University of Miskolc

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

Test methods of refractory materials

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COURSE DESCRIPTION

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Test methods of refractory materials

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Lecturer

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Target group

The course is offered for all students of the Kerpely Doctoral School, especially in the field of High Temperature Equipment and Heat Energy Management.

Language

English or Hungarian.

Scope

The aim of the course is to get familiar with the modern methods of testing refractory and refractory insulating linings materials used in high temperature equipment, which can be used to select the most suitable refractory lining system for the equipment.

Methodology

The subject is taught in a consultation system. We are organizing lectures for a larger number of enrolled students. A weekly individual lecture will be provided for 1-2 students. The three themes covering the current part of the curriculum and the available literature are listed below. Questions are also given for each topic area. Three lectures will be organized, where each time a different topic will be discussed. The acquired knowledge will be verified on the question and answer basis.

Constituent topics

Topic 1

Refractory raw materials: overview of the most important refractory raw material systems (1, 2 and multi-element ceramic systems, metallic based refractory materials). Forming and installing refractory materials.

Test questions:

1. *Categorize non-metallic refractory systems based on application temperature*
2. *What acidic refractory materials do you know of where are they used?*
3. *What basic refractory materials do you know of where are they used?*
4. *Select 3 high-temperature equipment (kiln, boiler), assign refractory lining materials for them, justify their choice.*
5. *Group the metallic refractory systems according to their application temperature.*
6. *What are the most important applications of metallic refractory materials?*
7. *What kind of refractory product groups do you know? Characterize them in 4-5 sentences!*
8. *How formed refractory products are built?*
9. *How does the non-formed refractory products are installed?*
10. *How fibre based refractory products are installed?*

Topic 2

Test methods: Refractory raw materials (oxidic, nonoxidic systems and metals). Classification of refractory products. Physical, chemical, mechanical and structurer properties of refractories.

Test questions:

1. *Describe the most important strength test methods of refractory products!*
2. *How do the strength properties of different refractory products vary depending on the temperature?*
3. *Describe the test methods for the most important structural properties of refractory products.*
4. *What is the magnitude of strength of each refractory product depending on the bulk density?*
5. *Present the test methods for the gas permeability of refractory products.*
6. *Give examples of cases where good gas permeability is required and where is not allowed!*

Topic 3

Test methods of refractory products II .: thermal stress and corrosion resistance.

Test questions:

1. *Present the test method for softening of refractory products under load.*
2. *Describe the residual dimensional changes of the refractory products due to heat.*
3. *Describe the defect resistance of formed refractory products.*
4. *Describe the definition of piroscope equivalents of formed refractory products.*
5. *Describe the test methods used for melt-cast fireproof products.*
6. *How and by what methods can the temperature / oven temperature conditions be determined?*
7. *What standard methods do you know to determine the thermal conductivity of formed refractory products?*
8. *Describe the thermal conductivity measurement with the laser pulse method.*
9. *Describe in detail the test methods for resistance to corrosive media in formed refractory products.*
10. *What corrosion processes occur in the refractory material of the side wall of a glass melting furnace?*

Recommended literature

1. C. A. Schacht: Refractories Handbook, Marcel Dekker, Inc. New York, 2004.
2. Gerald Routschka, Hartmut Wuthnow: Pocket Manual Refractory Materials: Design, Properties and Testing, Vulkan; 3 edition, 2008.
3. Barrie Jenkins, Peter Mullinger: Industrial and Process Furnaces: Principles, Design and Operation, Butterworth-Heinemann, 2011.

+ If need be, the student may get literature directly relevant to his/her research.

Completion, examination

Oral exam after the correct answers to the verification question.

Relevant topics for the complex examination

1. Methods and determination of mechanical strength parameters of different refractory products.
2. The methods and characteristics of the structural parameters of different refractory products.
3. The effect of temperature, and temperature change of different composition refractory products.

4. Thermal conductivity and heat transfer of different composition refractory products.
5. Analysing methods for corrosion properties of different composition refractory products.