

Conditions for Minimum Dynamic Loading of Multi-brake Hoists

Khoreshok Alexey A.^a, Tyulenev Maxim A.^b
 T. F. Gorbachev Kuzbass State Technical University,
 Kemerovo, Russian Federation
^ahaa.omit@kuzstu.ru, ^btma.geolog@kuzstu.ru

Vöth Stefan
 Technische Fachhochschule Georg Agricola für
 Rohstoff, Energie und Umwelt zu Bochum
 Bochum, Germany
 Voeth@tfh-bochum.de

Abstract - Hoists are equipment with unsteady service. Due to this, there is a considerable dynamic loading on the hoist and its elements, sometimes involving failure of equipment. On the other hand, technological development is going on. Modern control elements are widely used to realize economic and comfortable driving behavior. In this work the review is given of using modern technology with regard to reducing loads on crucial components of the hoist in order to prolong lifetime or to get a more economic design. The article presents the calculations in order to optimize the load of the hoists (lifting machines) proposed for different modes of their use. These calculations can be used to construct the braking hoisting units of a new design.

Keywords — Hoists; torque; dynamic; safety brakes.

I. INTRODUCTION

Matters of mining equipment reliability are increasing with particular importance due to the strengthened tendency of growth of volumes of coal mined in Kuzbass (Western Siberia, Russia) [1-3]. Today they are the object of primary attention of the Government [4-5] as the matter of labor security and safety [6-7] as well as tightening of the requirements for the owners of the coal companies [8].

Hoists are mechanical systems with different spots of load introduction [9, 10]. They are used in all sectors of the mining industry – both underground [11, 12] and in open cast [13] mining, also it's an important element of the work safety [14, 15].

II. MATERIALS AND METHODS

The load itself, motors and brakes introduce forces and torques, all differing over time. Due to these variations the elements of the hoist are exposed to dynamic internal forces. An example is the torque in the gearing input shaft during a braking process out of hoisting of the load (Figure 1). Tremendous torque peaks occur, e.g. as result of the change

from hoisting to braking and the peak involved with this change of condition. EN 13001-2 proposes dynamic factor of up to $\phi_5=3,0$ for systems with significant clearance [16]. It would be of advantage to reduce or even to remove such loading peaks. Following conditions for minimum dynamic loading of hoist elements are shown.

This is a text with more detailed information to publication [17]. Definitions of the used qualities static load torque M_{st}^* , load factor LF, mass factor MF and braking factors BFHB and BFSB are introduced there.

Static load torque M_{st}^* :

$$M_{st}^* = \frac{m_{SWL} \cdot g \cdot r}{i_G \cdot i_S}$$

Load factor LF:

$$LF = \frac{m}{m_{SWL}}$$

Mass factor MF:

$$MF = \frac{\theta_1}{\theta^* + LF \cdot m^*}$$

Braking factor BFHB:

$$BF_{HB} = \frac{M_{HB}}{M_{st}^*}$$

Braking factor BFSB:

$$BF_{SB} = \frac{M_{SB}^*}{M_{st}^*}$$

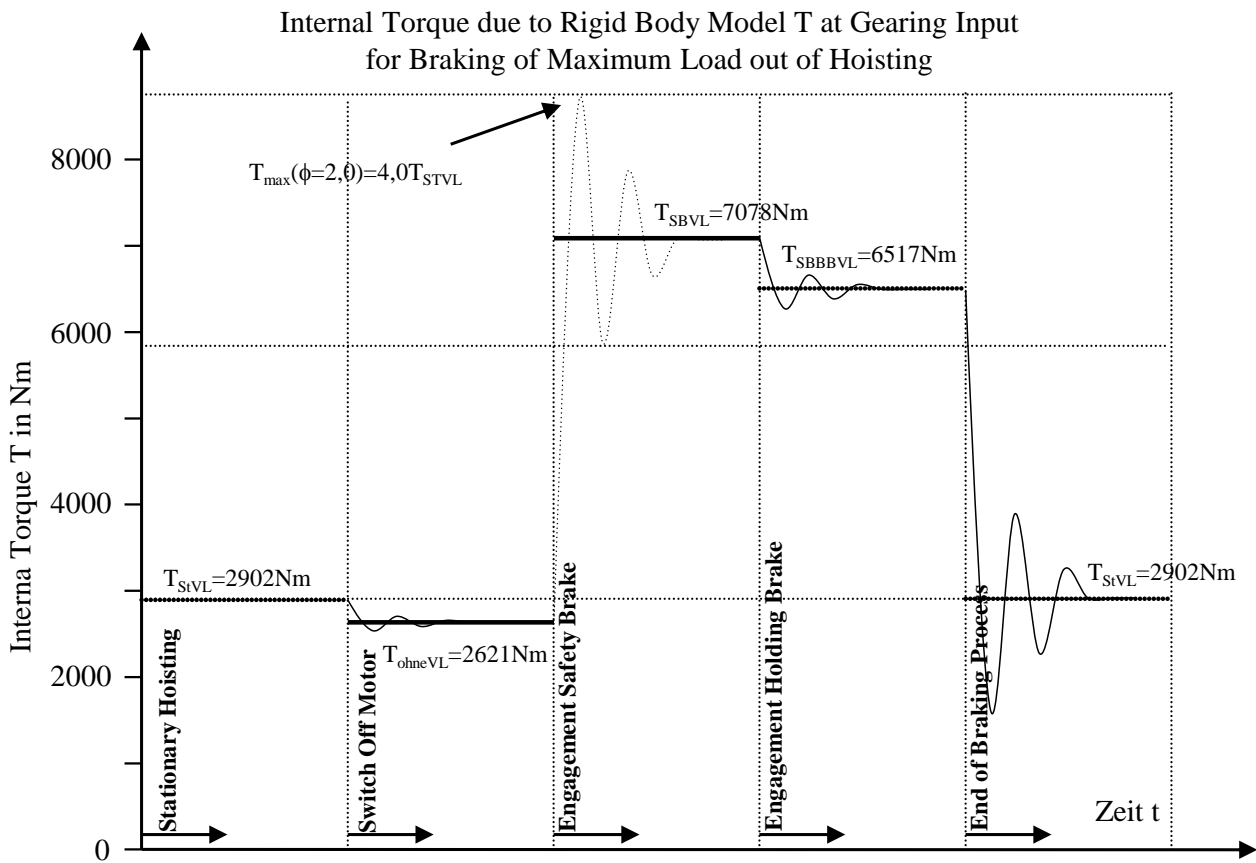


Figure 1: Dynamic torque in input shaft of gearing hoist during braking out of hoisting

Typical quantities are load factor $LF = 0.1 \dots 1.0$, mass factor $MF = 0.8 \dots 0.95$ and brake factor $BFSB = 1.7 \dots 2.2$.

