



University of Miskolc

Faculty of Materials Science and Engineering  
Antal Kerpely Doctoral School of Materials Science  
& Technology



# Combustion and gasification theory

Prof. Dr. Palotás Árpád Bence

## **COURSE DESCRIPTION**

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## Lecturer

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<http://combustion.uni-miskolc.hu/tanszek/palotas.html>

## Target group

The course is offered for all students of the Kerpely Doctoral School, especially in the field of thermal energy management.

## Language

English or Hungarian.

## Scope

The scope of the course besides the basic concepts of combustion technology, the familiarisation with the detailed chemical processes occurring combustion, pyrolysis and gasification. The course also includes relevant calculations and modelling of the processes.

## Methodology

The subject follows the (personalized) theme of the students' research topic. By assigning primarily English-language literature. The student is studying individually, besides attending lessons. The subject's lecturer is consulted on demand, at least once a week where an opportunity is given to the student to discuss the relevant arising issues of the subject.

## Constituent topics

### **Topic 1**

**Thermodynamics and kinetics of combustion:** practical fuels, stoichiometry, chemical and phase equilibria, equilibrium calculations. The principle laws of thermodynamics, energy retention, flame spread, ignition conditions and limits.

### **Test questions:**

1. Describe the most important practical fuels!
2. Describe the combustion theory calculations for solid, liquid and gaseous fuels!
3. Describe the principle laws of thermodynamics.
4. What does the temperature of the flame depend on?
5. Describe the combustion equations of the hydrocarbon of your choice.
6. What does it depend on the energy content of a fuel?
7. What does it depend on the heat capacity of a substance?
8. How can the reaction heat be influenced?
9. What and how does the flame propagation rate depend on?

10. How can ignition limits be changed?

## **Topic 2**

**Oxidation processes:** Typical combustion processes of different types of fuel.

### **Test questions:**

1. Describe the processes that occur in the combustion of hydrogen.
2. Describe the processes involved in the combustion of methane.
3. Describe the processes involved in combustion of carbon monoxide.
4. Describe the processes occurring in the combustion of carbon.
5. Describe the processes occurring in the combustion of methanol.
6. Describe the processes occurring in the combustion of kerosene.
7. Describe the processes occurring in the combustion of biomass.
8. Describe the formation process of nitrogen oxides.
9. Describe the pollutants and their properties occurring in the process of combustion.

## **Topic 3**

**Gasification theory:** Fundamentals of gasification processes, advantages, disadvantages, carbon gasification, methanol synthesis, industrial technologies

### **Test questions:**

1. Describe the advantages and disadvantages of gasification.
2. What type of industrial technologies do you know of?
3. Describe the basic chemical equations of methanol synthesis?
4. What type of industrial methanol production processes you know of?
5. Describe the technologies for the biomass gasification
6. What is the difference between combustion, gasification and pyrolysis?
7. Describe the benefits and difficulties of hydrogen combustion?
8. Describe the advantages and disadvantages of methanol combustion?

## **Recommended literature**

1. . C. K. Law: Combustion Physics, Cambridge University Press, 2006.
2. Turns S. R.; An Introduction to Combustion-Concepts and Applications. McGraw Hill, 2000.
3. G. A. Olah, A goeppert and G. K. Surya Prakash: Beyond Oil and Gas – The Methanol Economy. Wiley-VCH, 2009

## **Completion, examination**

Oral exam after the correct answers to the verification question.

## **Relevant topics for the complex examination**

1. Which energy carrier would you choose to serve the heat demand of any industrial process and why?
2. What is the "methanol based economy" and what are its difficulties?
3. What kind of carbon gasification technologies do you know of, what are their advantages or disadvantages?
4. Describe the physical and chemical characteristics of the flames. How these characteristics can be influenced?