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Influence of chemical composition, form and morphology of surface of NaCl grains on mechanical properties of water soluble cores

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With development of a number of branches (automobile industry) the demand of increasingly more complex and more exacting castings that are mechanically cleanable with difficulties only is growing. Application of the technology of disposable water soluble cores from inorganic salts is one of solutions of troublesome problems of removing the cores from places hardly accessible for cleaning. Solubility in water enables reversal crystallization of the salt from the water solution what is a precondition for forming a closed ecological cycle of the core manufacture. Application of salt cores can be met in processes of low-pressure casting, gravity casting in dies, and in connection with just running research project in pressure castings from Al-alloys. The article brings results of checking the cores made from cooking salts (NaCl) predominantly available on the Czech market. It is aimed at two main technologies (shooting and high-pressure squeezing) of their manufacture and it investigates the influence of chemical composition, form and morphology of the grain surface on mechanical properties (bending strength) of water soluble salt cores for their application for high-pressure die casting of Al-alloys.

Keywords: NaCl, p.a., cooking salt, salt cores, non-ferrous metals

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References

[1] BŘUSKA, M. et al. Influence of repeated remelting of the alloy RR.350 on structure and thermo – mechanical properties. *Manufacturing Technology*, March 2013, Vol. 13, No. 1, pp. 31 – 35. ISSN 1213-2489.

[2] PEZDA, J. Modification of the EN AC-42000 aluminium alloy with use of multicomponent electrolysis of sodium salt. *Metalurgija*, Januar – March 2014, Vol 53, Issue 1, pp. 55-58.

[3] LICHÝ, P.; BEŇO, J.; CAGALA, M.; Inoculant Addition Effect on Thermomechanical and Thermophysical Properties of Mg-Sr Magnesium Alloy. *Manufacturing Technology*, March 2013, Vol. 13, No. 1, pp. 64-67. ISSN 1213-2489.

[4] NOVÁ, I.; MACHUTA, J.; Squeeze casting results of aluminium alloys. *Manufacturing Technology*, March 2013, Vol. 13, No. 1, pp. 73-79

[5] JASIONOWSKI, R.; PODREZ-RADZISZEWSKA, M.; ZASADA, D. Cavitation erosion resistance of the chosen aluminum alloys. *Manufacturing Technology*, March 2013, Vol. 13, No. 1, pp. 22-28. ISSN 1213-2489.

[6] JELÍNEK, P. et al. Solná jádra v technologii tlakového lití. In 5. Holečkova konference. 1. vyd. Brno: Česká slévárenská společnost, 2013, s. 63 – 67. ISBN 978-80-02-02427-9.

[7] ADÁMKOVÁ, E. et al. Technology of Water Soluble Cores for Foundry Applications. In *Proceedings* XX. International Student's Day of Metallurgy. March 14 – 16th, 2013, Cracow, Poland, 8 p. (CD-ROM) ISBN 978-83-63663-14-8.

[8] FUSCH, B.; EIBISCH, H.; KOERNER, C. Core viability simulation for salt core technology in high-pressure die casting. International *Journal of Metalcasting*, Summer 2013, Vol. 7, Issue: 3, pp. 39 – 45. ISSN 1939-5981

[9] RAI JITENDER, K.; LAJIMI AMIR, M.; XYROUCHAKIS, P. An intelligent system for predicting HPDC process variables in interactive environment. *Journal of materials processing technology*. July 2008, Vol. 203, Issue. 1-3, pp. 72-79.

[10] JELÍNEK, P. et. al. Vývoj technologie výroby solných jader. *Slévárenství*, 2013, ročník LXI, č. 1-2, s. 28 – 31. ISSN 0037-6825.

[11] JELÍNEK, P. et. al. Ovlivňování pevnostních charakteristik solných ve vodě rozpustných jader. *Slévárenství*, 2012, ročník LX, č. 3-4, s. 85 – 89. ISSN 0037-6825.

[12] TSOUKALAS, V. D. Optimization of injection conditions for a thin- walled die-cast part using a genetic algorithm method. *Journal of engineering manufacture*. September 2008, Vol. 222, Issue. 9, pp. 1097 – 1106. ISSN 0954-4054

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Production and properties of metal foams from non-ferrous metals alloys

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Metal foams belong thanks to their unique properties into the group of new and perspective materials. The paper deals with foundry procedures used for production of cast metal foams based on non-ferrous metals alloys. Individual procedures of production in lab and pilot conditions are described, which result in casting with certain structural regularity. Attention is paid also to the obtained microstructure of these cast materials and to evaluation of their properties. The experimental part summarises the existing research works in this area, including future possibilities of their use. Cast metal foams are not yet produced in Czech Republic on industrial scale.

Keywords: metal foams, aluminium alloys, microstructure

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References

[1] BANHART, J. (2005). Aluminium foams for lighter vehicles. *International Journal of Vehicle Design*, Vol. 37, No. 2/3, pp. 114–125.

[2] BANHART, J. (2001). Manufacture, characterisation and application of cellular metals and metal foams. *Progress in Materials Science*, Vol. 46, pp. 559–632.

[3] MICHNA, Š. (2005) Encyklopedie hliníku. Prešov, ISBN 80-89041-88-4.

[4] GAILLARD.Z- DAIRON, J-FLEURIOT, M.: Les materiaux cellulaires: une innovation aux applications multiples, Fonderie, 2010, Issue 1, pp. 21-33.

[5] PAULIN, I., et. al.: Synthesis of aluminium foams by the powder metallurgy process – compacting of precursors, *Materiali in Tehnologie/Materials and technology* 45 (2011) 1, pp. 13-19

[6] DAIRON,J. et al.: Mousses métalliques: CTIF innove dans les matériaux cellulaires. Fonderie - Fondeur d´aujourd´hui, 2009, Issue 295, pp.12-19.

[7] CHOLEWA,M.,DZIUBA-KALUŽA,M.:Analysis of structural properties of skeleton castings regarding the crystallization kinetics, Archives of Materials Science and Engineering, (38),2009,Issue 2,pp.93-102

[8] NOVAKOVA-MARCINCINOVA, L., JANAK, M. (2012). Application of progressive materials for rapid prototyping technology. *Manufacturing Technology*, Vol. 12, No. 12, pp. 75-79

[9] NOVAKOVA-MARCINCINOVA, L., NOVAK-MARCINCIN, J., TOROK, J., BARNA, J. (2013). Selected experimental tests of materials used in rapid prototyping area. *Manufacturing Technology*, Vol. 13, No. 2, pp. 220-226.

[10] TILLOVÁ, E., CHALUPOVÁ, M., HURTALOVÁ, L., ĎURINÍKOVÁ, E. (2011). Quality control of microstructure in recycled al-si cast alloys. *Manufacturing Technology*, Vol. 11, No. 1, pp. 70-76.

[11] CZAJKOWSKA et al:Application of Electron Scaning Microscope in the Analysis of the Structure of Casting Non- Conformities Aimed at Optimization of Technological Process Parameters, *Manufacturing Technology*,Vol. 13, No.2,pp.164-169

[12] BŘUSKA,M. at al.: Influence of repeated remelting of the alloy RR.350 on structure and thermo-mechanical properties, *Manufacturing Technology*, Vol. 13, No. 1, pp. 31-35

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Study of interactions between molding materials and magnesium alloys melt metal

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For production of castings from magnesium alloys it is necessary to use covering or protective materials, which prevent reaction of the melt with air (air oxygen). With respect to the surface quality of castings it is absolutely necessary to monitor also the mutual interaction of the alloy with material of the mould or the core. The objective of this paper consists in investigation of influence of cores based on inorganic salts on the structure and surface quality of the castings made of the magnesium alloy AZ91 at gravity casting. Within the frame of experiment we studied by metallographic and SEM analyses the surface quality of castings from the side of cores and changes of structure of the castings' surface.