III. DISCUSSION

For a closer look on the behaviour a loss-free, partly redundant hoist with safety brakes is considered (Figure 2).

Central element of the hoist is the gearing. The load is suspended by a load attachment device and a rope drive with

8/2 reeving. Both ropes are running onto a drum each, which are coupled with the gearing output shafts. On the board disc of each rope drum a safety brake is located. The hoist is driven by two motors which are connected to the gearing input shafts. On the motor shafts axis a service brake is located each.

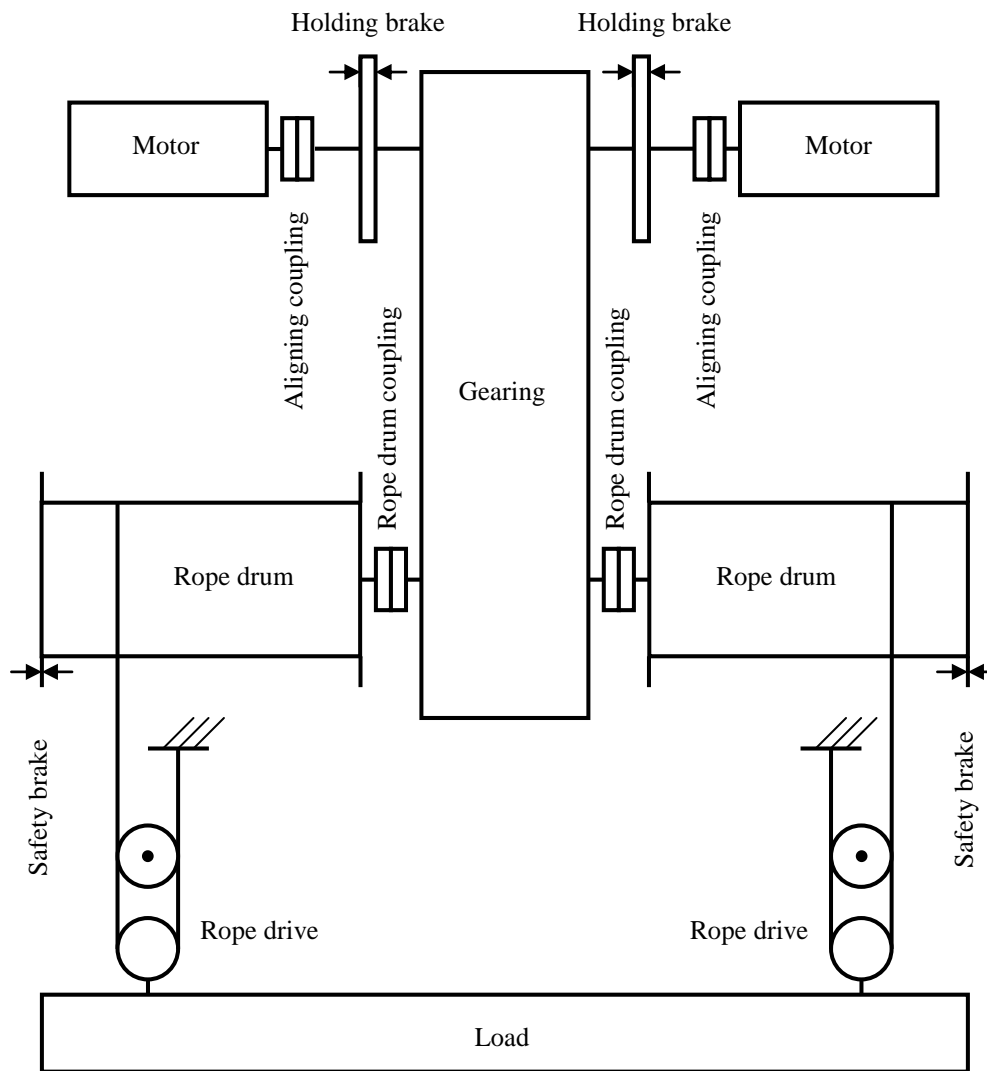


Figure 2: Reference system

The reference hoist is described by the following data:

Motor speed	$n_1 = 1500 \text{ min}^{-1}$
Hoisting speed	$v_H = 45 \text{ m/min}$
Mass, motor shaft	$\theta_1 = 20 \text{ kgm}^2$
Mass, rope drum shaft	$\theta_2 = 500 \text{ kgm}^2$
Mass, load attachment device	$m_{LAM} = 10 \text{ t}$
Mass SWL	$m_{SWL} = 52 \text{ t}$
Radius, rope drum	$r = 0.5 \text{ m}$
Gearing ratio	$i_G = 26.2$
Rope drive ratio	$i_S = 4$

Service brake torque	$MBB = 5.8 \text{ kNm}$
Dead time service brake	$ttotBB = 0.4 \text{ s}$
Safety brake torque	$MSB = 130 \text{ kNm}$
Dead time safety brake	$ttotSB = 0.1 \text{ s}$
Gearing stiffness	$c = 4 \times 10^4 \text{ Nm/rad}$
Clearance drum coupling	$s = 3^\circ$

The hoist with given data is regarded as a rigid mass model with definitions according to Figure 3. Three masses are defined: One rotating mass at each end of the gearing and a translational mass to model load plus load attachment device. Positive direction of movement is lifting. Braking torques are defined positive for positive movement, lifting.

