Перечень опубликованных работ за 2020 г.

Отечественные издания

1. Сулейменов Б.А., Доштаев Б.Ж., Болеева Л.К., Интеллектуальные системы управления технологическими процессами в фосфорной промышленности / монография. – Алматы: Шикула, 2020. - 223 с. 62 ил.

Зарубежные издания

1. Toktassynova, N., Fourati, H., Suleimenov, B. Application of grey system theory to phosphorite sinter process: From modeling to control, Asian Journal of Control, Статья в печати (Scopus, процентиль журнала 70), DOI: 10.1002/asjc.2348.
2. Makhanbet M., Tiejun Lv ; Orynbet M., Suleimenov B. A Fully Distributed and Clustered Learning of Power Control in User-Centric Ultra-Dense HetNets / IEEE Transactions on Vehicular Technology (Early Access). - 2020.
с.1-1 Статья в печати (Scopus, процентиль журнала 98/98/96), DOI: 10.1109/TVT.2020.3013329
3. Suleimenov B.A., Kulakova E., Development of intelligent systems for optimal processes control., (article). Resource-saving technologies of raw-material base development in mineral mining and processing. Multi-authored monograph. – Petroșani, Romania: UNIVERSITAS Publishing, 2020. – P.514. c.198-204 doi: 10.31713/m913
4. Kulakova Ye. A., Suleimenov B. A. Development and Research of Intelligent Algorithms for Controlling the Process of Ore Jigging. International Journal of Emerging Trends in Engineering Research. – 2020. Vol. 8. No.9, c.6240-6246. doi: 10.30534/iieter/2020/214892020

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Ссылка https://onlinelibrary.wiley.com/doi/abs/10.1002/asjc.2348

https://www.scopus.com/record/display.uri?eid=2-s2.0-85083637768&origin=resultslist

Asian Journal of Control

SPECIAL ISSUE

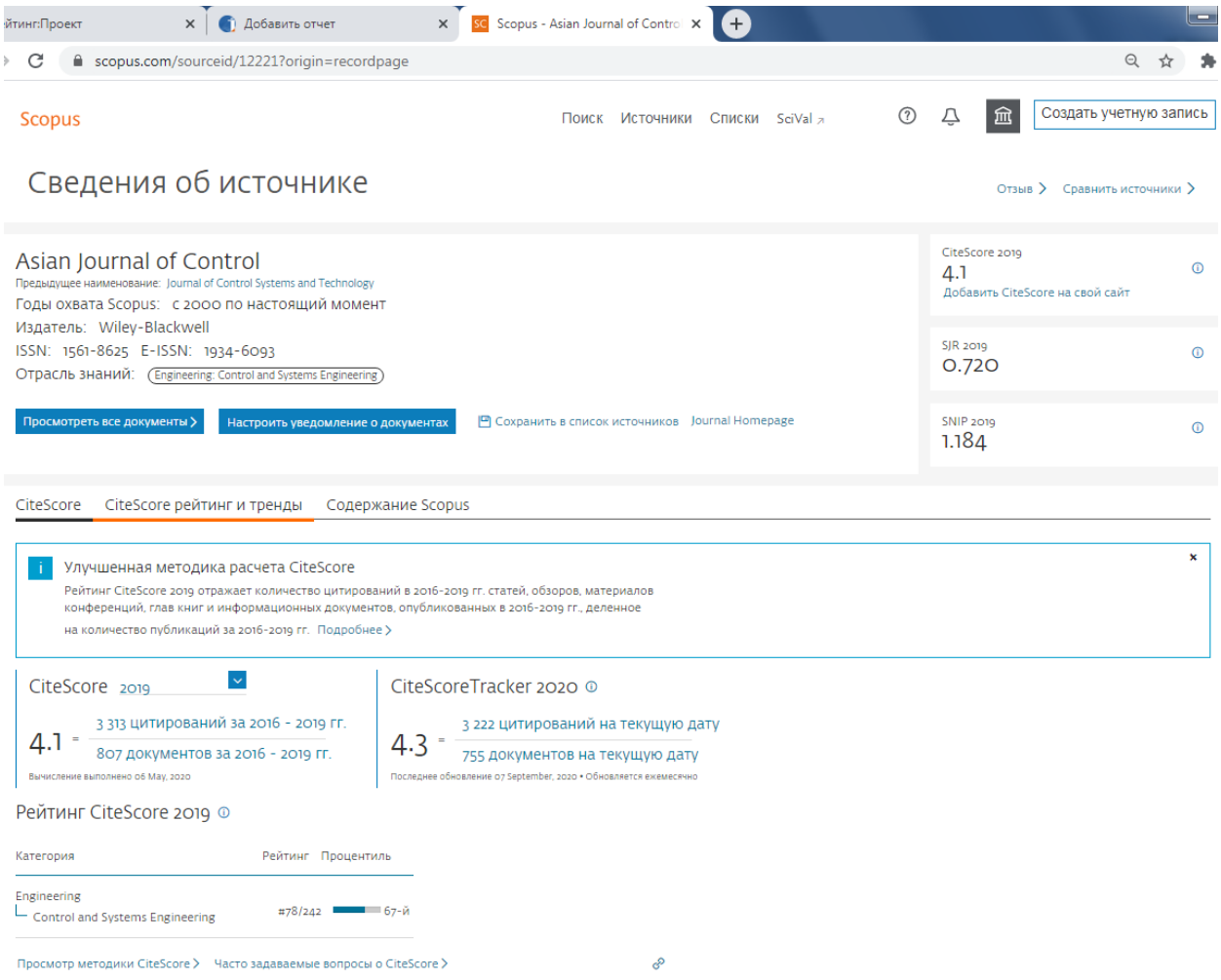
Application of grey system theory to phosphorite sinter process: From modeling to control

