Міністерство освіти і науки України

Національний університет

“Львівська політехніка”

ЗБІРНИК

НАУКОВИХ ПРАЦЬ

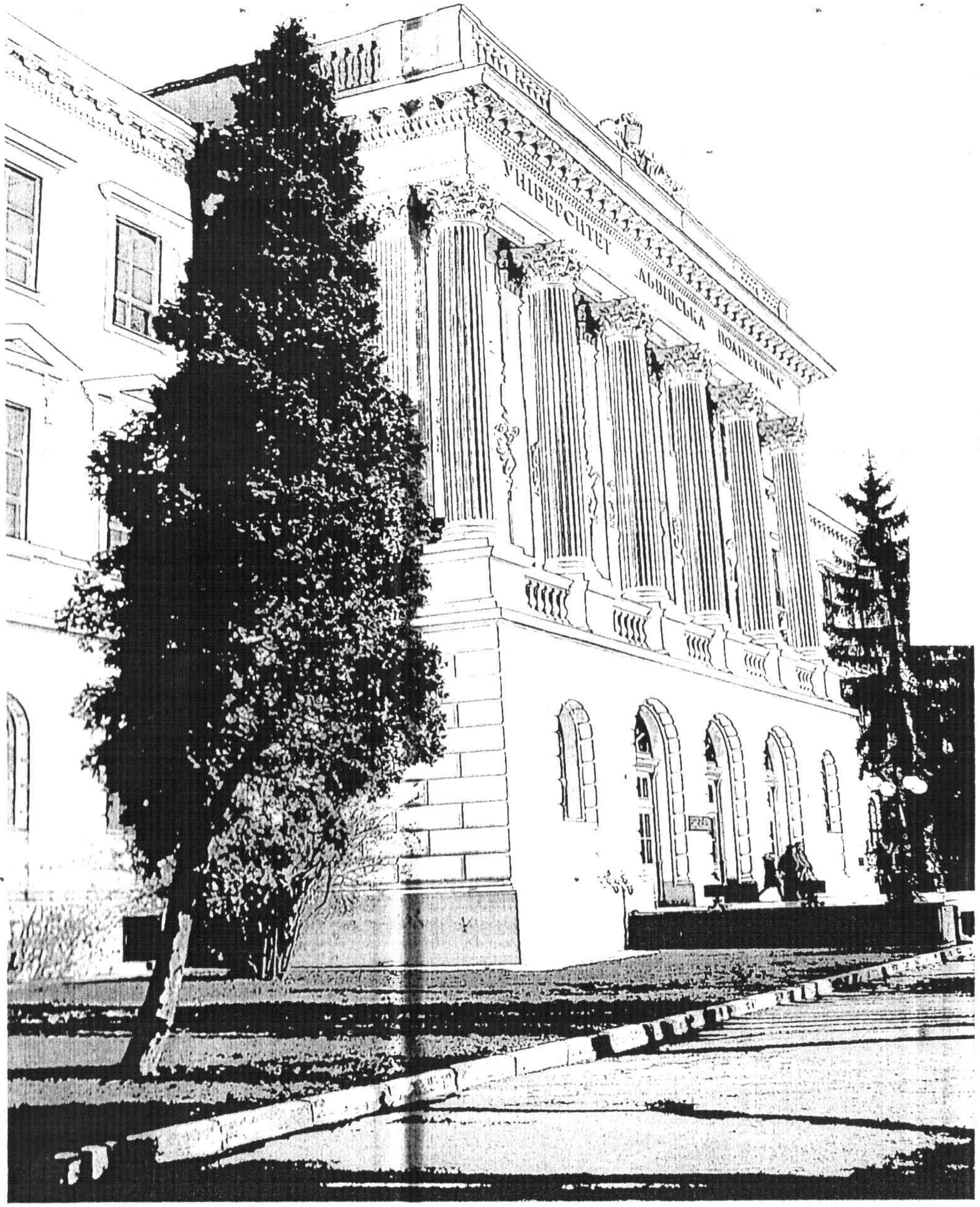
VII-ої Міжнародної

науково-технічної конференції

“Прогресивні технології в машинобудуванні”