Keywords: magnesium alloys, casting surface quality, salt cores, microstructure

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References

[1] EPERJEŠI, L.; MALIK, J.; EPERJEŠI, S.; FECKO, D. (2013). Influence of returning material on porosity of die castings. *Manufacturing Technology*, Vol. 13, No. 1, pp. 36-39.

[2] MALIK, J.; FUTÁŠ, P.; VASKOVÁ, I. (2009). Return material in technology of pressure die casting. *Slévárenství*. Vol. 57, no. 3-4, pp. 91-93.

[3] LICHÝ, P.; BEŇO, J.; Cagala, M. (2013). Inoculant Addition Effect on Thermomechanical and Thermophysical Properties of Mg-Sr Magnesium Alloy. *Manufacturing Technology*, Vol. 13, No. 1, pp. 64-67.

[4] NOVÁ, I.; MACHUTA, J. (2013). Squeeze casting results of aluminium alloys. *Manufacturing Technology*, Vol. 13, No. 1, pp. 73-79.

[5] MICHELS, H.; BÜNCK, M.; BÜHRIG-POLACZEK, A. (2010). Suitability of lost cores in rheocasting process. *Trans. Nonferrous Met. Soc. China*, Vol. 20, pp. 948 - 953

[6] JELÍNEK, P.; ADÁMKOVÁ, E.; BEŇO, J.; MIKŠOVSKÝ, F.; BRYKSÍ, V.; FICKOVÁ, M. (2013). Ověření solných jader na tlakově litém pokusném odlitku [Verification of salt cores on the test casting cast under pressure]. *Technológ*, Vol. 5, No. 2, pp.17-22

[7] JELÍNEK, P.; MIKŠOVSKÝ, F; BEŇO, J.; ADÁMKOVÁ, E. (2013). Development of foundry cores based on Inorganic salts. *Materiali in tehnologije / Materials and technology*, Vol. 47, No. 6, pp. 47-51

[8] HÄNSEL, H. (2002). Ein anorganisches bindersystem der innovativen Art. *Giesserei*, Vol. 89, No. 2, pp.74-76

[9] FALLER, M.; MÖSSNER, A.(2009) Die Zukunft wartert schon heute. *Giesserei*, Vol. 96, No. 9, pp. 72-74

[10] DOBOSZ, S.; JELÍNEK, P.; MAJOR-GABRYŚ, K. (2011). Development tendencies of moulding and core sands. *China Foundry*, Vol. 8, No. 4, pp. 438-446.

[11] KASINA, M; VASILKO, K. (2012) Experimental Verification of the Relation between the Surface Roughness and the Type of Used Tool Coating. *Manufacturing Technology*, Vol. 12, No. 12, pp. 27-30

[12] NOVAK, M.; KASUGA, H.; OHMORI, H. (2013). Differences at the surface roughness by the ELID and grinding technology. *Manufacturing Technology*, Vol. 13, No. 2, pp. 210-215.

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Offline Programming for Robotic Deburring Process of Aluminium Wheels

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The paper presents application of Siemens RobotExpert software of industrial robot offline programming. The deburring process of aluminium wheel is described and developed. The robotic work-cell contains robot ABB IRB 1600id and two axes positioner ABB IRBP A 750 D 1000 H 700. The final robot tool path is checked using the collision viewer, the joint status monitor, the tool centre point speed viewer and tracker.

Keywords: Deburring, RobotExpert, Aluminium, Offline Programming, Wheels.

References

[1] AURICH, J. C., DORNFELD, D., ARRAZOLA, P. J., FRANKE, V., LEITZ, L., MIN, S. (2009). Burrs—analysis, control and removal. In: *CIRP Annals-Manufacturing Technology*, Vol. 58, No. 2, pp. 519-542. CIRP.

[2] BOLIBRUCHOVA, D., RICHTARECH L. (2013). Study of the gas content in aluminum alloys, In: *Manufacturing Technology*, Vol. 13, No. 1, pp. 14-20. UJEP. Usti nad Labem.

[3] BRUNA, M., KUCHARCIK, L., SLADEK, A. (2013). Complex evaluation of porosity in A356 aluminium alloy using advanced porosity module, In: *Manufacturing Technology*, Vol. 13, No. 1, pp. 26-30. UJEP. Usti nad Labem.

[4] DANISOVA, N., RUZAROVSKY, R., VELISEK, K. (2013) Designing of intelligent manufacturing assembly cell by moduls of system catia and E-Learning module creation, In: *Advanced Materials Research*, Vol. 628, pp. 283-286. TTP. Switzerland.

[5] DIETZ, T., SCHNEIDER, U., BARHO, M., OBERER-TREITZ, S., DRUST, M., HOLLMANN, R., HÄGELE, M. (2012). Programming System for Efficient Use of Industrial Robots for Deburring in SME Environments. In: *Robotics; Proceedings of ROBOTIK 2012; 7th German Conference on*, pp. 1-6. VDE.

[6] HOLUBEK, R., VELISEK, K. (2013). Incorporation, programming and use of an ABB robot for the operations of palletizing and depalletizing at an academic research oriented to intelligent manufacturing cell, In: *Applied Mechanics and Materials*, Vol. 282, pp. 127-132. TTP. Switzerland.

[7] HRUBY, J., RENTKA, J., SCHINDLEROVA, V., KREJCI, L., SEVCIKOVA, X. (2013). Possibilities of prediction of service life of forming tools, In: *Manufacturing Technology*, Vol. 13, No. 2, pp. 178-181. UJEP. Usti nad Labem.

[8] JAYAWEERA, N., WEBB, P. (2010). Measurement assisted automated robotic edge deburring of complex components. In: *Proceedings of the 9th WSEAS international conference on Signal processing, robotics and automation*, pp. 133-138. World Scientific and Engineering Academy and Society, Cambridge.

[9] KOSTAL, P., VELISEK, K. (2011). Flexible manufacturing system, In: *World Academy of Science, Engineering and Technology*, Vol. 77, pp. 825-829. WASET. Las Cruces.

[10] MENZIE, W. D. (2010). *The global flow of aluminum from 2006 through 2025*, US Department of the Interior, US Geological Survey.

[11] MEURER, B., HAFERKAMP, D., JORG, A. (2001). Use of simulation in the production of cast aluminium wheels. In: *CASTING PLANT AND TECHNOLOGY INTERNATIONAL*, Vol. 17, No. 3, pp. 14-23. Solingen.

[12] NOVA, I., MACHUTA, J. (2013). Squeeze casting results of aluminium alloys, In: *Manufacturing Technology*, Vol. 13, No. 1, pp. 73-79. UJEP. Usti nad Labem.

[13] PAN, Z., POLDEN, J., LARKIN, N., VAN DUIN, S., NORRISH, J. (2012). Recent progress on programming methods for industrial robots. In: *Robotics and Computer-Integrated Manufacturing*, Vol. 28, No. 2, pp. 87-94.

[14] SADILEK, M., CEP, R., BUDAK, I., SOKOVIC, M. (2011). Aspects of using tool axis inclination angle, In: *Strojniski Vestnik/Journal of Mechanical Engineering*, Vol. 57, No. 9, pp. 681-688. University of Ljubljana. Ljubljana.

[15] STAS, O., TOLNAY, M., MAGDOLEN, L. (2010). Artificial intelligence in analysis of fast dynamic actions, In: *ASME 2010 10th Biennial Conference on Engineering Systems Design and Analysis, ESDA2010*, pp. 885-889. Yeditepe University, Istanbul.

[16] MICHNA, S., NAPRSTKOVA, N. (2012). Research into the causes cracking of aluminum alloys of Al – Cu during mechanical machining, In: *Manufacturing Technology*, Vol. 12, No. 12, pp. 47-51. UJEP. Usti nad Labem.

[17] ZHANG, H., et al. (2006). On-line path generation for robotic deburring of cast aluminum wheels. In: *Intelligent Robots and Systems, IEEE/RSJ International Conference on*, pp. 2400-2405. IEEE, Beijing.