Nigina Toktassynova, Hassen Fourati, Batyrbek Suleimenov

First published: 19 April 2020 | https://doi.org/10.1002/asjc.2348

Abstract

The sintering process of phosphorite ore occurs with a large amount of return caused by untimely process control. The control task of phosphorite ore sintering is to regulate the parameters of the process to obtain a high quality sinter. The parameter clearly responsible for sinter quality is the temperature in the wind box. Therefore, in order to solve the control task, it is necessary to predict the highest temperature of the charge (also known as the burn through point (BTP)). In this paper, the theory of grey systems is used as a predictive model, which makes it possible to obtain an adequate model that uses a small number of initial samples of real temperature data. Based on the grey model GMC(1,n) a new optimal model is presented, which is constructed by using optimization algorithm. Optimal model predicts the BTP, and to establish an optimal regulation, a control synthesis is carried out through an optimization of the prediction according to the "particle swarm" algorithm.



2.Meruyert Makhanbet; Tiejun Lv ; Marat Orynbet ; Batyrbek Suleimenov, A Fully Distributed and Clustered Learning of Power Control in User-Centric Ultra-Dense HetNets. IEEE Transactions on Vehicular Technology (Early Access) 2020. P 1-1 **(Scopus, процентиль журнала 98/98/96)**, DOI: 10.1109/TVT.2020.3013329