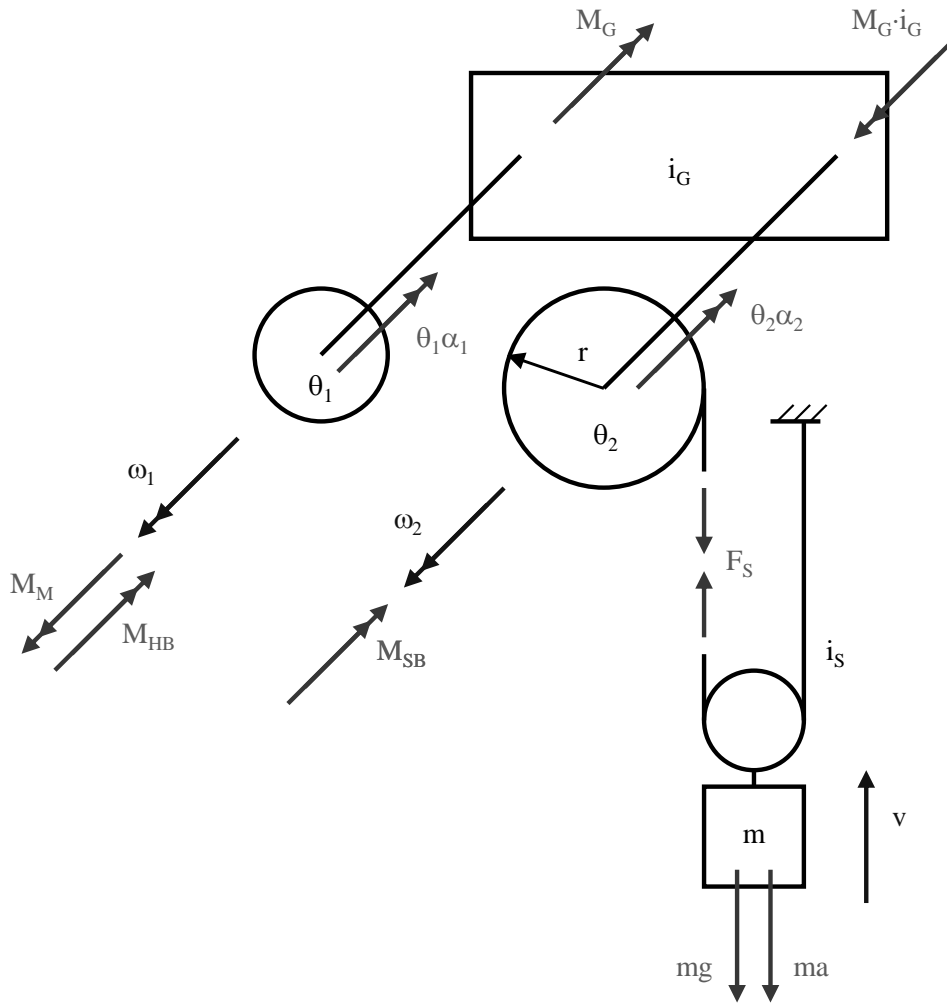


Figure 3: Rigid mass model

Basic for further considerations is the equation for the motor shaft acceleration:

$$\dot{\omega}_1 = \frac{M_M - M_{HB} - M_{SB}^* - LF \cdot M_{St}^*}{\theta_1 + \theta_2^* + LF \cdot m^*}$$

The torque in the gearing input shaft is determined by:

$$M_G = M_M - M_{HB} - \theta_1 \dot{\omega}_1$$

These formulae are valid for all conditions of the systems, either driven or braked down.

In case of braking in emergency cases with the safety brake the torque in the gearing input shaft will reach different levels, depending on given hoisting or lowering modus. Out of hoisting should generally be considered:

$$\frac{M_{Gmax}}{M_{st}^*} = \phi(MF(LF + BF_{SB}) - LF) + LF$$

With full load (load factor LF = 1.0) this will lead to

$$\frac{M_{Gmax}}{M_{st}^*} = \phi(MF(BF_{SB} + 1) - 1) + 1$$

With neglecting of dynamic effects (dynamic factor $\phi=1.0$) this reduces to

$$\frac{M_{Gmax}}{M_{st}^*} = MF(BF_{SB} + 1)$$

Equivalent equations for braking out of lowering are:

General:

$$\frac{M_{Gmax}}{M_{st}^*} = \phi(MF(LF - BF_{SB}) - LF) + LF$$

Load factor LF = 1.0:

$$\frac{M_{Gmax}}{M_{st}^*} = \phi(MF(1 - BF_{SB}) - 1) + 1$$

Dynamic factor $\phi = 1.0$:

$$\frac{M_{G_{max}}}{M_{st}^*} = MF (1 - BF_{SB})$$

Summarizing, the following general equation can be given:

$$\frac{M_{G_{max}}}{M_{st}^*} = \phi (MF (LF \mp BF_{SB}) - LF) + LF$$

+ Hoisting / - Lowering

Out of these relations high dynamic internal forces may occur. The height of the peaks depends on the base level, the target level and dynamic behaviour (Figure 4). The dynamic behaviour expressed by dynamic factor ϕ , probably, can not be changed to reduce such peaks. Therefore, conditions are examined to reach the same level for the base level (T_1 , T_2) and the target level (T_2 , T_1).

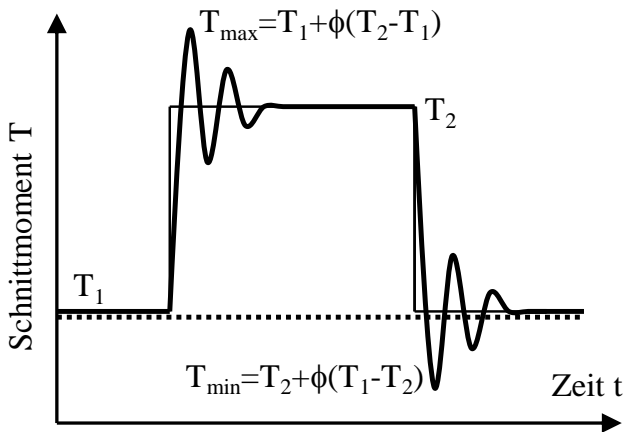


Figure 4: Dynamic loading on input shaft of gearing hoist during braking out of hoisting

The target of the research is to evaluate conditions to have no variation of shaft torque from the moment before braking to the moment just after beginning of braking. These conditions are to be evaluated under the assumption of synchronous activation of holding brake and safety brake.