[18] ZILIANI, G.; VISIOLI, A.; LEGNANI, G. (2007). A mechatronic approach for robotic deburring. In: *Mechatronics*, Vol. 17, No. 8, pp. 431-441. Elsevier.

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Effect of adding iron to the AlSi7Mg0.3 (EN AC 42 100, A356) alloy

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Iron is the most common and harmful impurity in aluminum casting alloys and has long been associated with an increase of casting defects. While the negative effect of iron is clear, itsmechanism is not fully understood. In generally,iron is associated with the formation of Fe-rich intermetallic phases. This article deals with different iron content in aluminum alloy A356. After castingswere in test samples observed intermetallic phases and influence of iron on another elements in alloy. This alloy was not inoculatedor modified. The negative influence of iron wasn't eliminated by "iron correctors". The main objective of this experiment was to determine of such iron content, which corresponds to the iron content of secondary aluminum alloy.

Keywords: iron, intermetallic phases, secondary aluminum alloy

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References

[1] TAYLOR, J.A. (2004). The effect of iron in Al-Si casting alloys, 35th Australian Foundry Institute National Conference, Adelaide, South Australia, pp. 148-157.

[2] SAMUEL, A.M., SAMUEL, F. H., DOTY, H. W. (1996). Observation on the formation of β- Al5FeSi phase in 319 type Al-Si alloys. Journal of Materials Science, Vol. 31, pp. 5529-5539

[3] ĎURNIKOVÁ, E., TILLOVÁ, E. (2011). Phase and structure characteristics of recycled AlZn10Si8Mg cast alloy. Journal for science research and production, *Manufacturing Technology*, Vol. 11, No. 11, pp. 70-76

[4] BRŮNA, M., KUCHARČÍK, L., SLÁDEK, A. (2013). Complex evaluation of porosity in A356 aluminium alloy using advanced porosity module. In *Manufacturing Technology*, Vol. 13, No. 1, p. 26-30

[5] HURTALOVÁ, L., TILLOVÁ, E. (2013). Elimination of the negative effect of Fe-rich intermetallic phases in secondary (recycled) aluminium cast alloy. In *Manufacturing Technology*, Vol. 13, No. 1, p. 44-50

[6] KEJZLAR, P. (2012). Structure and mechanical properties of Fe-25Al-5Zr and Fe-30 Al-5Zr intermetallic alloys. In *Manufacturing Technology*, Vol. 12, No. 13, p. 131-135

[7] PALM, M. (2005). Concepts derived from phase diagram studies for the strengthening of Fe-Al-based alloys. *Intermetallics*. Vol. 13, pp. 1286.

[8] TILLOVÁ, E., CHALUPOVÁ, M., HURTALOVÁ, L., ĎURNÍKOVÁ, E. (2011). Quality control of microstructure in recycled Al-Si cast alloys. In *Manufacturing Technology*, Vol. 11, No. 11, p. 70-76

[9] MICHALCOVÁ, A., VOJTĚCH, D. (2012). Structure of rapidly solidified aluminium alloys. In *Manufacturing Technology*. ISSN 1213-2489. vol. 12, p.166-169

[10] LIPIŃSKI, T. (2011). Use Properties of the AlSi9Mg Alloy With Exothermical Modifier. In *Manufacturing Technology*. ISSN 1213-2489. vol. 11, p. 44-49

[11] SLÁDEK, A. – BOLIBRUCHOVÁ, D. – PASTIRČÁK, R. – VAŠKO, I. (2010). The influence of antimony on the properties of AlSi7Mg0,3 alloy. In: Proceedings of 69th world foundry congress. Hangzhou China. Pp 261 – 266

[12] EPEREJEŠI, Ľ. – MALIK, J. – EPEREJEŠI, Š – FECKO, D. (2013) Influence of returningmaterial on porosity of diecasting. In *Manufacturing Technology*., Vol.13,No.1, pp.36-39

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Effect of Germanium on Secondary Lead-free Tin Solders

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The paper deals with the lead-free soldering and influence of germanium amount in lead-free secondary solder Sn99. Lead-free soldering is an emerging area in the metallurgy of non-ferrous metals with a non-harmful effect on the environment. This method of soldering is very important for connecting materials in precision electrical engineering. In the experimental part of the paper are evaluated properties of lead-free solder Sn99 with graduated amount of Ge, compared with lead-free solder with the addition of nickel and silver. The goal was to provide knowledge on the impact of germanium on microstructure change, solderability and formation of oxides on the surface. From the results it can be concluded that germanium in lead-free solders reduces the formation of oxides on the surface by the addition of 0.01 wt. % Ge to the batch. With the amount of 0.01 wt. % also the grain is refined in the microstructure, resulting in improved castability. In terms of solderability experiments confirmed that germanium improves the flowability of solder on the PCB substrate.

Keywords: secondary lead-free solder, Sn99, Ge, soft solders

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References

[1] Bezolovnaté spájkovanie. 2013. [online].Dostupné na internete: https://www.zlwima.rwthaachen .de/micro/htm/download/DownloadKosice/5_sk.pdf.

[2] Yamamoto, T.- Tsubone, K.(2007). Assembly Technology Using Lead-free Solder. *FUJITSU Sci Tech*. J. January 2007, 48 pp.50-58.

[3] Felder. (2010) [online]. *Ni - Ge electronic solders*.. [cit. 2013-03-11]. Dostupné na internete:

[4] http://www.felder.de/picture/upload/file/PDF/Produktinformationen/en/NiGe-Electronic %20Solders.pdf,.

[5] LENG P.E., WONG,T.L., NOVSHAD, A., IBRAHIM A. (2009) BGA Lead-free C5 Solder System Improvement by Germanium addition to Sn3.5Ag and Sn3.8Ag-0.7-Cu Solder Alloy. 11th *Elektronics technology konference.*

[6] BEL, H., GROSSMANN, G.(2009). *Reflow Technology*, Fundamentals of Reflow Soldering. 2009. 78 s.

[7] BAVLNA, J. Vplyv germánia na spájky. *Diplomová práca*, ŽU, 2013, s. 47.

[8] PIETRIKOVÁ, A., LIVOVSKÝ, L., ĎURIŠIN, J. (2009) Sledovanie štruktúr spojov na báze zliatiny SAC. 2009. *Elektroscope*, č. II., pp 5.

[9] EPERJEŠI, Ľ., MALIK, J., EPERJEŠI, Š., Fecko, D. (2013). Influence of returning materila on porosity of die casting, *Manufacturing Technology*, March 2013, Vol. 13, No. 1, pp. 36-39.

[10] WEISS, V. – STRIHAVKOVA, E. (2012). Influence of the homogenization annealing on microstructure and mechanical properties of AlZn5.5Mg2.5Cu1.5 alloy. In: *Manufacturing Technology*, Volume 12, pp. 297 – 302. ISSN 1213-2489.

[11] MICHALCOVÁ, A. – VOJTECH, D. (2012). Structure of rapidly solidified aluminium alloys. In: *Manufacturing Technology*, Volume 12, pp. 166 – 169. ISSN 1213-2489.

[12] DOBRZAŃSKI, L. A.; MANIARA, R.; SOKOLOWSKI, J. H. The effect of cast Al-Si-Cu alloy solidification rate on alloy thermal characteristics. *Journal of Achievements in Materials and Manufacturing Engineering* - JAMME, 2006, Vol. 17, 1-2, pp. 217-220.

[13] LIPINSKI, T. (2011). Use Properties of the AlSi9Mg Alloy With Exothermical Modifier. In *Manufacturing Technology*. ISSN 1213-2489. vol. 11, pp. 44-49.

