



GASIFICATION

5 ECTS

AGH University of Science and Technology

Course responsible: Prof. dr Marek Ściażko, Institute of Chemical Processing of Coal IChPW, Zabrze, Poland

Course overview

The course is built of two parts: lectures and project.

Lectures will dwell on the most important gasification technologies as the way of solid fuels (lignite, coal, biomass) conversion to refined gas (synthetic gas, methane, hydrogen), liquid fuels and energy (IGCC).

Projects: each student will be provided with research papers and books as well technical data concerned with particular gasification processes and units. Students are then required to prepare and present the process design and/or mass and energy balance for a selected process of coal or biomass gasification and syngas upgrading.

Lectures content: World balance of primary energy sources; General characteristics of solid fuel conversion processes, status and perspective of gasification technologies. Solid fuels for gasification processes: characteristics, classification and methods of fuel analysis. Fundamentals of biomass and coal gasification: mechanism and reactions of gasification, coal and biomass pyrolysis, thermodynamic and kinetic aspects of gasification, bed types, feed systems, process classification, process selection, gasification criteria. Overview of industrial gasification technologies of coal gasification: BLG, Shell, Texaco, Siemens, PWR etc. Coal upgrading for gasification reactors; Steam and oxygen production for coal gasification. Syngas upgrading: gas impurities, gas quality requirements for chemical syntheses and IGCC, cooling processes, removal of acid gases, gas conditioning, side processes i.e. acid gas recovery and compression of carbon dioxide Integrated Gasification Combined Cycle (IGCC) with Carbon Capture and Storage, Gas from coal gasification for chemical applications; Hydrogen production by coal gasification; Gas to Liquids Processes GTL . UCG - Underground coal gasification. Biomass gasification: kind of fuel, fuel input, application, feedstock related problems; Overview of commercial gasification technologies of biomass gasification and co-gasification of coal and biomass: PRENFLO, CHOREN etc. Nuclear cogeneration: employment of HTR for coal and biomass gasification .Utilization of by-products and waste treatment; Environmental performance of coal gasification; Techno-economic assessment of coal gasification processes

Projects – content:

1. Development of the process concepts and process chains of coal/biomass gasification technology for different applications:
 - Generation of chemical products (NH₃, H₂, SNG, MeOH, liquid fuels)
 - Co-generation process (heat and electricity production)
 - Poly-generation process (heat, electricity and chemical production)
 - IGCC without and with CCS
2. Drawing up of mass and energy balances for selected coal/biomass gasification systems
3. Evaluation of the techno- and eco-efficiency of gasification processes
4. Process modelling of coal or biomass pyrolysis and gasification including thermodynamics laws and chemical reactions principles.

Outcome of the course

After the course student should:

- Have the knowledge of the major coal and biomass gasification technologies, coal and biomass preparation for the process, gasification media production, gas conversion and purification and quality parameters of gasification products, syngas utilization, basic synthesis of fuels and chemicals from syngas.
- Understand chemical reactions involved in coal conversion, particularly by gasification, enhancing modelling skill of gasification providing basic knowledge of gasification thermodynamics and kinetics.
- Be able to prepare the process design of coal and biomass gasification (gasification island: coal preparation unit, steam preparation and air separation unit, gasifier, gas conversion and purification unit; co- and poly-generation processes) as well as to prepare mass and energy balance of the gasification processes.

Course coordinator & teachers

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