KD2380 Corrosion and Surface Protection 7.5 credits

Korrosion och ytskydd

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for KD2380 valid from Autumn 2024

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Chemical Science and Engineering,Chemistry and Chemical Engineering

Specific prerequisites

Completed degree project 15 credits, 50 credits in chemistry or chemical engineering, 20 credits in mathematics, numerical analysis and/or data science. English B/6.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completion of the course the student will be able to:

- Explain and describe different electrochemical/corrosion processes of metals/alloys and degradation of polymeric materials at different conditions, as well as describe different corrosion phenomena, methods for surface treatment and corrosion prevention strategies.
- Apply acquired corrosion-relevant theoretical knowledge on practical examples.
- Develop, put into practice and synthesize knowledge of specific industry- and/or society-relevant corrosion research problems, find underlying reasons for the problems and propose solutions or recommendations for action via targeted written and oral presentations.

Course contents

The main objective of the course is to develop fundamental and deep knowledge in the theory for degradation and corrosion of materials in various environments and to present existing protection strategies for prevention of corrosion in different contexts.

The course concerns fundamental theory of the thermodynamics and kinetics of the corrosion process of metals and alloys as well as polymer materials both in atmosphere and water solutions. Thermodynamics include the consideration and calculation of standard potentials, chemical dissociation constants, Nernst equation, and potential pH diagrams (Pourbaix). Electrochemical reactions governing corrosion of metals and alloys will be addressed both at deaerated, aerated, acidic, and alkaline conditions. Simple calculations and estimations on corrosion rates in solution will be performed based on standard potential tables and Faraday's law.

The influence of properties of metals and their oxides on the corrosion behavior will be addressed, which is exemplified by different corrosion types. For these corrosion types, the principles (prerequisites, initiation, progress, failure) and ways to avoid that specific corrosion type will be discussed for: atmospheric corrosion, high temperature corrosion, pitting corrosion, crevice corrosion, intergranular corrosion, stress corrosion cracking, erosion corrosion, fretting corrosion, microbiologically influenced corrosion, galvanic corrosion, selective corrosion, and uniform corrosion. It will be analyzed, which corrosion type(s) occur in a specific environment and for a specific engineered material. Materials and environments that will be addressed are the most common engineered metallic materials including carbon and low alloy steels, stainless steels, aluminum (alloys), copper (alloys), titanium (alloys), and nickel (alloys), and environments, including air (indoor and outdoor), surface water, cement and concrete, cooling water, waste water, sea water, and high temperature applications.

The principle, information outcome, and limitations of different corrosion prediction methods will be discussed. Specifically, standard electrode potential tables and Pourbaix diagrams, galvanic series, electrochemical accelerated tests, surface analytical tests, and mass loss and gain measurements, will be compared. Existing corrosion protection strategies, including surface treatments and coatings are described and choices of material are discussed from a corrosion point of view. Specifically, inhibitors, anodic and cathodic protection, and adjustment of environment and material design will be addressed.

Examination

- PRO1 - Project, 2.0 credits, grading scale: A, B, C, D, E, FX, F
- TEN1 - Written exam, 5.0 credits, grading scale: A, B, C, D, E, FX, F
- ÖVN1 - Home Assignments, 0.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Project (PRO1; 2 credits)
Examination (TEN1; 5 credits)
Home assignments (ÖVN1; 0.5 credits). Requirement for pass: >75% completed

Final grade assigned based on:
PRO1 - A-F: 20% of final grade
TEN1 - A-F: 80% of final grade

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.