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Possibilities of iron elimination in aluminium alloys by vanadium

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Presence of iron is a common problem in Al-Si based alloys. Due to iron influence, mechanical and foundry properties of alloys are decreasing, so it is necessary to balance the influence in a certain way. One of possible solutions is addition of alloying elements, also called correctors of iron, into the melt. In this paper, the influence of vanadium on decreasing negative effect of iron in secondary alloy AlSi6Cu4 is assessed. In experimental part, properties of alloy with various addition of vanadium are evaluated. Microstructural and EDX analysis of selected structural parts are also a part of the experimental measurements. Based on statements from realised measurements can be stated that vanadium is an element, which can be used to correct negative effect of iron in secondary alloy AlSi6Cu4.

Keywords: AlSi6Cu4 alloy, correction of iron, vanadium, iron based phases.

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References

[1] BOLIBRUCHOVÁ, D., RICHTÁRECH, L. (2013). Study of the gas content in aluminium alloys. In: *Manufacturing Technology*, March 2013, Vol. 13, No. 1, pp. 14 - 20.

[2] TILLOVÁ, E., CHALUPOVÁ, M. (2009). *Structural analysis of Al-Si cast alloys*, pp. 191. EDIS, Žilina. ISBN 978-80-554-0088-4. (in Slovak)

[3] TAYLOR, J. A. (2004). The effect of iron in Al-Si casting alloys. In: *35th Australian Foundry Institute National Conference*, Adelaide, South Australia, pp. 148 – 157.

[4] HURTALOVÁ, L., TILLOVÁ, E. (2013). Elimination of the negative effect of Fe-rich intermetallic phases in secondary (recycled) aluminium cast alloy. In: *Manufacturing Technology*, March 2013, Vol. 13, No. 1, pp. 44-50.

[5] DINNIS, C. M., TAYLOR, J. A., DAHLE, A. K. (2005). As-cast morphology of iron-intermetallics in Al–Si foundry alloys. In: *Scripta Materialia* vol. 53, Issue 8, pp. 955 – 958.

[6] PETRÍK, J., HORVATH, M. (2011). The iron correctors in Al-Si alloys. In: *Annals of Faculty Engineering Hunedoara – International Journal of Engineering*, pp. 401 – 405. ISSN 1584-2673.

[7] SZARVASY, P., PETRÍK, J., ŠPEŤUCH, V. (2005). Use of iron correctors for improving properties of silumin castings. In: *Slévárenství*, Vol. 53, Issue 11-12, pp. 521 - 524. ISSN 0037-6825. (in Slovak)

[8] KUCHAŘ, L., DRÁPALA, J. (2003). *Binary systems of aluminium – admixture and their importance for metallurgy* pp. 218. Delta Print, Děčín. ISBN 80-239-1469-3.

[9] PASTIRČÁK, R., URGELA, D., KRIVOŠ, E. (2012). Production of casting by paternless process. In: *Archives of foundry engineering*, Vol.12, Issue 1, pp. 87 - 92.

[10] ZHU, S., et al. (2013). Influences of Nickel and Vanadium Impurities on Microstructure of Aluminum Alloys. In: *JOM*, Vol. 65, Issue 5, pp. 584 - 592.

[11] Brůna, M., KUCHARĆÍK, L., SLÁDEK, A. (2013). Complex evaluation of porosity in A356 aluminium alloy using advanced porosity module. In: *Manufacturing Technology*, Vol. 13, No.1 pp.26–30.

[12] ŽIHALOVÁ, M. (2013). *Elimination of Fe in secondary alloy AlSi6Cu4 by vanadium*. Diploma thesis, pp. 60. (in Slovak)

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Prediction of the Porosity of Al Alloys

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The main goal of the research presented in this paper is to gain a deeper understanding of solidification processes in terms of porosity formation in AlSi7Cu0.5Mg alloy through complex data evaluation obtained from thermal analysis, simulation software ProCAST and also from real melts. Formation of porosity (micro, macro porosity) was examined under different casting conditions, the pouring temperature varied from 730 °C to 650 °C. The experiment will attempt to analyze, how the pouring temperature effects the formation and character of porosity. For this purpose was various methods were used, not only real castings evaluation, but also advanced porosity module integrated into simulation software ProCAST. Experiments also try to compare simulation results with real conditions, to determine software abilities and accuracy. Specific casting and mold were designed to be able to observe porosity formation.

Keywords: simulation, thermal analysis, porosity, aluminum alloys

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References

[1] MEDLEN, D., BOLIBRUCHOVÁ, D. (2012) The influence of remelting on the properties of AlSi6Cu4 alloy modi-fied by antimony. In: *Archives of foundry Engineering*, January-march, pp. 81-86, vol. 12, ISSN 1897-3310.

[2] KANTORÍK, R., BOLIBRUCHOVÁ, D. (2011). Free melt surface monitoring with the help of metal flow simulation in moulds. In: *International Foundry Research*, 2011, vol. 63, issue 2, pp. 18 – 23, ISSN 0046-5933.

[3] SLÁDEK, A., BOLIBRUCHOVÁ, D., PASTIRČÁK, R., VAŠKO, I. (2010). The influence of antimony on the properties of AlSi7Mg0.3 alloy. In: *Proceedings* of 69th world foundry congress: Hangzhou China. Pp 261 – 266.

[4] WEISS, V., STRIHAVKOVA, E. (2012). Influence of the homogenization annealing on microstructure and mechanical properties of AlZn5.5Mg2.5Cu1.5 alloy. In: *Manufacturing Technology*, Volume 12, pp. 297 – 302. ISSN 1213-2489.

[5] MICHALCOVÁ, A., VOJTECH, D. (2012). Structure of rapidly solidified aluminium alloys. In: *Manufacturing Technology*, Volume 12, pp. 166 – 169. ISSN 1213-2489.

[6] MACKAY, R. I., DJURDJEVIC, M. B., SOKOŁOWSKI, J. H. (2000) Effect of cooling rate on fraction solid of metallurgical reactions in 319 alloy. *AFS Trans.*00–25:521–30.

[7] MAJID KARIMIAN, ALI OURDJINI, MOHD HASBULLAH IDRIS, M. BSHER, A. ASMAEL (2011). "Effect of Pouring Temperature and Melt Treatment on Microstructure of Lost Foam Casting of Al-Si LM6 Alloy". *Advanced Materials Research* .264 – 265.

[8] S. SHIVKUMAR (1994). Modeling of Temperature Losses in Liquid Metal during Casting Formation in Expendable Pattern Casting Process. *Materials Science and Technology*, 10 986-992

[9] TILLOVÁ, E., CHALUPOVÁ, M., HURTALOVÁ, L., ĎURNÍKOVÁ, E. (2011). Quality control of microstructure in recycled Al-Si cast alloys. In *Manufacturing Technology*, Vol. 11, No. 11, p. 70-76

[10] BRŮNA, M., KUCHARČÍK, L., SLÁDEK, A. (2013). Complex evaluation of porosity in A356 aluminium alloy using advanced porosity module. In *Manufacturing Technology*, Vol. 13, No. 1, p. 26-30

[11] ROUČKA, J. (2004). *Metallurgy of Non-ferrous alloys.* Brno. 1. Edition. 1. Edition. VUT Brno, 2004, 148p. ISBN 80-214-2790-6.

[12] CAMPBELL, J. (2003). *Castings*. Vol. 2, Butterworth – Heinemann, Oxford, pp. 242 – 255. ISBN 978-0750647908.

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Using the Design of Experiment Method to Evaluate Quality of Cuts after Cutting Aluminum Alloy by AWJ

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The article deals with the use of the SPC method, specifically the DoE method – Design of Experiment method, during evaluation of a finished area of aluminum allow AlMg3 with an abrasive waterjet (AWJ). Design of experiment utilized a basic model, which presents a process as a change in input factors on an output characteristic. The basis of this method stems from the fact that the output characteristic, which expresses a specific measured qualitative attribute has its variability. We can identify numerous factors that affect the quality of finished area when cutting material with the help of an abrasive waterjet. With the help of statistical methods within quality management, we can determine which factors are important. Four input factors, feed speed, thickness of the material, water pressure and mass flow of the abrasives mass flow, were selected to evaluate an output factor, roughness of surface Ra. With the help of the 2^4 experiment, with the help of software, we can observe and evaluate the importance of these processing factors. Based on results from the experiment one can come to conclusions which will help with finding optimal conditions for achieving the most abrasive surface possible after cutting of aluminum alloy AlMg3, using the AWJ technology.