Ссылка:
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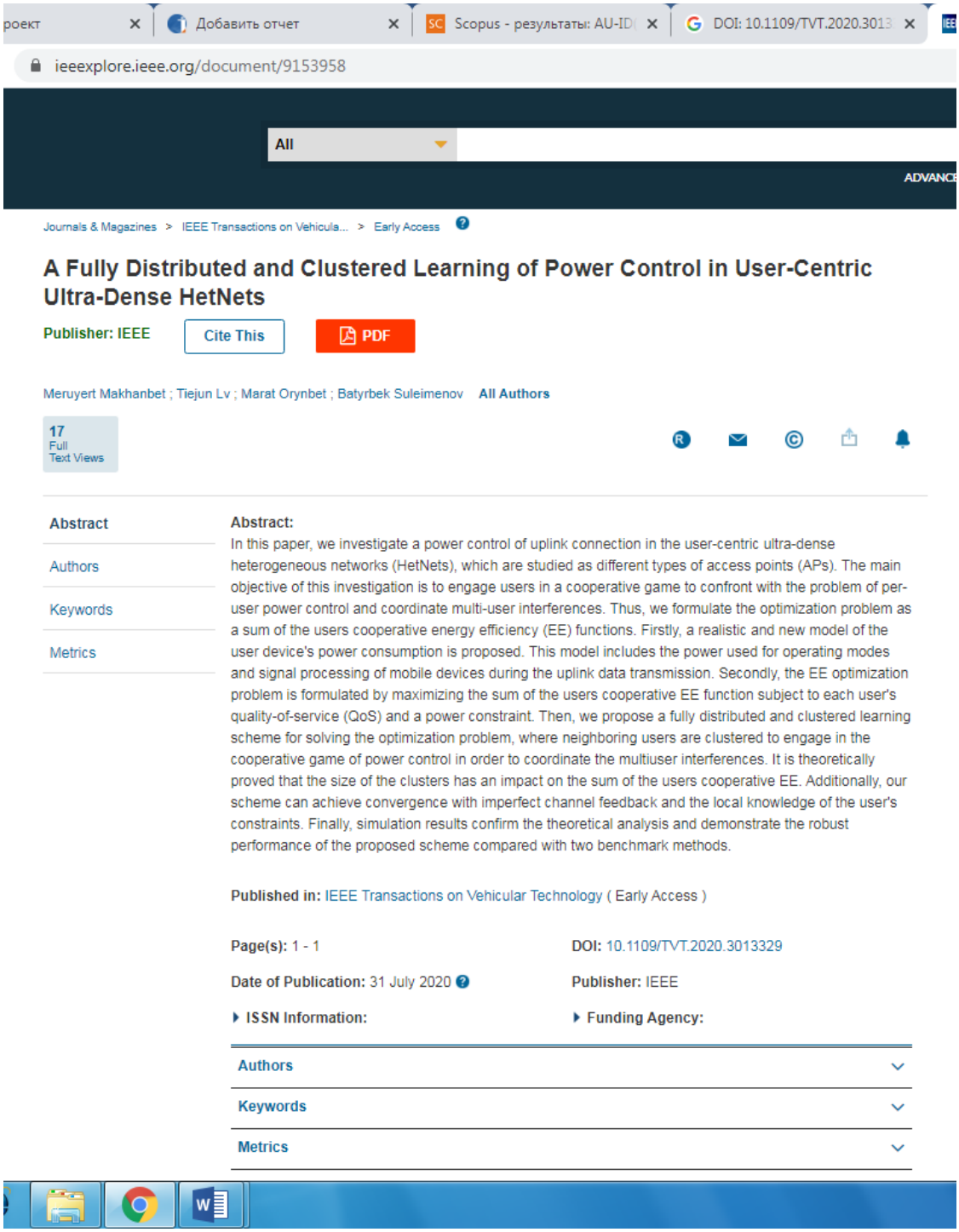
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DOI: 10.1109/TVT.2020.3013
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A Fully Distributed and Clustered Learning of Power Control in User-Centric Ultra-Dense HetNets
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PDF
Meruyert Makhanbet ; Tiejun Lv ; Marat Orynbet ; Batyrbek Suleimenov All Authors
17
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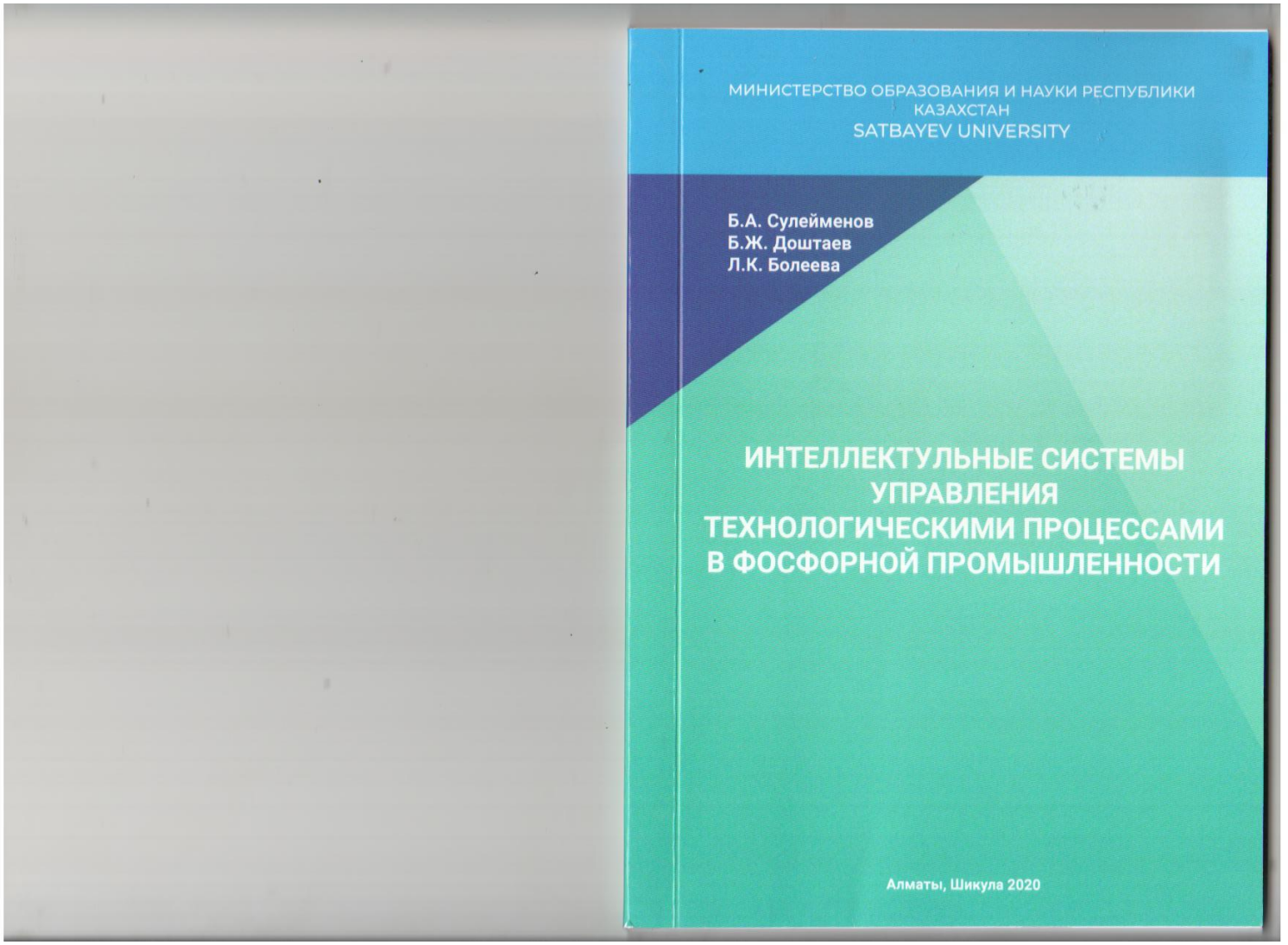
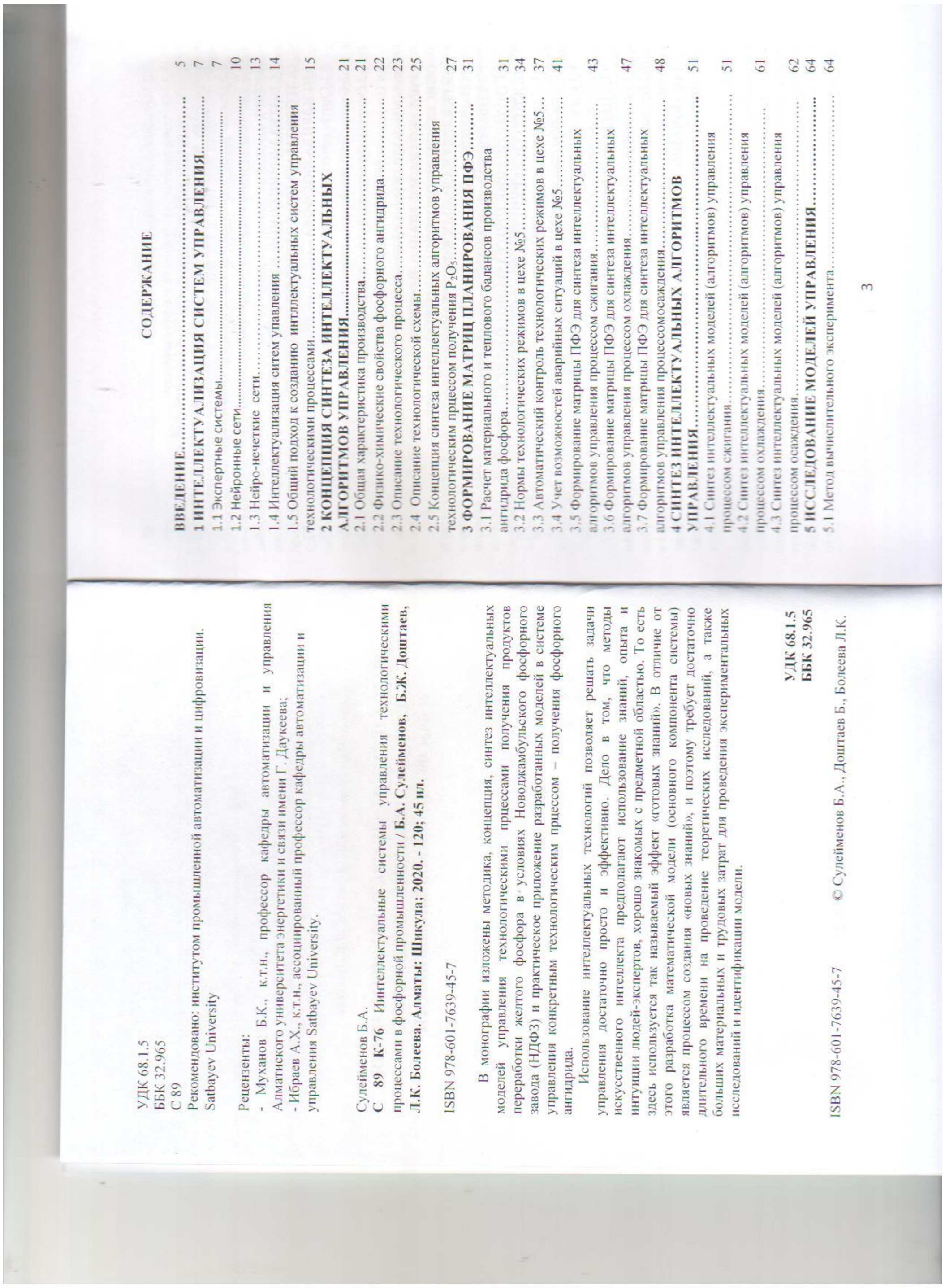
Abstract:
In this paper, we investigate a power control of uplink connection in the user-centric ultra-dense heterogeneous networks (HetNets), which are studied as different types of