For hoisting this leads to the following brake factors:

$$BF_{HB} = -LF - MF \frac{\theta_{ges}^*}{M_{st}^*} \cdot \frac{\Delta\omega}{\Delta t}$$

$$BF_{SB} = (MF - 1) \frac{\theta_{ges}^*}{M_{st}^*} \cdot \frac{\Delta\omega}{\Delta t}$$

Attention: $\Delta\omega$ negative for Braking out of Hoisting

For lowering the results are:

$$BF_{HB} = LF + MF \frac{\theta_{ges}^*}{M_{st}^*} \cdot \frac{\Delta\omega}{\Delta t}$$

$$BF_{SB} = (1 - MF) \frac{\theta_{ges}^*}{M_{st}^*} \cdot \frac{\Delta\omega}{\Delta t}$$

Attention: $\Delta\omega$ positive for Braking out of Lowering

Summarizing, the following equations for the brake factors can be given:

$$BF_{HB} = \mp \left(LF + MF \frac{\theta_{ges}^*}{M_{st}^*} \cdot \frac{\Delta\omega}{\Delta t} \right)$$

$$BF_{SB} = \mp (1 - MF) \frac{\theta_{ges}^*}{M_{st}^*} \cdot \frac{\Delta\omega}{\Delta t}$$

Attention: $\Delta\omega$ negative for Braking out of Hoisting, $\Delta\omega$ positive for Braking out of Lowering

The braking factors for the holding brake BF_{HB} , for the safety brake BF_{SB} and the sum of both $BF_{HB} + BF_{SB}$ are shown for hoisting in Figure 5 and for lowering in Figure 6.

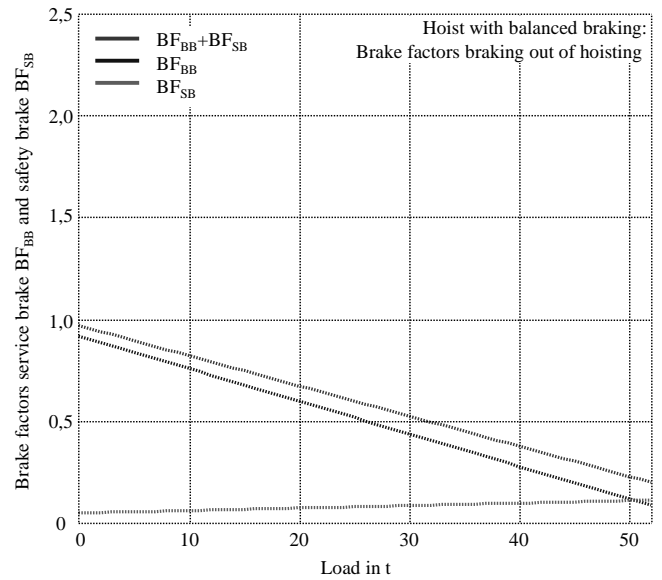


Figure 5: Braking factors for braking out of hoisting

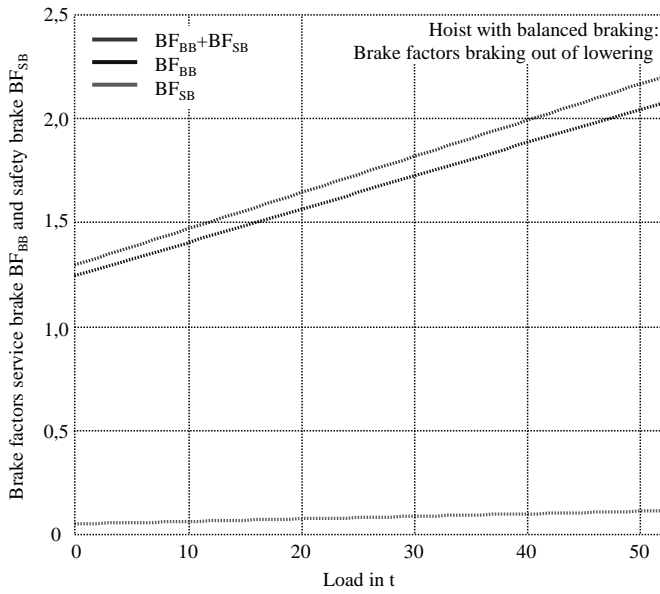


Figure 6: Braking factors for braking out of lowering

IV. RESULTS

To check the results, the internal torque for the gearing input shaft is considered for different load cases. Compared are the static load torque and the dynamic torque during braking.

Case 1: Hoisting, Dead load, Nominal Speed

$$LF = \frac{m}{m_{SWL}} = \frac{10t}{62t} = 0.161$$

$$M_G = 467.4Nm = 0.161M_{st}^*$$

Case 2: Hoisting, Maximum Load, Nominal Speed

$$LF = \frac{m}{m_{SWL}} = \frac{62t}{62t} = 1.0$$

$$M_G = 2902.1Nm = 1.0M_{st}^*$$

Case 3: Hoisting, Half Load, Nominal Speed

$$LF = \frac{m}{m_{SWL}} = \frac{31t}{62t} = 0.5$$

$$M_G = 1453.2Nm = 0.5M_{st}^*$$

Case 4: Lowering, Dead load, Nominal Speed

$$LF = \frac{m}{m_{SWL}} = \frac{10t}{62t} = 0.161$$

$$M_G = 472.2Nm = 0.163M_{st}^*$$

Case 5: Lowering, Maximum Load, Nominal Speed

$$LF = \frac{m}{m_{SWL}} = \frac{62t}{62t} = 1.0$$

$$M_G = 2889.7Nm = 1.0M_{st}^*$$

Case 6: Lowering, Half Load, Nominal Speed

$$LF = \frac{m}{m_{SWL}} = \frac{31t}{62t} = 0.5$$

$$M_G = 1442.8Nm = 0.5M_{st}^*$$

As shown, in all the cases the static load torque and the dynamic torque are equal. If the determined brake factors are applied, no dynamic loading of the gearing input as a result of braking shaft will occur any more. Certainly this insinuates a perfect braking system, which means a braking system with controllable braking torques at all brakes and a synchronous activation of all braking systems. Certainly synchronous activation should take place in a minimum of time [18].