Keywords: abrasive waterjet, surface quality, DoE, SPC, factor analysis.

References:

[1] MAŇKOVÁ, Ildikó. *Progresívne technológie*. Košice: Vienala Košice, 2000. 275 s. ISBN 80-7099-43-4.

[2] VAGASKÁ, Alena. *Štatistické riadenie kvality čelne frézovaného povrchu hliníka*, http://www.sjf.tuke.sk/transferinovacii/pages/archiv/transfer/14-2009/pdf/084-087.pdf Dostupné na internete (20.08.2013).

[3] HASHISH, Mohamed. *Optimalization Factors in Abrasive Waterjet Machining*, ASME 1992, Journal of Engineering for Industry, Vol 113, 1991, No.2.

[4] HASHISH, Mohamed. *Material properties in Abrasive-Waterjet Machining*, ASME 1995, Journal of Engineering for Industry, Vol 117.

[5] ŤAVODOVÁ, Miroslava; NÁPRSTKOVÁ, Nataša. *Hodnocení kvality povrchu materiálu po řezání AWJ*, Strojírenská technologie Roč. 17, č.3 (2012), s. 186-192. ISSN 1211-4162.

[6] WANG, J. *Abrasive Waterjet Machining of Engineering Materials*, Monograph Series, Materials Scienceb Foundations, Volume 19, 200. ISBN 978-0-87849-918-2.

[7] HRABČAKOVÁ, Ivana. *Matematické modelovanie vplyvu technologických parametrov na parametre kvality v procese delenia konštrukčnej ocele.* Manufacturing Technology, 2010, roč. IX, č.1, s.74-76. ISSN 1335-7972.

[8] CHAO, J. et al. *Characteristic of Abrasive Waterjet Generated Surfaces and Effects of Cutting Parameters and Structure Vibration.* ASME, Journal of Engineering for Industry, Vol 117, Nov., 1995. 516-525.

[9] MONTGOMERY, D.,C. *Design and Analysis of Experiments*. 5th edition, Hamilton Printing Company, 2001. ISBN 0-471-31649-0.

[10] http://archiv.ipaslovakia.sk/UserFiles/File/ZL/Prumyslove%20inzenyrstvi%20casopis/2010_3_Rie%c5%a1enie%20probl%c3%a9mov%20met%c3%b3dou%20DoE.pdf, Dostupné na internete (02.09.2013).

[11] KUČEROVÁ, Marta. *Stanovenie úrovní vstupných faktorov pri procese popúšťania drôtu metódou DoE*. http://www.sjf.tuke.sk/transferinovacii/pages/archiv/transfer/23-2012/pdf/159-163.pdf. Dostupné na internete (20.08.2013).

[12] NOVAK, Martin. *Surface quality of hardened steels after grinding*. Manufacturing Technology, 2011, roč. XI, č. 11. s. 55- 59. ISSN 1213-2489.

[13] HLOH, Sergej; VALÍČEK, Jan. *Vplyv faktorov na topografiu povrchov vytvorených hydroabrazívnym delením.* Prešov: FVT TU v Košiciach so sídlom v Prešove, 2008. 125 s. ISBN 978-80-553-0091-7.

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Fracture surface of recycled AlSi10Mg cast alloy

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Recycled aluminium alloys are made out of aluminium scrap (new or old) and workable aluminium garbage by recycling. Due to the increasing production of recycled aluminium cast alloys is necessary to ensure their strict metallurgical control. The mechanical properties and the microstructure character depends on the chemical composition; melt treatment conditions, solidification rate, casting process and the applied thermal treatment. The mechanical properties depend on the morphologies, type and distribution of Si, Cu, Mg and Fe-phases, on the grain size, DAS and porosity distribution. Improvement of mechanical properties and structure of Al-alloys can often significantly increase the using lifetime of a casting. Different elements are added to achieve the optimum casting and mechanical properties. Modification can be achieved by several methods as faster solidification, mould vibration, melt agitation in mushy state and melt inoculation by using chosen elements like Sr, Na, Sb etc. Present work is focused on study of the effect of Sr-modification on the structure and mechanical properties of recycled AlSi10Mg cast alloy. For study and identification of intermetallic phases' was utilized standard (HF), colour (MA) and deep etching (HCl) in order to reveal the three-dimensional morphology of the silicon particles and intermetallic phases. For element composition of the specimen was used X-ray (EDX) analysis. Finally, the effect of modification on silicon morphology and fracture surface was examined.

Keywords: fracture surface, recycled Al-Si cast alloys, fractographic analysis, intermetallic phases

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References

[1] MAHFOUD, M., PRASADA RAO, A. K. et all. (2010): The role of thermal analysis in detecting impurity levels during aluminum recycling. *J Therm Anal Calorim*, 100, pp. 847-851.

[2] DAS, S. K., GREEN, J. A. S. (2010): Aluminum Industry and climate change-assessment and responses. *JOM*, 2010, Vol. 62, No. 2, pp. 27-31 www.tms.org/jom.html.

[3] IBRAHIM, M. F., SAMUEL, E., SAMUEL, A. M., AL-AHMARI, A. M. A., SAMUEL, F. H. (2011): Impact toughness and fractography of Al-Si-Cu-Mg base alloys. *Materials & Design*, Volume 32, Issue 7, pp. 3900-3910.

[4] TILLOVÁ, E., CHALUPOVÁ, M., HURTALOVÁ, L., ĎURINÍKOVÁ, E. (2011). Quality control of microstructure in recycled Al-Si cast alloys. *Manufacturing Technology*, Vol. 11, pp. 70-76.

[5] MICHNA et al. (2007): *Aluminium materials and technologies from A to Z.* Adin, s. r. o., Prešov, ISBN 978-80-89244-18-8

[6] TILLOVÁ, E., CHALUPOVÁ, M. (2009). *Structural analysis of Al-Si alloys*. EDIS Žilina (in Slovak).

[7] *ASM Handbook* (2002). Vol.15 - Casting, ASM International.

[8] KNUUTINEN, A., NOGITA, K., McDONALD, S. D., DAHLE, A. K. (2001). Modification of Al-Si alloys with Ba, Ca, Y and Yb. *Journal of Light Metals*, 1, pp. 229-240.

[9] COMALCO (1997). Modification of foundry Al-Si alloys. Technical report No. 4., Comalco Aluminum Limited. Brisbane, Australia.

[10] KAUR, P.K., PANDEY, O. P. (2010): Structural and age hardening characteristics of near eutectic Al-Si alloys. *International Journal of Materials Research, 101, 9*, pp. 1158-1165

[11] STŘIHAVKOVÁ, E., WEISS, V. (2012): The Identification of the structures new type Al-Si-Mg Ca alloys with

different Ca content using of the color metallography. *Manufacturing technology*, Vol. 12, No. 13, pp.

[12] PEZDA, J. (2009): Effect of modifying process on mechanical properties of EN AB-42000 silumin cast into sand moulds. *Archives of Foundry Engineering*, Vol. 9, 4, pp. 187-190.

[13] BOLIBRUCHOVÁ, D., BRÚNA, M. (2013): Influencing the crystallization of secondary alloy AlSi6Cu4 with strontium. *Manufacturing technology*, Vol. 13, No. 1, 2013, pp. 7-14.

[14] FARKAŠOVÁ, M., TILLOVÁ, E., CHALUPOVÁ, M. (2013): Modification of Al-Si-Cu cast alloy. *FME Transactions*, New series, Vol. 41, 3, pp. 210-215.