access points (APs). The main objective of this investigation is to engage users in a cooperative game to confront with the problem of per-user power control and coordinate multi-user interferences. Thus, we formulate the optimization problem as a sum of the users cooperative energy efficiency (EE) functions. Firstly, a realistic and new model of the user device's power consumption is proposed. This model includes the power used for operating modes and signal processing of mobile devices during the uplink data transmission. Secondly, the EE optimization problem is formulated by maximizing the sum of the users cooperative EE function subject to each user's quality-of-service (QoS) and a power constraint. Then, we propose a fully distributed and clustered learning scheme for solving the optimization problem, where neighboring users are clustered to engage in the cooperative game of power control in order to coordinate the multiuser interferences. It is theoretically proved that the size of the clusters has an impact on the sum of the users cooperative EE. Additionally, our scheme can achieve convergence with imperfect channel feedback and the local knowledge of the user's constraints. Finally, simulation results confirm the theoretical analysis and demonstrate the robust performance of the proposed scheme compared with two benchmark methods.
Published in: IEEE Transactions on Vehicular Technology (Early Access)
Page(s): 1 - 1
DOI: 10.1109/TVT.2020.3013329
Date of Publication: 31 July 2020
Publisher: IEEE
ISSN Information:
Funding Agency:
Authors
Keywords
Metrics