5 - 9 лютого

2018



Національний університет "Львівська політехніка" вітає учасників VII-ої Міжнародної науково-технічної конференції "Прогресивні технології в машинобудуванні"

Institute of Engineering Mechanics and Transport

CONFERENCE PROCEEDINGS

VII INTERNATIONAL SCIENTIFIC CONFERENCE

"ADVANCED TECHNOLOGIES IN MECHANICAL ENGINEERING"

5-9 February 2018
Lviv-Zveniv (Carpathians)

ЗМІСТ

1. JAVAMACH CLUSTER - SYNERGETICS OF INFROMATIC, QUASIMATERIAL AND ENERGY FLOWS IN INDUSTRY 4.0
Dobrotvorskiy S.S, ***Doctor of Technical Sciences, Professor,***
Sokol E.I, ***Doctor of Technical Sciences, Professor,***
Permyakov A.A. ***Doctor of technical sciences, professor,***
Gnuchikh S.S, ***post-graduate student***
The National Technical University "Kharkiv Polytechnic Institute" 14

2. PNEUMATIC TRANSPORTATION SYSTEMS OF SHEET MATERIAL
Ivanko Andrii, ***Ph.D. Associate Professor,***
MarchenkoOleksandr ***graduate student***
Igor Sikorsky Kyiv Polytechnic Institute, Kyiv, Ukraine 15

3. GRINDING SYSTEM MODELLING AND SIMULATION
[1]**Lishchenko N.V.**, ***PhD, associate professor,***
[2]**Larshin V.P.**, ***Doctor of Science, professor***
[1]*Odessa National Academy of Food Technologies*
[2]*Odessa National Polytechnic University* 17

4. MANUFACTURING TECHNOLOGY AND PROPERTIES WEARFIRMNESS TERMITE CAST IRON
[1]**Zhyhuts Yy.Yy**, ***prof.,*** [2]**Lazar V.F.**, ***as. prof.,*** [2]**Hom'ak B.Ya.**, ***as. prof.***
[1]*Uzhhorod National University*
[2]*Mukachevo State University* 20

5. ВПЛИВ ВЕЛИЧИНИ ТЕХНОЛОГІЧНОГО ЗАЗОРУ ЗАМКОВОЇ НАРІЗІ НА ШВИДКІСТЬ ПОТОКУ БУРОВОГО РОЗЧИНУ У ЇЇ ГВИНТОВОМУ З'ЄДНАННІ
Борущак Л.О., ***к.т.н., доцент,*** **Онисько О.Р.**, ***к.т.н., доцент***
Івано-Франківський національний технічний університет нафти і газу 24

6. КОМП'ЮТЕРНО -ІНТЕГРОВАНА СИСТЕМА ЗАБЕЗПЕЧЕННЯ ФОРМОУТВОРЕННЯ ЗУБЧАСТИХ КОЛІС
Воронцов Б.С., ***к.т.н., доцент,*** **Пасічник В.А.**, ***д.т.н., професор***
Національний технічний університет України «Київський політехнічний інститут імені Ігоря Сікорського» 27

7. МОДЕЛЮВАННЯ ДИНАМІЧНИХ ПРОЦЕСІВ ТРАНСПОРТУЮЧИХ КАНАТНИХ СИСТЕМ ДЛЯ ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ ТЕХНОЛОГІЧНИХ ОПЕРАЦІЙ
Гелетій В. М., ***к.т.н,*** **Новіцький Я.М.** ***к.т.н, доцент,***
Кий А.В., ***асистент***
*Національний університет «Львівська політехніка» *Національний лісотехнічний університет України.* 30

8. КОНЦЕПЦІЯ ЗУБОФРЕЗЕРНОГО ВЕРСТАТУ ДЛЯ НАРІЗАННЯ І ЧИСТОВОГО ОБРОБЛЕННЯ ВЕЛИМКОМОДУЛЬНИХ ЗУБЧАСТИХ КОЛІС
Грицай І.Є., ***д.т.н, проф.,*** **Кук А.М.**, ***к.т.н., доц.***
Національний університет «Львівська політехніка» 31

