MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION

Federal State Autonomous Education “Ural Federal University named after the first President of Russia B.N. Yeltsin”

Institute of New Materials and Technologies

Signed and Approved

Vice-rector for Research

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ V.V. Kruzhaev

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COURSE PROGRAM

**METHODS of gainING in performance OF non-ferrous metallurgy processes**

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| **Information about the course program** | **Accounting data** |
| **Educational program**  Metallurgy of ferrous, non-ferrous and rare metals  (05.16.02) | **Specialty code**  22.06.01  **Curriculum** № 6513 (version 2) |
| **Major**  Materials technology | **Training program code**  22.06.01 |
| **Level of training**  Highly qualified personnel |
| **Federal State Educational Standard** | **The Ministry of Education and Science of the Russian Federation approval FSES HE order details:**  July 30, 2014 No. 888 (amended April 30, 2015) |

**Ekaterinburg**

**2018**

**1. GENERAL CHARACTERISTIC OF THE DISCIPLINE**

**Methods of gaining in performance of non-ferrous metallurgy processes**

**1.1. Annotation of the content of the discipline**

The purpose of the discipline is the study of modern achievements and prospects for the development of resource-saving technologies for the production of non-ferrous, rare and precious metals, as well as the development of skills for independent analysis of topical issues of metallurgy and ways to solve them based on the use of resource-saving technical solutions.

**1.3. Planned learning outcomes for the discipline**

After mastering this course, the graduate student must acquire the following competencies:

- the ability to critically analyze and evaluate current scientific achievements, generate new ideas in solving research and practical problems, also in the interdisciplinary fields (UC-1);

- the ability and willingness to theoretically justify and optimize the technological processes of obtaining promising materials and the production of new products from them, taking into account the consequences for society, the economy and the environment (GPC-1);

- the ability and willingness to develop and produce technological documentation for promising materials, new products and means of technical quality control of manufactured products (GPC-2);

- the ability and willingness to economically evaluate the production and non-production costs of creating new materials and products, to work to reduce their cost and improve quality (GPC-3);

- the ability and willingness to comply with regulatory requirements that ensure the safety of production and operational activities (GPC-4);

- the ability and willingness to perform theoretical and experimental research as a lead contractor using computer technology (GPC-6);

- the ability to choose instruments, sensors and equipment for conducting experiments and recording their results (GPC-10);

- the ability and willingness to develop a process, tooling, working documentation, route and operational flow charts for the manufacture of new products from advanced materials (GPC-11);

- the ability and willingness to participate in carrying out technological experiments, to carry out technological control in the production of materials and products (GPC-12);

- the ability and willingness to demonstrate a systematic understanding of the current state and perspective of the chosen (professional) branch of scientific knowledge (PC-1);

- the ability and willingness to conduct research in the chosen (professional) branch of scientific knowledge using modern methods and technologies (PC-2);

- readiness to identify, develop problems, using the scientific approach, conduct and implement the results of the study in the chosen (professional) branch of scientific knowledge (PC-3);

- the ability to critically analyze, evaluate and synthesize new ideas in the chosen (professional) branch of scientific knowledge, related fields (PC-6);

As a result of mastering the course, the student must to:

**Know:**

- The basics of the theory and practice of using resource-saving technical solutions in the production of non-ferrous, rare and precious metals;

- Prospects for the development of resource-saving technical in the interests of improving the efficiency and environmental safety of metallurgical production and related industries.

**Be able to:**

- analyze technical and technological solutions in the production of non-ferrous, rare and noble metals;

- evaluate the effectiveness and prospects of technical and technological solutions for the development of a specific metallurgical technology, related industries and the mineral and raw material complex as a whole.

**Master** (demonstrate skills and experience):

- methods for calculating the technical and economic efficiency of technological solutions, search, analysis and scientific substantiation of promising areas of development of metallurgical production.

