UNIVERSITY OF BORÅS

Thermal energy recovery
Termisk energiåtervinning

7.5 credits
7.5 högskolepoäng

Ladok Code: A524TA
Version: 1.0
Established by: Committee for Education in Technology 2021-09-03
Valid from: Autumn 2021

Education Cycle: Second cycle
Main Field of Study (Progressive Specialisation): Energy Technology (A1F)
Disciplinary Domain: Technology
Prerequisites: Meets the requirements for admission to the Master Programme Resource Recovery — Sustainable Energy Technological Processes
Subject Area: Energy Technology
Grading Scale: Seven-degree grading scale (A-F)

Content

The course aims to provide an increased knowledge of thermal processes in order to utilise the energy content of various fuels. The largest of these processes is combustion, which is also the main focus of the course. Other thermal processes such as gasification and pyrolysis are also included. The topics that are dealt with in the course are technical aspects of the processes, which include overall descriptions of various techniques such as fluidised bed boiling and grate-firing as well as Rankine cycle cogeneration. An important aspect of all thermal treatments is the remaining solid material, often referred to as ash, and the course primarily addresses what happens to the inorganic material during combustion. Furthermore, a study visit is carried out to an incineration plant at which calculations are made.

Basic combustion technology with materials and heat balances for cogeneration are discussed. This includes calculations of theoretical air volume, combustion reactions, and amount of exhaust gases formed. Additionally, different measures of efficiencies are discussed. The course contains two laboratory sessions; one to produce the calorific value of a fuel and the other to measure emissions during combustion.

Learning Outcomes

After completing the course, the student will be able to:

Knowledge and understanding
1.1 explain basic concepts in combustion such as excess air and exhaust gas losses and be able to explain various technical measures when it comes to combustion in relation to emission reduction,
1.2 describe the construction of a steam boiler,
1.3 explain the steam power cycle and how the system structure affects its efficiency,
1.4 describe the most common techniques for the combustion of solid, liquid, and gaseous fuels,
1.5 describe how gasification works and what the most common techniques are,
1.6 describe the most common gasification reactions and their temperature and pressure dependence,
1.7 explain what happens to inorganic material during thermal treatment.

Skills and abilities
2.1 apply basic heat and mass balances together with process data to calculate flows in an incineration plant,
2.2 calculate different efficiencies for different types of steam power plants,
2.3 perform combustion calculations,
2.4 identify the important parts of different thermal energy technology processes and explain how they work,
2.5 experimentally determine the calorific value of a solid fuel,
2.6 experimentally determine excess air as well as emissions of CO and NOx.

Evaluation ability and approach
3.1 evaluate and assess the function of energy technology processes.

Forms of Teaching

Teaching takes place in the form of lectures, exercises, written assignments, seminars, study visits, and laboratory sessions. Teaching is conducted in English.

The language of instruction is English.

Forms of Examination

The course is examined through the following exams:

- Examination

Learning outcomes: 1.1-1.7, 2.1-2.4
Credits: 5.0
Grading scale: Seven-point grading scale (A-F)

- Seminar

Learning outcomes: 1.4-1.5, 3.1
Credits: 1.0
Grading scale: Pass/Fail

- Study visits

Learning outcomes: 2.1
Credits: .5
Grading scale: Pass/Fail

- Laboratory session

Learning outcomes: 2.3, 2.5-2.6
Credits: 1.0
Grading scale: Pass/Fail

The grade on the examination governs the grade on the entire course, which is issued only when all of the course components are completed and passed.

If the student has received a decision/recommendation regarding special pedagogical support from the University of Borås due to disability or special needs, the examiner has the right to make accommodations when it comes to examination. The examiner must, based on the objectives of the course syllabus, determine whether the examination can be adapted in accordance with the decision/recommendation.

Student rights and obligations at examination are in accordance with guidelines and rules for
the University of Borås.

Literature and Other Teaching Methods

Student Influence and Evaluation

The course is evaluated in accordance with current guidelines for course evaluations at the University of Borås in which students' views are to be gathered. The course evaluation report is published and returned to participating and prospective students in accordance with the above-mentioned guidelines, and will be taken into consideration in the future development of courses and education programmes. Course coordinators are responsible for ensuring that the evaluations are conducted as described above.

Miscellaneous

The course is primarily a programme course and is part of the Master's Programme Resource Recovery — Sustainable Technological Energy Processes. This syllabus is a translation from the Swedish original.