V. CONCLUSION

Hoists are dynamic systems with a corresponding dynamic loading of the hoist elements. For safety oriented hoists with brakes on the axis of the motor shaft and on the axis of the rope drum can be shown, that these dynamic loadings can be removed by suitable braking. Synchronous braking with determined torques will prevent the gearing input shaft to be loaded dynamically by braking in theory.

Real systems will have deviations with regard to braking torques [19] and synchrony [20]. It is the task for further work to examine possible real system behavior [21, 22] and the gain remaining due to these variations.

REFERENCES

- [1] Tyulenev M, Zhironkin S., and Litvin O. The low-cost technology of quarry water purifying using the artificial filters of overburden rock. Pollution Research, 2015, vol. 34 (4): pp 825-830.
- [2] Zhironkin S.A. Governmental factoring development of TEK Kuzbass. Ugol', 2001, vol. 6, pp. 62.
- [3] Zhironkin S.A. Prospects and new possibilities investment attracting to Kuzbass coal mining industry. Ugol', 2002, vol. 6, pp. 31-36.
- [4] Zhironkin S.A. Factoring and leasing development at coal mining industry of Kuzbass as an important element of its financial part. Ugol', 2001, vol. 4, pp. 29-30.
- [5] Zhironkin S.A. About measures of vixel circulation development and vixelability definition of fuel-and-power complex' enterprises. Ugol', 2002, vol. 4, pp. 47-48.
- [6] Lesin Y.V., Lukyanova S.Y., and Tyulenev M.A. Mass transfer of dispersed particles in water filtration in macro-grained media. Journal of Mining Science, 2010, vol. 46(1), pp. 78-81.
- [7] Lesin Y.V., Luk'yanova S.Y., and Tyulenev M.A. Formation of the composition and properties of dumps on the open-pit mines of

- Kuzbass. IOP Conference Series: Materials Science and Engineering, 2015, vol. 91 (1), 012093.
- [8] Tyulenev M, Zhironkin S., Kolotov K., and Garina E.. Background of innovative platform for substitution of quarry water purifying technology. *Pollution Research*, 2016, 35(2), pp. 221-226.
- [9] RWTÜV. Schriftenreihe, Heft 8, Krane, Bemessung und Sicherheit. Dresden, 1981, 222 p.
- [10] Schmeink M. Dynamische Beanspruchung von Hubwerksgetrieben, Tagungsband 22. Internationale Kranfachtagung, Magdeburg, 2014, pp.211-215.
- [11] Khoreshok A. On side cutting bit when operating at sheerer drums. *Ugol'*, 2002, vol. 7, pp. 10-11.
- [12] Aksenov V.V., Khoreshok A.A., and Beglyakov V.Yu. Justification of creation of an external propulsor for multipurpose shield-type heading machine – GEO-WALKER. *Applied Mechanics and Materials*, 2013, vol. 379, pp. 20-23.
- [13] Tyulenev M.A., and Lesin Y.V. Justification complex purification technology open-pit mines wastewater. Taishan: Academic Forum – Project on Mine Disaster Prevention and Control, 2014, pp. 441-444.
- [14] Kovalev V., Gerike B., Khoreshok A., and Gerike P. Preventive Maintenance of Mining Equipment Based on Identification of Its Actual Technical State. Taishan Academic Forum – Project on Mine Disaster Prevention and Control, 2014, pp. 184-189.
- [15] Tyulenev M, Zhironkin S. and Litvin O. The low-cost technology of quarry water purifying using the artificial filters of overburden rock. *Pollution Research*, 2015, vol. 34 (4). pp. 825-830
- [16] DIN (Hrsg.). DIN EN 13001-2: Crane safety, General design, Part 2: Load actions, DIN Deutsches Institut für Normung e.V., Beuth Verlag, 2014, 34 p.
- [17] Vöth S., and Tyulenev M. Pod'emnye mashiny s tormozami bezopasnosti [Hoists with safety brakes]. *Vestnik Kuzbasskogo gosudarstvennogo tehnikeskogo universiteta*, 2016, vol. 1(113), pp. 88-97.
- [18] Römer R. Electrohydraulic lifting device and method for controlling said electrohydraulic lifting device, Patent WO 2014/005839 A1, 2013.
- [19] Römer R. Difference between dynamic and static coefficient of friction, *Port Technology International*, 56th Edition, Winter 2012, pp. 49-51.
- [20] Vöth S. Safety Systems for Container Cranes, 17th ITI Symposium, Dresden. 2014, pp. 144-151.
- [21] Melchers K., Kretschmann Yu., Goerke-Mallet P., Kleineberg K., and Tyulenev M. Elementy i aspekty post-ekspluatatsionnogo perioda gornyykh predpriyatij [Elements and aspects of post-operational period of mining enterprises]. *Vestnik Kuzbasskogo gosudarstvennogo tehnikeskogo universiteta*, 2015, vol. 6, pp. 3-13.
- [22] Prokopenko S.A. Multiple service life extension of mining and road machines' cutters. *Applied Mechanics and Materials*, 2014, vol. 682, pp. 319-323.



THE 8TH RUSSIAN-CHINESE SYMPOSIUM COAL IN THE 21ST CENTURY: MINING, PROCESSING AND SAFETY

10-12 OCTOBER, 2016
KEMEROVO, RUSSIA

The 8th Russian-Chinese Symposium

Coal in the 21st Century:

Mining, Processing and Safety

10-12 October, 2016
Kemerovo, Russia

**The conference was funded by RFBR according to the
research project n^o 16-05-20506**

Edited by:

Oleg V. Tailakov

Vice-Rector on Research and Strategic Development, KuzSTU

e-mail: tov@kuzstu.ru



**ATLANTIS
PRESS**

ATLANTIS PRESS

AMSTERDAM – PARIS – BEIJING

ISBN: 978-94-6252-232-9

This book is part of the series *Advances in Engineering Research* (Volume 92) (ISSN 2352-5401) published by Atlantis Press.

