LAB1)

Examiner:

Anders Eliasson

08-790 7255

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Lectures and exercises

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 will give opportunity to discuss application of theory and to solve problems. Problem solving will be done both by the students and by the assistant.

Assistant: Lu Yu-Chiao (Ishana), yclu@kth.se

Computer assignment (Övn1: 1,5 credits)

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

Assistant: Nils Andersson nilsande@kth.se

Laboration – experimental work

Assistant: Nils Andersson nilsande@kth.se

Study visit (Lab1: 0,7 credits)

A mandatory study visit is planned to a foundry. For H19 it will be towards the Scania foundry and the metal research department. 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 (Ten1: 3,8 credits)

The examination is in two parts. The first part is answered without any aid, while during the second part the use of handed out course material (Summary pages) is allowed. Note, this means that only the Summary pages/course material is allowed, no personal notes. Exams registration is done through your “KTH menu”.

Responsible: Anders Eliasson, anderse@kth.se

Course schedule H19

Date	Time	Place	#	Topic	Chapter
26/8	08-10	B23	L1-2	Information and introduction. Component casting. Cast house processes. Chapter 1-2	1.1-1.2 2.1-2.6
27/8	08-10	B23	L3	Casting hydrodynamics. Chapter 3.	3.1-3.7
2/9	08-10	B23	E1	Component casting. Cast house processes. Casting hydrodynamics.	Chapter 1-3
3/9	08-10	B23	L4a	Heat transport at component casting – structure formation. Chapter 4-5	4.1-4.4 5.1-5.7
5/9	10-12	B22	L4b	Heat transport at Sand mould casting - good contact Chapter 4-5	4.1-4.4 5.1-5.7
9/9	08-10	B23	E2	Heat transport at component casting.	Chapter 4-5
10/9	08-10	B23	L4c	Heat transport at component casting - poor contact. Chapter 4-5	4.1-4.4 5.1-5.7
11/9	15-18	M122	CL1	Computer lab – Introduction to MagmaSoft	
16/9	08-10	B23	E3	Heat transport at component casting - poor contact.	Chapter 4-5
17/9	08-10	B23	L5	Structure and structure formation in cast materials. Chapter 6.	6.1-6.11
18/9	15-17	B23	L6	Microsegregation and solidification processes in alloys. Macroseggregations. Chapter 7, 11.	7.1-7.9 11.1-11.9
20/9	09-12	M122	CL2	Computer lab – Introduction to Assignment	
23/9	08-10	B23	E4	Structure and structure formation in cast materials. Microsegregation and solidification processes.	Chapter 6-7, 11
25/9	15-18	M122	CL3	Computer lab – Work with Assignment	
26/9	10-12	L31	L7a	Precipitation of pores and slag inclusions at casting processes. Chapter 9.	9.1-9.9
27/9	10-12	B23	L7b	Precipitation of pores and slag inclusions at casting processes. Chapter 9.	9.1-9.9
30/9	08-10	B23	E5	Reaction kinetics and precipitation of gas pores and non-metallic phases during solidification.	Chapter 9
1/10	08-10	B23	L8a L8b	Solidification and cooling shrinkage of metals. Chapter 10 Information about study visit.	10.1-10.7
2/10	15-18	M122	CL4	Computer lab – Final work with Assignment	
3/10	13-17	Scania	Field trip	Study Visit at Scania AB, Södertälje. Note: the visit starts at 13.00 in Södertälje, please be there at time!	
7/10	08-10	B23	E6	Solidification and cooling shrinkage.	Chapter 10
10/10	08-10	L31	L9	Repetition: Casting and solidification. Information about the exam.	
11/10	09-12	L31	Sem	Seminar – Presentations of Study visit groups	
11/10	13-15	L21	E7	Repetition	
25/10	08-13	W43	TEN1	Examination.	
17/12	08-13	B23	TEN1	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	8-1	8-6	
			8.6	Carefully	8-2	8-7
				Browse	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	8-5	8-10	
			9.8	9-1	9-6	
			9.9	Browse	9-2	9-7
				Carefully	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	9-5	9-10	
			10.7	Browse	10-1	10-6
				Some Browse	10-2	10-7
Macrosegregation in Alloys	11.1 – 11.5	Browse	10-3	10-8		
			11.6 – 11.9	Carefully	10-4	10-9
					10-5	10-10
					11-1	11-6
					11-2	11-7
		11-3	11-8			
			11-4	11-9		
			11-5			

Bold: recommended exercises.