9. МОДЕЛЮВАННЯ ПАРАМЕТРІВ, ЯКІ ВИЗНАЧАЮТЬ ЕКСПЛУАТАЦІЙНІ ВЛАСТИВОСТІ ЗУБЧАСТИХ ПЕРЕДАЧ З АСИМЕТРИЧНИМИ ПРОФІЛЯМИ ЗУБЦІВ
Грицай І.Є., ***д.т.н., проф.,*** **Волошин В.Д.**, ***магістр***
Національний університет «Львівська політехніка» 35

10. ЗМІНА ВМІСТУ ХІМІЧНИХ ЕЛЕМЕНТІВ У ПОВЕРХНЕВОМУ ШАРІ ПІД ЧАС ФРИКЦІЙНОГО ЗМІЦНЕННЯ ДЕТАЛЕЙ МАШИН
Гурей І.В., ***д.т.н., професор,*** **Гурей Т.А.**, ***к.т.н., доцент,***
Гурей В.І., ***к.т.н.***
Національний університет «Львівська політехніка» 38

11. ПОЛІПШЕННЯ ЯКОСТІ ПОВЕРХНЕВОГО ШАРУ СТАЛІ 30ХГСА КОМБІНОВАНОЮ ЛАЗЕРНО-ДЕФОРМАЦІЙНОЮ ОБРОБКОЮ
Данилейко О.О. ***аспір.,*** **Джемелінський В.В.** ***к.т.н., проф.,***
Лесик Д.А. ***к.т.н., асис.***
Національний технічний університет України «Київський політехнічний інститут ім. Ігоря Сікорського» 41

12. ПОРІВНЯЛЬНИЙ АНАЛІЗ МЕТОДІВ АЗОТУВАННЯ ЗУБЧАТИХ КОЛІС
[1]**Долгов М.А.**, ***д.т.н, доцент,*** [2]**Заїчко К.В.**,
[3]**Смирнов І.В.**, ***д.т.н, професор***
[1]*Інститут проблем міцності імені Г.С.Писаренка НАН України*
[2]*Державний науково-дослідний інститут МВС України*
[3]*Національний технічний університет України «Київський політехнічний інститут імені Ігоря Сікорського»* 44

ones. Because of its complexity and significance, the model based identification approach involves understanding the process model (don't confuse with the grinding system model). In this connection the methods for process modelling are of great impotence as they are in decision making.

Methods for process modelling discussed further. Besides the model definition mentioned above another term to explain 'model' may be as follows: a model is the abstract representation of a manufacturing process which serves to link causes and effects [2]. That is why the description of the correlation of different quantities of a real system to correspond to a modeled system is the dominant task of process models. In grinding, the dependences of settings on process quantities such as grinding forces *F*, temperature *T*, and acoustic emission *AE* as well as on output quantities such as surface roughness and surface integrity (surface layer quality like grinding burns and residual stresses) may be mapped too on the basis of F. Klocke' representation [3]. Taking into account this representation, a model of technological grinding system can be represented as follows (Fig. 2). The model consists of the following state parameters: Q'_w, V'_w, F, T, AE, where Q'_w is the specific material removal rate in $mm^3/(s \cdot mm)$, V'_w is the specific material removal in mm^3/mm.

References

1. *Freeman Herbert. Discrete-time systems: an introduction to the theory / Herbert Freeman. – New York: J. Wiley, 1965. – 241 p.*
2. *Tönshoff, H.K. Process monitoring in grinding / H.K. Tönshoff, T. Friemuth, J.C. Becker. – CIRP Annals – Manufacturing Technology. – Volume 51, Issue 2. – 2002. – P. 551-571.*
3. *Klocke Fritz. Manufacturing Processes 2: Grinding, Honing, Lapping / Fritz Klocke. – Berlin: Springer, 2009. – 433 c.*

MANUFACTURING TECHNOLOGY AND PROPERTIES WEARFIRMNESS TERMITE CAST IRON

[1]**Zhyhuts Yy.Yy, *prof.*, [2]Lazar V.F., *as. prof.*, [2]Hom'ak B.Ya., *as. prof.***