<http://www.atlantis-press.com/publications/proceedings/aer/>

The proceedings series *Advances in Engineering Research* (AER) aims at publishing proceedings from conferences on the theories and methods in fields of engineering applied to multiple areas, including:

- aerospace engineering
- biological engineering
- civil engineering
- chemical engineering
- electrical engineering
- financial engineering
- industrial engineering
- material engineering
- mechanical engineering
- nanotechnology
- petroleum engineering
- textile engineering

Publishing information

The series aims at publishing original proceedings from international conferences. With a fast turnaround time and free access on the Internet, the proceedings in this series provide an excellent means for conferences and their participants to quickly publish their articles to the widest possible audience.

The series as a whole has as an ISSN-number where each individual volume of proceedings will have its own ISBN-number.

© ATLANTIS PRESS, 2016

www.atlantis-press.com

ISBN: 978-94-6252-232-9

This book is published by Atlantis Press, scientific publishing, Paris, France.

All rights reserved. No part of this book may be reproduced, translated, stored or transmitted in any form or by any means, including electronic, mechanical, photocopying, recording or otherwise, without prior permission from the publisher.

The 8th Russian-Chinese Symposium

Coal in the 21st Century: Mining, Processing and Safety

Organizers

- T.F. Gorbachev Kuzbass State Technical University, Russia
- Shandong University of Science and Technology, China

Programme Committees

Honorary Co-Chairs

- Vladimir A. Kovalev, T.F. Gorbachev Kuzbass State Technical University, Russia
- Ren Tingqi, Shandong University of Science and Technology, China

Members

- Aleksei E. Kontorovitch, Federal Coal and Coal Chemistry Research Centre SB RAS, Russia
- Vladimir I. Klishin, Coal Institute of the Federal Coal and Coal Chemistry Research Centre SB RAS, Russia
- Zinfer R. Ismagilov, Federal Coal and Coal Chemistry Research Centre SB RAS, Russia
- Valeriy N. Kochetkov, Federal Coal and Coal Chemistry Research Centre SB RAS, Russia
- Yury N. Malyshev, V.I. Vernadsky State Geological Museum RAS, Russia
- Anton V. Selinin, Kuzbass Technopark, Russia
- Valeriy N. Zakharov, Research Institute of Comprehensive Exploitation of Mineral Resources RAS (IPKON RAS), Russia
- Oleg V. Tailakov, T.F. Gorbachev Kuzbass State Technical University, Russia
- Alexander I. Kopitov, T.F. Gorbachev Kuzbass State Technical University, Russia
- Evgeniy P. Yutyaev, SUEK-Kuzbass, Russia
- Yunliang Tan, Shandong University of Science and Technology, China
- Weijia Guo, Shandong University of Science and Technology, China
- Zhe Wei-ming, Shandong University of Science and Technology, China
- Weiguo Qiao, Shandong University of Science and Technology, China
- Zhou Shixue, Shandong University of Science and Technology, China

Organizing Committee

Chairman

- Oleg A. Ostanin, T.F. Gorbachev Kuzbass State Technical University, Russia

Members

- Aleksey A. Khoreshok, T.F. Gorbachev Kuzbass State Technical University, Russia
- Vladimir I. Udovitskyi, T.F. Gorbachev Kuzbass State Technical University, Russia
- Vladimir V. Pershin, T.F. Gorbachev Kuzbass State Technical University, Russia
- Oleg I. Litvin, T.F. Gorbachev Kuzbass State Technical University, Russia
- Tatiana V. Mikhailova, T.F. Gorbachev Kuzbass State Technical University, Russia
- Svetlana I. Grigashkina, T.F. Gorbachev Kuzbass State Technical University, Russia
- Georgy M. Dubov, T.F. Gorbachev Kuzbass State Technical University, Russia
- Andrey V. Zykov, T.F. Gorbachev Kuzbass State Technical University, Russia
- Anna A. Kvasova, T.F. Gorbachev Kuzbass State Technical University, Russia

Foreword

The 8th Russian-Chinese Symposium “Coal in the 21st Century: Mining, Processing and Safety” was organized jointly by T.F. Gorbachev Kuzbass State Technical University (Russia) and Shandong University of Science and Technology (China), which have had a long-term partnership of 25 years. The event was designed to promote the development of the Russian-Chinese scientific and technical cooperation in the field of mining including high-technology coal mining and deep coal processing, reduction of anthropogenic impact on the environment, production and operation of modern equipment, means and methods of industrial safety in the coal industry, as well as modern technologies of construction and modernization of the coal industry operations.

The symposium brought together the leading Russian and Chinese scientists working in the field of coal, heads of coal-mining companies, industrial safety professionals, managers and specialists of the government. The Symposium participants expanded their scientific and business contacts in the field of mining and defined new promising areas of research and engineering research aimed at the development of the coal industry.

We are confident that the 8th Russian-Chinese Symposium “Coal in the 21st century: Mining, Processing, Safety” will contribute to a new quality of relations between the scientists of Russia and China in the field of the mining science for the benefit of the two countries. We sincerely thank the local and foreign scholars who provided their support to the Symposium and all the authors who submitted their papers for publication.

Vladimir A. Kovalev

Rector, KuzSTU

Oleg V. Tailakov

Vice-Rector on Research and Strategic Development, KuzSTU

Table of Contents

Foreword	v
----------------	---

Section 1. Advanced technologies in construction and upgrading of coal mining enterprises