[15] TILLOVÁ, E., FARKAŠOVÁ, M., CHALUPOVÁ, M. (2013): The role of antimony in modifying of Al-Si-Cu cast Alloy. *Manufacturing technology*, Vol. 13, 1, pp. 109-114.

[16] MAKHLOUF, M. M., GUTHY, H. V. (2001): The aluminum-silicon eutectic reaction: mechanisms and crystallography. *Journal of Light Metals*, 1, pp. 199-218.

[17] MICHNA, Š., NÁPRSTKOVÁ, N. (2012): The Application of Fractography to Resolve the Issue of Castings Quality in the Automotive Industry. *Manuf. and Ind. Eng*., 11 (3), p. 50-53.

[18] WARMUZEK, M. (2004): Aluminum-Silicon-Casting Alloys: Atlas of Microfractographs, ASM International, Materials Park.

[19] MICHNA, Š., NÁPRSTKOVÁ, N. (2012). Research into the causes cracking of aluminum alloys of Al-Cu during mechanical machining. *Manufacturing Technology*. Volume 12, June 2012, pp. 47-51.

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Plastic Deformation Properties of Magnesium Alloy AZ61

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The main object of this research was the influence of plastic deformation on magnesium alloy AZ61 with 0.5 wt. % of Ca. Tested specimens were loaded by three - point bending test and by pressure deformation. Hardeing and softening were measured also. Specimens were studied in two structural states: as - cast state and in state after heat treatment. During three - point bending test specimens were plastically deformed by dislocation slip and twinning. The compression loading of experimental specimens after heat treatment led to slip and twinning plastic deformation. Cracks were created in the surrounding area of the indentation and there was also cracking of inter-metallic phases present in the microstructure. Changes in the intensity and distribution of plastic deformation were caused by deformation strengthening and shifting of grain boundaries. Grain reorientation and strengthening of neighbouring grains occurred during the growth of plastic deformation and the hardness was increased. After reaching annealing temperature of 300 °C, decrease of the material hardness was observed.

Keywords: magnesium alloy, plastic deformation, twinning, softening, hardening

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References

[1] ZHU, R., WU, Y. J., et al.: Cyclic Softening of Ultrafine – grained AZ31 Magnesium Alloy Processed by Equal – channel Angular Pressing. In *Materials Letters*. 2011. Volume 65, Issues 23 – 24, p. 3593 – 3596.

[2] TILLOVÁ, E., CHALUPOVÁ, M., et al.: Quality Control of Microstructure in Recycled Al – Si Cast Alloys. In *Manufacturing Technology.* 2011. Volume 11, No. 11, p. 70 – 76. ISBN 987 – 80 – 7414 – 415- 8

[3] MORDIKE, B.L., EBERT, T.: Magnesium Properties- applications – potential. In *Materials Science and Engineering A.* 2001. Volume 302, Issue 1, p. 37 – 45.

[4] BARNETT, M. R.: Twinning and the Ductility of Magnesium Alloys Part I: "Tension" Twins. In *Materials Science & Engineering.* 2007. Volume 464, Issues 1 – 2, p. 1 – 7.

[5] BARNETT, M. R.: Twinning and the Ductility of Magnesium Alloys Part II: "Contraction" Twins. In *Materials Science & Engineering.* 2007. Volume 464, Issues 1 – 2, p. 8 – 16.

[6] YOO, M. H.: Slip, Twinning, and Fracture in Hexagonal Close – packed Metals. In *Metallurgical Transactions A.* 1981. Volume 12, Issue 3, p. 409 – 418.

[7] SHAMSI, M., SANJARI, M. et al.: Study of Fractional Softening of AZ31 Magnesium Alloy under Multistage Hot Deformation. In *Materials Science and Technology.* 2009. Volume 25, No. 8, p. 1039 – 1045.

[8] LICHÝ, P., BEŇO, J., CAGALA, M.: Inoculant Addition Effect on Thermomechanical and Thermophysical Properties of Mg-Sr Magnesium Alloy. In *Manufacturing Technology*. 2013. Volume 13, No. 1, p. 64 – 67. ISSN 1213 – 2489

[9] JIANG, L., JONAS, J . J. et al.: Twinning and Texture Development in Two Mg Alloys Subjected to Loading Along Three Different Strain Paths. In *Acta Materialia*. 2007. Volume 55, Issue 11, p. 3899 – 3910.

[10] LOU, C., ZHANG, X., et al.: Characteristics of Twin Lamellar Structure in Magnesium Alloy during Room

Temperature Dynamic Plastic Deformation. In *Journal of Materials Science & Technology*. 2013.

[11] JOHNSON, W., WALTON, A.C.: An Experimental Investigation of the Energy Dissipation of a Number of Car Bumpers under Quasi-static Lateral Loads. In *International Journal of Impact Engineering.* 1983. Volume 1, Issue 3, p. 301 – 308.

[12] PALČEK, P., HLAVÁČOVÁ, I., CHALUPOVÁ, M. Influence of AZ61 Structure on the Plastic Deformation Around a Crack. In *DAS*. 2012. ISBN 978-86-7083-762-1, p. 134 – 135.

[13] PALČEK, P., HLAVÁČOVÁ, I., CHALUPOVÁ, M.: The Study of Plastic Deformation in the Crack Surrouding in AZ61 Alloy. In *FME Transactions*. 2013. Volume 41, No. 2, p. 103 – 108 ISSN 1451 – 20 92

[14] KOIKE, J. 2005. Enhanced Deformation Mechanisms by Anisotropic Plasticity in Polycrystalline Mg Alloys at Room Temperature. In *Physical Metallurgy and Materials Science*. Japan. 2005. Volume 36, Issue 7, p. 1689 – 1696.

[15] GEHRMANN, R., FROMMERT, M. M, GOTTSTEIN, G. 2005. Texture Effects on Plastic Deformation of Magnesium. In *Materials Science and Engineering A*. Germany. 2005. Volume 395, Issue 1- 2, p. 338 – 349.

[16] AFRIN, N., CHEN, D.L., CAO, X., JAHAZI, M. 2007. Strain Hardening Behavior of a Friction Stir Welded Magnesium Alloy. In *Scripta Materialia*. Canada. 2007. Volume 57, Issue 11, p. 1004 – 1007.

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The Influence of Porosity on Mechanical Properties of Casts Produced from Al - Si Alloys

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The aim of the research was to evaluate influence of porosity size on mechanical properties of AlSi7Mg0.3 (EN AC 42 100) alloy before and after thermal treatment. For the analyses casts of the same production type (forms used for tires production) were used. They were casted employing low-pressure casting technology. Since the negative influence of porosity on mechanical properties of Al alloys is generally known there is no quantitative assessment. In this research relation of porosity size in the structure of AlSi7Mg0.3 alloy and its mechanical properties is verified and quantified. Static tensile testing has proven the relation between porosity size in a structure of an Al material and its mechanical properties. Image analysis was applied in quantitative measurement of the porosity. The measurement was performed on prepared metallographic specimens. Porosity size is considered as a fraction of pore area to the total area of the analyzed specimen and is taken in percentage.

Keywords: porosity, gassing, AlSi7Mg0.3 alloy, mechanical properties**,** intermetallic phases

References

[1] GRÍGEROVÁ, T. a kol.: *Zlivárenstvo neželezných kovov*, 1988, ALFA Bratislava, SNTL Praha, ZNK 063-566-88.

[2] MONDOLFO, L. F.: *Aluminium Alloys, Structure and Properties, Butterworths,* London 1979.

[3] MICHNA, Š.: *Identifikace vad u Al – slitin ve slévárenském procesu*., Transactions of the Technical Univerzity of Košice 4/97, ISSN 1335-2334.

[4] BOLIBRUCHOVÁ, D., TILLOVÁ, E.: *Zlievárenské zliatiny Al-Si*, ŽU v Žiline – EDIS, 2005, ISBN 80-8070-485-6.