3. Сулейменов Б.А., Доштаев Б.Ж., Болеева Л.К., Интеллектуальные системы управления технологическими процессами в фосфорной промышленности. – Алматы: Шикула, 2020. - 223 с.; 62 ил. (Монография)


МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РЕСПУБЛИКИ КАЗАХСТАН
SATBAYEV UNIVERSITY
Б.А. Сулейменов
Б.Ж. Доштаев
Л.К. Болеева
ИНТЕЛЛЕКТУЛЬНЫЕ СИСТЕМЫ УПРАВЛЕНИЯ ТЕХНОЛОГИЧЕСКИМИ ПРОЦЕССАМИ В ФОСФОРНОЙ ПРОМЫШЛЕННОСТИ
Алматы, Шикула 2020



УДК 68.1.5
ББК 32.965
С 89
Рекомендовано: институтом промышленной автоматизации и цифровизации.
Satbayev University

Рецензенты:
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Сулейменов Б.А.
С 89 К-76 Интеллектуальные системы управления технологическими процессами в фосфорной промышленности / **Б.А. Сулейменов, Б.Ж. Доштаев, Л.К. Болеева. Алматы: Шикула; 2020. - 120; 45 ил.**

ISBN 978-601-7639-45-7

В монографии изложены методика, концепция, синтез интеллектуальных моделей управления технологическими прцессами получения продуктов переработки желтого фосфора в условиях Новоджамбульского фосфорного завода (НДФЗ) и практическое приложение разработанных моделей в системе управления конкретным технологическим прцессом – получения фосфорного ангидрида.

Использование интеллектуальных технологий позволяет решать задачи управления достаточно просто и эффективно. Дело в том, что методы искусственного интеллекта предполагают использование знаний, опыта и интуиции людей-экспертов, хорошо знакомых с предметной областью. То есть здесь используется так называемый эффект «готовых знаний». В отличие от этого разработка математической модели (основного компонента системы) является процессом создания «новых знаний», и поэтому требует достаточно длительного времени на проведение теоретических исследований, а также больших материальных и трудовых затрат для проведения экспериментальных исследований и идентификации модели.

УДК 68.1.5
ББК 32.965

ISBN 978-601-7639-45-7

СОДЕРЖАНИЕ

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4. Suleimenov B.A., Kulakova E., Development of intelligent systems for optimal processes control., (article). Resource-saving technologies of raw-material base development in mineral mining and processing. 198-204 p-p. Multi-authored monograph. – Petroșani, Romania: UNIVERSITAS Publishing, 2020. - 514 p. doi: 10.31713/m913

Ссылка: https://ep3.nuwm.edu.ua/18359/

UDC 622.002 https://doi.org/10.31713/m901

Recommended for publication by the Academic Board of the National University of Water and Environmental Engineering, Ukraine. Minutes № 5, 29.05.2020

Reviewers: ***Mihaela TODERAS***, Ph.D.Habil.Eng., Professor,
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Resource-saving technologies of raw-material base development in mineral mining and processing. Multi-authored monograph. – Petroşani, Romania: UNIVERSITAS Publishing, 2020. - 514 p.

ISBN 978-973-741-694-0

The monograph considers potential technological development of ore mining and processing industries through updating mining machines and technologies
The book is intended for a broad mining audience of scholars, practitioners, postgraduates and students.

UDC 622.002

ISBN 978-973-741-694-0

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https://doi.org/10.31713/m913

DEVELOPMENT OF INTELLIGENT SYSTEMS FOR OPTIMAL PROCESS CONTROL

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Abstract

The search for resource-saving technologies implies not only research in the field of new methods of processing raw materials, but also new approaches to managing technological processes. Another important way of resource saving is the ability to quickly assess the technical condition of equipment, which will allow to timely prevent the emergency state of the main and auxiliary technological equipment. The paper deals with the development of intelligent control systems and diagnostics of processes using fuzzy logic, neural networks and hybrid models for creating control algorithms. The subject of the research is control algorithms developed to determine the key variables of the copper melting process in a liquid bath and algorithms for evaluating the technical condition of turbine units. All algorithms are developed on the basis of PFE matrices compiled by experienced technology experts during a "thought" experiment. The resulting models are carefully studied and analyzed for their sensitivity, stability, and single-valuedness. The absolute error of discrepancy between experimental and calculated variables became the criterion of adequacy.