Resource approach to the estimation of international cooperation in integrated development of calciphyre deposits <i>Kamkicheva Olga, Voznaya Anna, Mikhailova Tatyana, Gribanova Galya</i>	1
Research on secondary support time of soft rock roadway <i>Duohua Wu, Weiguo Qiao, Weijie Song, Pershin Vladimir</i>	5
Roadway support optimization by improved BP neural network and numerical simulation <i>Jun Wang, Yunliang Tan</i>	11
The prediction of distribution characteristics of the in-situ stress for Liuhuanggou mine field <i>Shi Yongkui, Ding Yonglu, Wang Xiaomeng, Xu Mingwei</i>	17
Research on development law of overburden rock fracture in steeply inclined and very thick coal seam mining <i>Weimin Cheng, Lulu Sun</i>	21
The improved construction of reinforced-concrete support of slope mouth <i>Pershin Vladimir, Vojtov Michail, Budnikov Pavel</i>	27
“Lean production” in the coal mining industry <i>Mikhalchenko Vadim, Rubanik Yuri, Osokina Natalia, Mikhalchenko Anna</i>	33
Lean governance as a condition for the creation of intellectual coal industry <i>Zaruba Natalyi, Egorova Natalyi</i>	39
A new method for studying the roadway stability <i>Zhongcheng Qin, Shengchao Wang, Xin Yu, Bin Cao</i>	45
Application of SCADA systems in the coal mining industry <i>Samorodova Lyudmila, Lyubimov Oleg, Yakunina Yulia</i>	50
Justification of requirements for crushed rock for open-pit automobile road topping <i>Shabaev Sergey, Boyko Dmitriy</i>	55
The research in the use of monolithic concrete for the mine construction <i>Gilyazidinova Natalia, Rudkovskaya Nadezhda, Santalova Tatiana</i>	62
Filling of the vertical mine workings with the autoclave slag-concrete <i>Uglyanitsa Andrey, Solonin Kirill</i>	66

Prestressing method of rigid joints in multi-storey steel frame mining <i>Vershinin Dmitry, Dobrachev Valery</i>	72
Dynamic models of deformation of crustal blocks in the area of development of coal deposits - the basis of the information security of their development <i>Solovitskiy Aleksandr</i>	80
Rock destruction with volumetric compression <i>Gogolin Vyacheslav</i>	86
Considering behind limit deformation for calculation of coal pillars parameters by finite element method <i>Ermakova Inna, Pirieva Natalya</i>	90

Section 2. Increasing open-pit and underground coal mining efficiency

Evaluation model for the level of development of work organization system in coal mines <i>Koroleyva Tatiana, Grigashkina Svetlana</i>	95
The necessity and ways to develop the methodology of management decision making support for innovative development of mining regions in Russia <i>Lazarenko Sergey, Dubov Georgiy, Zykov Andrei, Shirokolobova Anastasia</i>	100
Methods and schemes of opening-up the quarry fields at various bedding conditions of deposits <i>Kolesnikov Valery</i>	104
The improvement of the Bunton construction of mine-shaft equipment <i>Kopytov Aleksandr, Pershin Vladimir, Voitov Michail, Wetti Ahmed</i>	108
Adaptive technology of using backhoes for full coal extraction <i>Tyulenev Maxim, Khoreshok Alexey, Garina Ekaterina, Danilov Sergey, Zhironkin Sergey</i>	111
Influence of service conditions of quarry dump trucks on the thermal state large-size tires <i>Kulpin Aleksanadr, Stenin Dmitriy, Kultayev Evgeniy, Kulpina Evdokya, Borovtsov Valeriy</i>	116
The evaluation of production safety of coal-mining region <i>Kudrevatykh Natalya, Sheveleva Oksana</i>	120
Social technologies for management: opportunities for coal-mining enterprises <i>Zonova Olga, Nekhoda Evgeniya, Slesarenko Ekaterina</i>	125
Organization and assessment of efficiency of intra corporate control in the large coal mining company <i>Kucherova Elena, Tyuleneva Tatyana, Cherepanova Natalya</i>	130
Research on impact characteristics of inclined coal-rock composite body <i>Yunliang Tan, Yubao Zhang</i>	135
Clustering and emergent features of the regional economics of the Kemerovo Region <i>Bereznev Sergey, Kumaneeva Maria, Makin Maksim</i>	139

Justification of efficiency of heavy dump trucks effectiveness in open pit mines according to operating life criterion of the back axle <i>Panachev Ivan, Shirokolobov Georgiy, Kuznetsov Ilya, Shirokolobova Anastasia</i>	144
Using innovative technologies of 3D modeling for advanced planning of reclamation results <i>Aksenova Olesya, Pachkina Anna</i>	149
Influences on pressure releasing by blasting breaking hard roof <i>Wei Zhang, Yunliang Tan, Weiyao Guo, Shitan Gu, Dianrui Mu, Shanchao Hu</i>	153
Study on the distribution law of front abutment pressure of long fully-mechanized working face in deep mine <i>Yuguo Ji, Xianjun Wang, Yongpei Zhou, Xiantang Zhang</i>	159
Simulation and field measurement study on roof strata behavior of fully mechanized caving face <i>Weitao Liu, Wencheng Song, Jianning Wang</i>	163
Displacement back analysis based on GA-BP and PSO-BP neural network <i>Dongdong Gu, Yunliang Tan</i>	169

Section 3. Industrial safety in coal industry

Electrophysical monitoring of the processes of electroosmotic treatment of soil from oil pollution on laboratory installations <i>Shabanov Evgeniy, Prostov Sergey</i>	175
Debit gas in well as a comprehensive indicator of gas permeability of the coal seam <i>Shevchenko Leonid</i>	184
Analytical prediction of stability of earthfill dam <i>Bakhaeva Svetlana, Guriev Dmitriy</i>	188
Technical audit of external power supply networks of coal mines in the Kemerovo Region <i>Zakharov Sergei, Voronin Vyacheslav</i>	193
Impact assessment of mining and geological factors of Kuzbass coal mines on the level of their power consumption <i>Zakharova Alla, Lobur Irina, Shauleva Nadezda, Borovtsov Valeriy</i>	198
Determination of seismic safe distances during mining blasts with consideration of a dominant vibration frequency <i>Novinkov Aleksey, Tashkinov Aleksandr, Protasov Sergey</i>	202
Modeling of geomechanical processes case of uneven settling of foundations constructions <i>Sokolov Mikhail, Prostov Sergey</i>	206
Stabilization control techniques for a roadway in deep high-stress soft surrounding rock <i>Hu Jin-tan, Lin Deng-ge, Zhao Ru-mei</i>	213

Research on simulation and field measurement technology of floor mining failure depth <i>Wencheng Song, Chunbo Zhao, Guang Li, Donghui Wang</i>	220
--	-----