[5] MICHNA, Š., LUKÁČ, I. a kol.: *Encyklopedie hliníku*, 720 str., Adin s.r.o., Prešov SR, 2005, ISBN 80-89041-88-4.

[6] MICHNA, S, LUKÁC, I.: *Barevny kontrast, struktury a vady u hliniku a jeho slitin*, 214 str. Delta Print, Dečín ČR, ISBN 80-239-1636-X.

[7] LUKÁČ, I., MICHNA, S.: *Colour Contrast, Structure and Defects in Aluminium and Aluminium Alloys*.

[8] MICHNA, S., KUŚMIERCZAK, S.: *Praktická metalografie*, UJEP v Ústí nad Labem 2012, ISBN 978-80-7414-503-2

[9] NOVÁ, I., SOLFRONK , P., NOVÁKOVÁ, I.: *Vliv množství dislokací na tvařitelnost slitin hliníku*, Strojírenská technologie, XVI/2, r. 2011, str. 28-34, ISSN 1211-4162.

[10] VAJSOVÁ, V.: *Structural inhomogeneity by Al-Cu alloys casting into metal and bentonic form*. Transactions of the Universities of Košice, r. 2009, č. 1., ISSN 1355-2334.

[11] MICHNA, Š., NÁPRSTKOVÁ, N., LUKÁČ I.: *Mechanical Properties Optimization of AlSi12CuMgNi Alloy by Heat Treatment*. Metallofizika i Noveishie Teknologii, 11/2011, ISSN 1024-1809.

[12] VAJSOVÁ, V., MICHNA, Š.: *Optimization of AlZn5,5Mg2,5Cu1,5 Alloy Homogenizing Annealing*. Metallofizika i Noveishie Teknologii, Volume 32, No 7, July 2010, str. 949 – 959, ISSN 1024-1809.

[13] MICHNA, Š., MAJRICH, P.: *An analysis of the Process of Melting Food Packaging and Acquiring the Aluminium Alloy*, Металлург, 11/2012, ISSN 0026 – 0827 (IMPACT).

[14] MICHNA, S., NÁPRSTKOVÁ, N.: *Research into the causes cracking of aluminum alloys of Al – Cu during mechanical machining*, Manufacturing Technology, vol. 12, No. 12, June 2012, str. 47-51, ISSN 1213-2489.

[15] MICHALCOVÁ, A., VOJTĚCH, D.: *Structure of rapidly solidified aluminum alloys*, Manufacturing Technology, vol. 11, No. 13, December 2012, ISSN 1213-2489.

[16] MICHNA, Š., NÁPRSTKOVÁ, N.: *The use of fractography in the analysis of cracking after formel workpiece blank mechanical machining from the AlCuSnBi alloy*, Manufacturing Technology, vol. 11, No. 13, December 2012, ISSN 1213-2489.

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Influence of Cutting Tool Material on the Surface Roughness of AlMgSi Aluminium Alloy

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Milling is one of the most universal operations in machining processes because it can remove the redundant part of material efficiently, and moreover, it can produce almost all kinds of contour surfaces with a high quality finish. Surface roughness plays an important role in determining the product quality since it strongly influences the performance of mechanical parts as well as production cost. Many types of cutting materials are used as tool materials in today's metalworking industry. Selecting the proper cutting tool material for a specific machining application can provide substantial advantages including increased productivity, improved quality and ultimately reduced costs. This article is aimed at determining the influence of different tool materials on surface roughness of AlMgSi aluminium alloy after side milling with using of the analysis of variance (ANOVA).

Keywords: aluminium alloy, cutting tool material, milling, surface roughness

References

[1] SUTHERLAND, J. W., A Dynamic Model of the Cutting Force System in the End Milling Process, *Sensors and Controls for Manufacturing*, 1988, Vol. 33, pp. 53-62.

[2] WANG M. Y.; CHANG, H. Y. Experimental study of surface roughness in slot end milling. *International Journal of Machine Tools and Manufacture*, 2004, Vol. 44, pp. 51–7.

[3] COLAK, O. Milling surface roughness prediction using evolutionary programming methods. *Materials and Design*, 2007, Vol. 28, pp. 657–666.

[4] DEGARMO, E. P.; BLACK J. T.; KOSHERS, R. A. *Materials and Processes in manufacturing*, 9th edition, USA**:** Wiley, 2003.

[5] DAVIS, J.R. *Tool Materials* (ASM Specialty Handbook). Ohio: ASM International, Materials Park, 2005.

[6] PLANSEE TIZIT, Ltd., Austria. Tools for aluminium machining, 2013.

[7] ASILTURK, I.; AKKUS, H. Determining the effect of cutting parameters on surface roughness in hard turning using the Taguchi method. *Measurement*, 2011, Vol. 44, pp. 1697–1704.

[8] ASLAN, E.; CAMUŞCU, N.; BINGÖREN, B. Design optimization of cutting parameters when turning hardened AISI 4140 (63 HRC) with Al2O3+TiCN mixed ceramic tool. *Mater. Design*, 2007, Vol. 28, pp. 1618-1622.

[9] KOVÁČ, M.; ZVONČAN, M.; BEŇO, M.; PETERKA, J. Experimental view on surface integrity during conventional and high-speed milling of Aluminium alloy AlMgSil EN 6082. In *Comec 2012*: VII International Scientific Conference of Mechanical Engineering. November 5th to 8th 2012, Villa Clara, Cuba. Central University of Las Villas, 2012, 6p. ISBN 978-959-250-757-9.

[10] JERSÁK, J.; GANEV, N.; KOVALČÍK, J.; DVOŘÁČKOVÁ, Š.; KARÁSEK, J.; HOTAŘ, A. Surface integrity of hardened bearing steel after milling. *Manufacturing Technology*, 2010, Vol. 10, pp. 80-87.

[11] KOLAŘÍK, K.; GANEV, N.; PALA, Z.; BARCAL, J.; BAKALOVA, T.; ZEMAN, P. Investigation of Milled Surfaces of High-alloy Tools Steels in Respect to the Cutting Speed. *Manufacturing Technology*, 2008, vol. 9, pp. 35-39.

[12] ŠUGÁR, P.; ŠUGÁROVÁ, J.; PETROVIČ, J. Surface roughness analysis of metal spun parts. *Advanced Materials Research*, 2013, vols. 652-654, pp. 2006-2009.

[13] NOVÁK, M.; LATTNER, M.; RŮŽIČKA, L.; HOLEŠOVSKÝ, F. Grinding and surface quality parameters at automotive parts machining. *Manufacturing Technology*, 2010, Vol. 10, pp. 36-38.

[14] ŤAVODOVÁ, M. The surface quality of materials after cutting by abrasive water jet evaluated by selected methods. *Manufacturing Technology*, 2013, Vol. 13, No. 2, pp. 236-241.

[15] DMG/MORI SEIKI Co. Ltd., product catalogue (2013)

[16] BENARDOS P. G.; VOSNIAKOS G. Predicting surface roughness in machining: a review. *International Journal of Machine Tools and Manufacture*, 2003, Vol. 43, pp. 833–44.

[17] OCHODEK, V.; NESLUŠAN, M.; ROZSÍPAL, M.; ŠÍPEK, M. Non-destructive analysis of surface integrity in turning and grinding operations. *Manufacturing Technology*, 2010, Vol. 10, pp. 57-64.

[18] SHARMA, A.V.N.L.; SATYANARAYANA RAJU, P.; GOPICHAND, A.; SUBBAIAH, K.V. Optimization of cutting parameters on mild steel with HSS & Cemented carbide tipped tools using ANN. *International Journal of Research in Engineering and Technology*, 2012, Vol. 1, pp. 226-228.