**2. COURSE CONTENTS**

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| **Code** | **Section, topic** | **Content** |
| **Р1** | **Introduction**  **Actual problems of color metallurgy** | Trends in the development of human society and their relationship with the problems of the mineral resource complex. The influence of technical solutions in the metallurgy of non-ferrous metals on the indicators of scientific and technical progress, the development of the economy and the country's defense. The role of resource-saving technologies in solving the problems of color metallurgy. |
| **Р2** | **The main trends in the change of the raw material base of non-ferrous metallurgy and the prospects for its development** | The raw material base of non-ferrous metallurgy and the tendency of its change in relation to the main groups of color and rare metals. Involvement in the production of off-balance sheet and non-traditional raw materials, secondary raw materials and man-made raw materials. Features of the mineral resource base of energy and auxiliary raw materials and current problems of its development. Recycling of metals and materials as an effective way to reduce the load on the raw material base of color metallurgy. |
| **Р3** | **The current state and prospects for the development of resource-saving technologies in the metallurgy of non-ferrous, rare and precious metals** | Resource-saving technologies in the metallurgy of heavy non-ferrous metals. The introduction of autogenous technologies in the processing of sulfide raw materials of non-ferrous metals. The use of autoclave technologies and electro-hydrometallurgical technologies in the production of copper. Existing technologies and prospects for their development for the extraction of rare and precious metals from products and semi-products in the production of heavy non-ferrous metals. The use and implementation of continuous technological processes in the metallurgy of copper, nickel, zinc and lead.  Resource-saving technologies in the metallurgy of light metals. Enrichment of low-quality aluminum raw materials. Intensification of autoclave technologies for opening bauxite raw materials. The use of combined Bayer-sintering technologies for the processing of low-quality bauxite. Improving the efficiency of decomposition of aluminate solutions and related technical operations. The use of dry and semi-dry method of sintering the charge. Complex processing of aluminum-containing raw materials of natural and man-made origin with the extraction of rare metals. The development of high-ampere electrolysis technology of cryolite-alumina melt. The development of alternative technologies for the production of aluminum and alloys based on it. The introduction of energy- and material-saving processes in the production of titanium, magnesium and other light metals. |

**4. base of materials for current academic performance Evaluation and interim assessment**

**4.3.2. Sample essay topics (essay, creative works)**

* The use of autogenous processes in nickel metallurgy
* New directions in the processing of oxidized nickel ores
* Energy saving processes in copper metallurgy
* Application of hydrometallurgical technologies for copper production
* Using non-cyanide solvents to extract gold
* Perspective schemes for processing refractory gold-bearing raw materials
* Disposal of sludge waste in the production of associated production
* Creation of metallurgical productions closed in sulfur
* Optimization of alumina production material flows
* New trends in the construction of aluminum electrolysis cells

**6.3.4. Sample questions for credit**

1. The current state of the metallurgy of heavy non-ferrous metals (concretization) in Russia and abroad.

2. Theoretical foundations of autogenous methods for smelting concentrates.

3. Principles of implementation of the schemes of dumpless technology at the plants of non-ferrous metallurgy of the Urals.

4. The main directions of intensification of fire and electrolytic refining.

5. Features of nickel production from oxidized and sulphide nickel and copper-nickel ores in Russia and abroad.

6. Features of the depletion of slag autogenous processes and converter slags. Obtaining elemental sulfur from waste gases.

7. Methods for processing lead slag from the current issue of slag heaps of past years.

8. Modern continuous processes of refining rough lead.

9. Analysis of the extraction schemes of zinc from sulphide concentrates without prior roasting.

10. Hydrometallurgical schemes for the processing of collective sulfide concentrates and middlings.

11. Theoretical foundations and technology of electrochemical dissolution of cinders, concentrates, recycled materials.

12. Principles of complex processing of zinc-containing rare-metal dusts.

13. Theoretical foundations, features and practice of the implementation of yarosite, goethite, hematite processes.

14. The raw material base of alumina production in Russia.

15. The main technological schemes of alumina production.

16. Fundamentals of aluminum electrometallurgy.

17. The mechanism of electrode processes in the electrolysis of cryolite-alumina melts

18. Design of aluminum electrolysis cells.

19. Technological violations and their elimination.

20. Low-temperature electrolysis. State, prospects and development.

**7. METHODICAL AND INFORMATION SUPPORT**

**7.4. Databases, information, reference and search systems**

1. UrFU Zonal Scientific Library: http//lib.urfu.ru
2. Electronic Scientific Library: http://elibrary.ru
3. Cambridge Science, Technology & Medicine (STM) Journal, Cambridge University Press database http://www.journals.cambridge.org
4. Academic Search Complete database, EBSCO publishing company http://search.ebscohost.com
5. Web of Science SCI (WOS) database, Thompson Reuters company <http://apps.webofknowledge.com>
6. Search systems: yandex, google, rambler

## 7.5. Electronic educational resources

## http://study.urfu.ru/Aid/ViewMeta/