Section 4. Coal mining equipment. Production and operation

Enhancement of efficiency of the magnetic suspension of belt conveyor <i>Zacharov Aleksandr, Chepikov Pavel</i>	229
The power characteristics of the reversible radial crowns with disk tools for roadheaders of selective action <i>Mametyev Leonid, Khoreshok Alexey, Tsekhin Aleksandr, Mukhortikov Sergey, Borisov Andrey</i>	233
Conditions for minimum dynamic loading of multi-brake hoists <i>Khoreshok Alexey, Tyulenev Maxim, Vöth Stefan</i>	239
Evaluation of the technical condition of auger equipment units by vibration inspections <i>Mametyev Leonid, Drozdenko Yuriy, Lyubimov Oleg</i>	246
The diagnostics of motor-wheel gears of quarry dump trucks based on bearing wear monitoring <i>Kudrevatykh Andrey</i>	252
Evaluation of the open pit vehicles loading influence on the reliability of motor – wheel reducers <i>Stenin Dmitriy, Stenina Natalia, Bakanov Alexander</i>	256
Reducing dynamic loads of mining machinery electric drive at starting <i>Eshchin Evgeniy, Sokolov Igor</i>	260
Calculation and justification parameters of strengthening technology to produce drill rig shaft gear on the basis of mechanics of technological inheritance <i>Blumenstein Valeriy, Ferranti Alina</i>	265
Computer system for electric drives fault diagnosis of mining shovels <i>Kashirskikh Veniamin, Gargayev Andrey, Zavyalov Valeriy, Semykina Irina</i>	274
Research on the support technology of bolt and cable in deep high stress roadway <i>Weijie Song, Weiguo Qiao, Pershin Vladimir, Duohua Wu, Yanzhi Li</i>	280

Section 5. Deep coal processing. Coal chemistry. Gasification. Ecology

The role of innovative technologies in solving Kuzbass coal industry geo-ecological problems <i>Kovalev Vladymir, Khoreshok Alexey, Litvin Oleg</i>	287
Regarding one estimation of the technical condition of the selective headers <i>Kovalev Vladymir, Khoreshok Alexey, Gerike Boris, Meshkov Anatoliy</i>	291
Study of sulfur oxide reduction during combustion of coal-water slurry <i>Murko Vasiliy, Karpenok Viktor, Senchurova Yuliy, Tailakov Oleg, Khyamyalyainen Veniamin</i>	297

Cleaning the flue gases of thermal coal power plants from sulfur and nitrogen oxides <i>Shilyaev Mihail, Bogomolov Alexandr, Dvorovento Igor, Sysolyatin Andrey, Kryukov Sergey, Chemakin Maksim</i>	301
Investigation of the sorption properties of ore materials for the removal of sulfur dioxide from exhaust flue gases of power plants <i>Shikina Nadezhda, Teryaeva Tatyana, Ismagilov Zinifer, Khairulin S.R., Kuznetsov Vladimir, Rudina N.A.</i> ...	306
The development of gas energy potential of coal deposits as the necessary step towards the Russian coal industry modernization <i>Lazarenko Sergey, Dubov Georgiy, Shirokolobova Anastasia</i>	312
Catalysts for nitrogen oxides removal from flue gases <i>Shikina Nadezhda, Tailakov Oleg, Ismagilov Zinifer</i>	318
Justification of a method for determination of gas content in coal seams to assess degasification efficiency <i>Tailakov Oleg, Kormin Alexey, Zastrelov Denis, Utkaev Evgeniy, Sokolov Sergey</i>	324
Research in the propping agent for the hydraulic fracturing cracks for the methane extraction from the massive coal seams <i>Baev Mikhail, Khyamyalyaynen Veniamin</i>	330
Methodological bases of advanced geo-ecological problems resolving in neo-industrial clusters <i>Tyulenev Maxim, Lesin Yury, Vik Svetlana, Zhironkin Sergey</i>	333
Evaluation of the coking capacity indicator of coking coal concentrates based on the research of non-volatile residue strength via determination of the coking chemical products yield <i>Vasileva Elena, Cherkasova Tatyana, Subbotin Sergey, Nevedrov Aleksandr, Papin Andrey, Kolmakov Nikolay</i>	337
Dependence of the yield of chemical coking products from coal concentrates on their nature <i>Vasileva Elena, Cherkasova Tatyana, Subbotin Sergey, Nevedrov Aleksandr, Papin Andrey, Kolmakov Nikolay</i>	342
Coal waste as raw material for production of rare and trace elements <i>Cherkasova Tatiana, Cherkasova Yelizaveta, Tikhomirova Anastasia, Bobrovnikova Alyona, Papin Andrey, Nevedrov Aleksandr</i>	347
Operational reliability of corrosion protection of structures in industrialized region <i>Cherkasova Yelizaveta, Zolotuhina Natalia, Goryunova Irina, Bulanova Tatyana, Chenskaya Valentina</i>	350
Producing mesitylene by dehydrotreatment of C ₉ -aromatics distilled from coal pyrolysis products <i>Petrov Ivan, Tryasunov Boris</i>	353
Mechanochemical capture of carbon disulfide by magnesium-carbon composite <i>Bogu Liu, Qianqian Zhang, Pei Liu, Haipeng Chen, Hao Yu, Shixue Zhou</i>	361
Estimation of gross regional product losses due to the influence of environmental factors (in the context of an industrial region) <i>Petr Kosinskiy Petr, Vladimir Merkur'yev, A.V. Medvedev</i>	366

Environmental safety management of a coal mining enterprise <i>Golofastova Natalya, Mikhailov Vladimir, Galanina Tatiana</i>	372
Transformation of the ecological-economic system of the coal mining region <i>Mikhailov Vladimir, Golofastova Natalya, Seredyuk Ilya</i>	377
Effect of binder on chemically bonded fly ash aggregate based on Kuzbass coal combustion products <i>Alexander Zhikharev, Aleksey Kargin, Andrey Uglanica</i>	383
Numerical simulation of gas flow based on three-dimensional reconstruction using computed tomography <i>Xiangyu Chu, Gang Wang</i>	386
Sulfur transfer characteristics and pyrolysis simulation in the coal polygeneration process <i>Yaqing Zhang, Jialong Zhu, Peng Liang</i>	393