[1]*Uzhhorod National University*

[2]*Mukachevo State University*

Introduction. That is why the synthesis of materials on the basis of metallothermic processes as well as the investigation of the influence of new technological methods of getting metal on microstructure, chemical composition, mechanical properties of manufactured castings got great practical importance. Metallothermic reactions further and further become of great appliance in science and technology. Under the lack of energetic and raw basis, of special melting and cast equipment such technological processes of creating the materials become economically expedient, and their usage in already existed methods of casting production e. g. in technique of producing steel and cast iron castings with termite addition greatly rises the efficiency of production. Creating of the alloys on the basis of combined (metallothermic+SHS) processes allows getting materials with new technological properties the study of which has both scientific and practical importance.

2. The methods of experiment. While organizing the process of synthesis of steels and cast irons classic [1] termite reactions based on oxidation of aluminium and renovation of iron.

The task was to work up the method of calculating of burden composition on the basis of stoichiometric relationship of reaction components with the introduction of suitable coefficients taking into account the component activity and the coefficients of its adoption by metal. The method allows to establish the composition of metallothermic burdens and to calculate adiabatic temperature of its combustion. The main condition of the process is the necessity to have real temperature of burden combustion higher than the temperature of slag melting [2, 3] (for Al_2O_3 2400 K). The main structure components in termite cast irons that influence greatly the wear resistance are the carbides Cr, W, Mo, Ti and others. Wear resistance of synthesized cast irons under abrasive wear resistance depends on microhardness, form, replacement and quantity of structural components.

3. The directions of studies. Synthesized termite wear resistant cast irons in analogy with the cast irons dot by ordinary methods, can be divided into the following groups: grey, white, including non-alloyed, low-alloyed, nickel-chromium-plated, martensite and high chromium-plated.

Grey special thermite cast irons. It is the most convenient to get grey cast irons by metallotermic or combined (metalloterming+SHS) methods because of the high temperature within the zone of reacting of the components that leads under synthesis of alloys in conditions of micromelting to fast cooling and that in its turn gives the speeds of cooling higher than the critical ones and simultaneously martensite or needle-shape microstructure. These are the structures that are of the highest wear resistance. The burden composition for synthesis, chemical composition and components of the burden for getting wear resistant termite cast iron are shown in table 1. Within cast irons 1, 2 martensite is formed just during metallothermic melting without certain termomanufacturing which is furthermore connected with replacement of critical point regarding alloying of Ni.

Table 1.

Chemical composition of the burden for synthesis of grey termite cast iron

№	Electrode powder, per cent	Ferrosilicium (ФС 75)	Ferro-manganese (ФМн 75)	Ni powder	Ferrochrome	Ferroalu-minium termite
1	4,0–4,2	1,6–2,0	1,3–1,6	4,2–4,8	0,4–1,1 FeCr	The rest
2	4,0–4,2	3,3–3,8	1,0–1,5	4,0–4,5	0,7–1,4 FeCr	The rest
3	4,0–4,2	1,6–2,0	3,8–4,3	4,8–5,3	0,9–1,6 FeCr	The rest
4	4,0–4,2	1,6–6,0	4,0–4,3	5,5–6,1	–	The rest
5	4,0–4,2	2,0–2,7	4,3–5,1	5,5–6,0	0,7–1,4 FeMo	The rest

Cast irons contain great amount of austenite but after tempering we get th structure of martensite of tempering with hardness being 280-310 HB. In fact, it give the possibility for termite micromelting to decrease greatly the content of alloye elements (Mn and Mo) not making tempering cracks while doing this.

Wear resistance of manufactured cast irons may be compared using table 2. Ca iron manufactured by termite method may to some extend be classified as a grey iro not lower than «СЧ 30», and after tempering in cast irons 4 and 5, the limit of tensio strength has been established at the level not less than 500 MPa.