Finally, the conducted researches have shown high efficiency of the control algorithms, obtained by using the artificial intelligence methods. In comparison with classical methods of building analytical and statistical models, methods based on the knowledge and experience of human experts allow creating optimal control systems for complex technological processes significantly easier, faster and more efficient.

Introduction

One of the main ways of resource saving in the mining and metallurgical industries is the introduction of automated systems of optimal process control (APCS) at industrial enterprises in these industries, which allow more efficient process control with the least loss of material, heat, electricity, labour and other resources of an enterprise.

5.Kulakova Ye.A. ,Suleimenov B.A. Development and Research of Intelligent Algorithms for Controlling the Process of Ore Jigging. International Journal of Emerging Trends in Engineering Research. Volum 8. No.9, 2020. 6240-6246 p-p. doi: 10.30534/iieter/2020/214892020

http://www.warse.org/IJETER/static/pdf/file/ijeter215892020.pdf

ISSN 2347 - 3983

Volume 8. No. 9, September 2020

International Journal of Emerging Trends in Engineering Research

Available Online at http://www.warse.org/IJETER/static/pdf/file/ijeter214892020.pdf

https://doi.org/10.30534/iieter/2020/214892020

Development and Research of Intelligent Algorithms for Controlling the Process of Ore Jigging

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ABSTRACT

The search for methods for control the beneficiation of chromite ore, eliminating the loss of chromite in the form of tailings, has both economic and environmental importance. Jigging machines are used to enrich such ore. Optimal control of these units allows achieving maximum technological enrichment indices. So, in this study, a fuzzy logic approach was attempted for develop an intelligent algorithm to determine the optimal value of the key process variables: the level of the natural «bed» (mm), the pulsation rate of the jigging compartment (s-1) depending on the grade Cr2O3 of the raw ore (%), the grade Cr2O3 of the tailings (%) and the grade Cr2O3 of the concentrate fraction (%). The algorithm is based on the knowledge of competent expert, the knowledge base consisting of 64 operating modes. The values obtained by the fuzzy model and experimental values have a minimum divergence.

Key words :Chromite, Fuzzy Logic, Intelligent Algorithm, Jigging Machine, Knowledge Base.

1. INTRODUCTION

In the modern world, in the context of economic and emerging environmental crises, environmental and economic aspects of mining and processing of minerals come to the fore. Therefore, it is important to use technologies that minimize the negative impact of industrial production on the environment and workers' safety [1] in order to avoid losses of raw materials and energy resources at all stages of technological processing of minerals and organic matter [2]. Some of the recent examples are the technologies developed in India: the use of burned agricultural wasteas an effective method for strengthening concrete [3] and the use of crushed clam shellsin pervious concrete for low traffic areas [4].

The demand for chromite ore is growing every day. Therefore, it is necessary to look for new approaches to concentration that will ensure maximum extraction of the useful component from the extracted ore and can be used to process existing tailings.

Gravity dressing methods are used to process small and fine grades of mined ore. The modern concept of gravitational methods includes the separation of mineral particles under the influence of gravity force and resistivity, as well as the separation of particles by size and shape. The variety of particles with their individual properties complicates reliable quantitative description of gravitational processes. Therefore, the development of this method of dressing, despite its long history and wide range of application, is used mainly through experiments.

One of the most common methods of gravity dressing of chromite ore is the jigging process. Jigging is a method of gravitational dressing of minerals based on the separation of the mineral mixture into layers that differ in density; it takes place as a result of periodic exposure to ascending and descending flows of the isolation medium.

The final products of the jigging process are concentrate with a high content of the useful component and waste.

This paper proposes defining the key variables of the jigging process using artificial intelligence technologies. The result will be 2 algorithms using fuzzy logic and artificial neural networks. The algorithms will be tested on an independent sample (that is, on data that was not used for the neural network adaptation and the fuzzy algorithm knowledge acquisition). This procedure will allow us to evaluate the adequacy of the developed algorithms. Therefore, the algorithm used to obtain data with minimal discrepancies with the ideal experimental sample will be integrated into the jigging machine control system.