Table 2

Wear resistance of special cast irons

№	Termite material	Conditional value of resistance
1	Carbon steel (analogue of steel «У8»)	100
2	Termically manufactured termite alloyed cast iron	85
3	Martensite termite cast iron	50
4	Alloyed Mn and Mo martensite cast iron	40

Table 2 data witness the increasing of conditional resistance for martensit termite cast irons and rather great increasing for termically manufactured cast iron Under the synthesis of white termite cast iron the necessity to get high temperature i the zone of reacting of burden components is considered, that is why Cr and Mn ar introduced not in the shape of ferroalloys but like oxides Cr_2O_3, CrO_2, MnO, MnO_2 Pearlite matrix of such cast iron contains carbides Cr and Fe. Under considerabl gradient of temperatures under termite conditions micromelting white cast iron i produced in large measure simply, simultaneously it is the cheapest among the cas irons mentioned above, but its wear resistance is less than that of the alloyed one Introducing additionally into the burden even a small quantity of chromium i powder state or in the state of low carbon ferrochromium using breakage of graphit electrodes increase greatly wear resistance of mentioned cast iron. Usin roentgenostructural analysis method in the structures of these cast irons carbides Fe_3C and $(Fe,Cr)_3C$ as well as carbides $(Fe,Cr)C_3$ and others were detected, that provide the hardness of ~ 15000MPa. Microhardness of carbides $(FeCr)_3C$ – HV 10000-10500 MPa, $(FeCr)_7C_3$ and $(Fe, Cr)_{23}C_6$ 14500–17500 MPa. The properties of som marks of termite cast irons are shown in table 3.

Cast irons «ИЧХ15М3», «ИЧХ12М» and «ИЧХ12Г3М» are annealed (fo getting the structure of grain perlite) with further hardening. Cast irons «ИЧХ28Н2М2» and «ИЧХ12Г5» with the structure of alloyed austenite are hardened in an open air and «ИЧХ28Н2» are treated under the medium-temperature tempering. High speed of cooling under getting of not big castings or the castings with wall thickness to 25-30 mm allow to get at once austenite-martensite structure.

Table 3.

Mechanical properties of termite highly-alloyed cast irons

Mark[1]	HRC	σ_u, MPa
И4Х12М[1]	65–67	670
ИЧХ12Г5[1]	64–66	680
ИЧХ28Н2	53–57	620
ИЧХ2Н4 (nickhard)	60–62	660

[1]After proper thermal treatment

In other cases, the loading into furnace after hardening of casting at temperature 950°C, endurance 2–3 hours and cooling together with furnace or hardening in an open air is used. The probability of graphitization of castings from nickhard under synthesis of alloy by aluminotermic way decreases considerably because of considerable gradient of temperatures and high speed of heat abstraction, i.e. getting of martensite structure under casting goes considerably simpler. Hardness of these cast irons is in the limits of 9300–12000 MPa (per HV).

4. **Conclusion and recommendations.** Thus we may make a conclusion that aluminothermic ways can be used for producing of special termite alloyed cast irons expect for high-chromium cast irons during the synthesis of those the problems of technological character appear. Other types of special cast irons have in some cases even better properties than in cast irons produced by ordinary methods.

Designed compositions of termite mixtures are also suitable for technology of termite casting additives of high-temperature gradient. The work that has been carried out allows making a conclusion that for their mechanical properties synthesized specialized cast irons don't yield to "common" and the methods themselves are available for synthesis in principle of any black alloy.

References:

1. *Zhiguts, Yu.Yu. Technologies of obtaining and features of alloys synthesized by combined processes (monograph) / Yu.Yu. Zhiguz, V.F. Lazar, Uzhhorod: Invasor Publishing House, 2014. - 188 pp.*
2. *Zhiguts, Yu. Special grey and white termite cast irons / Yu. Zhiguts, V. Lazar // British Journal of Science, "London University Press". London. – 2014. – № 2 (6). – V. 1. – P. 201 - 207.*
3. *Zhiguts, Yu., Lazar V., Skyba Yu. Novel technologies of synthesizing nihard by metallothermic methods / Intercollegiate collection of Lutsk National Technical University "Scientific Notes". – 2016. – № 54. – С. 130 - 134.*