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Porous Ti-Si Alloys for Implants

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Porous alloys are very perspective materials for medical implants, particularly for surgical and dental applications. The reason - besides their biocompatibility - is their density. This is why the implants and bone replacements are lighter and more similar to a human bone in its structure and mechanical properties. Another advantage is good osseointegration, i.e. tissue growing through pores in the material, this makes the body accept the implant better and there is also no risk of rejection. New Ti-Si biomaterials were prepared by powder metallurgy using reactive sintering, during which the desired porous structure of the material is formed. In this experiment the observed subject was the microstructure of Ti-Si alloys, properties determined were porosity and yield strength in compression.

Keywords: titanium, silicon, porous, biomaterial

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References

[1] NOVÁK P., SITA L., KNAISLOVÁ A., VOJTĚCH D., Powder metallurgy preparation of porous titanium for medica implants, *Metal* 2012.

[2] OH I.-H., NOMURA N., MASAHASHI N., HANADA S., Mechanical properties of porous titanium compacts prepared by powder sintering, *Scripta Materialia*, 49 (2003) 1197-1202

[3] VOJTĚCH D., KUBÁSEK J., VODĚROVÁ M., Structural, mechanical and in vitro corrosion characterization of as-cast magnesium based alloys for temporary biodegradable medical implants, *Manufacturing technology*, 12/2012, pages 285-292

[4] GEETHA, M. ET AL., Ti based biomaterials, the ultimate choice for orthopaedic implants – A review, *Progress in Materials Science*, 54 (2009), 397 – 425.

[5] BARBAS A., BONNET A.S., LIPINSKI P., PESCI R., DUBOIS G, Application of reaction sintering to the manufacturing of a spacecraft combustion chamber of SiC ceramics, *Journal of Materials Processing Technology*, 192 (2002) 408-411.

[6] NOVÁKOVÁ L., HOMOLA P., KAFKA V., Microstructure Analysis of Titanium Alloys after Deformation by means of Asymmetric Incremental Sheet Forming, *Manufacturing technology*, 12/2012, pages 201-206

[7] NOVÁK P., MICHALCOVÁ A., MAREK I., VODĚROVÁ M., VOJTĚCH D., Possibilities of the observation of chemical reactions during the preparation of intermetallics by reactive sintering, *Manufacturing technology*, 12/2012, pages 197-201

[8] RILEY, D.P., Synthesis and characterization of SHS bonded Ti5Si3 on Ti substrates, *Intermetallics*, 14 (2006), 770 – 775.

[9] GEPREEL, M. A.-H., NIINOMI, M., Biocompatibility of Ti-alloys for long-term implantation, *Journal of the Mechanical Behavior of Biomedical Materials*, 20 (2013), 407 – 415.

[10] ZHANG, L., WU, J., Ti_5Si_3 and Ti_5Si_3-based alloys: alloying behavior, microstructure and mechanical property evaluation, *Acta Materialia*, 46 (1998), 3535 – 3546.

[11] MEYERS, M.A., CHAWLA, K.K. (2009). Mechanical behavior of materials, CAMBRIDGE UNIVERSITY PRESS.

[12] CASTELLANI, C., LINDTNER, R.A., HAUSBRANDT, P., et al. (2011). Bone–implant interface strength and osseointegration: Biodegradable magnesium alloy versus standard titanium control. *Acta Biomaterialia*, 7, 1, pp. 432-440.

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Mechanical and corrosion properties of Mg based alloys considered for medical applications as biodegradable materials

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Magnesium and its alloys are considered as suitable biodegradable materials which can be gradually dissolved in organism without production of toxic compounds. The present study is oriented on new group of possible biodegradable materials based on Mg-LMM (Mg- low melting metals) alloys. Due to the limited information about the effect of Ga, Sn and In on mechanical and corrosion properties, structure studies, mechanical and corrosion testing were performed. Corrosion behaviour of materials was studied using measuring of weight changes, Mg ions release and also by EIS technique in SBF (simulated body fluid) that is close in composition with human plasma. The obtained results indicate positive effect of both Ga and Sn on tensile and compressive properties, compared to the almost neglectable effect of In. On the contrary, all materials were characterized by decreased corrosion resistances compared to pure Mg. Mainly structure conditions were responsible for observed differences in corrosion rates.

Keywords: magnesium, tensile properties, compressive properties, corrosion

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References

[1] SEITZ, Jan-Marten, WULF, Eric, FREYTAG, Patrik, BORMANN, Dirk, et al. The Manufacture of Resorbable Suture Material from Magnesium. *Advanced Engineering Materials*, 2010, 12(11), 1099-1105.

[2] KRAUSE, Annett, HÖH, Nina, BORMANN, Dirk, KRAUSE, Christian, et al. Degradation behaviour and mechanical properties of magnesium implants in rabbit tibiae. *Journal of Materials Science*, 2010/02/01 2010, 45(3), 624-632.

[3] THOMANN, M., KRAUSE, Ch, BORMANN, D., VON DER HÖH, N., et al. Comparison of the resorbable magnesium . alloys LAE442 und MgCa0.8 concerning their mechanical properties, their progress of degradation and the bone-implant-contact after 12 months implantation duration in a rabbit model. *Materialwissenschaft Und Werkstofftechnik*, 2009, 40(1-2), 82-87.

[4] NOVAKOVA, Lucie, HOMOLA, Petr AND KAFKA, Vaclav Microstructure Analysis of Titanium Alloys after Deformation by means of Asymmetric

[5] Incremental Sheet Forming. *Manufacturing technology*, 2012, 12(13), 201-206.

[6] WITTE, Frank, HORT, Norbert, VOGT, Carla, COHEN, Smadar, et al. Degradable biomaterials based on magnesium corrosion. *Current Opinion in Solid State and Materials Science*, 2008, 12(5–6), 63-72.

[7] AMBROSE, Catherine G. AND CLANTON, Thomas Oscar Bioabsorbable Implants: Review of Clinical Experience in Orthopedic Surgery. *Annals of Biomedical Engineering*, 2004, 32(1), 171-177.

[8] WITTE, F., KAESE, V., HAFERKAMP, H., SWITZER, E., et al. In vivo corrosion of four magnesium alloys and the associated bone response. *Biomaterials*, 2005, 26(17), 3557-3563.

[9] WAIZY, Hazibullah, DIEKMANN, Julia, WEIZBAUER, Andreas, REIFENRATH, Janin, et al. In vivo study of a biodegradable orthopedic screw (MgYREZr-alloy) in a rabbit model for up to 12 months. *Journal of Biomaterials Applications*, January 3, 2013 2013.

[10] WANG, Guixue, GE, Shuping, SHEN, Yang, WANG, Honggang, et al. Study on the biodegradability and biocompatibility of WE magnesium alloys. *Materials Science and Engineering: C*, 2012, 32(8), 2190-2198.

[11] STAIGER, Mark P., PIETAK, Alexis M., HUADMAI, Jerawala AND DIAS, George Magnesium and its alloys as orthopedic biomaterials: A review. *Biomaterials*, 2006, 27(9), 1728-1734.

[12] EDDY JAI POINERN, Gérrard, BRUNDAVANAM, Sridevi AND FAWCETT, Derek Biomedical Magnesium Alloys: A Review of Material Properties, Surface Modifications and Potential as a Biodegradable Orthopaedic Implant. *American Journal of Biomedical Engineering*, 2013, 2(6), 218-240.

[13] KRAUS, Tanja, FISCHERAUER, Stefan F., HÄNZI, Anja C., UGGOWITZER, Peter J., et al. Magnesium alloys

for temporary implants in osteosynthesis: In vivo studies of their degradation and interaction with bone. *Acta Biomaterialia*, 2012, 8(3), 1230-1238.

[14] XIN, Y., HU, T. AND CHU, P. K. In vitro studies of biomedical magnesium alloys in a simulated physiological environment: a review. *Acta Biomater*, Apr 2011, 7(4), 1452-1459.

[15] DALIBOR, Vojtěch, JIŘÍ, Kubásek AND MILENA, Voděrová Structural, mechanical and in vitro corrosion characterization of as-cast magnesium based alloys for temporary biodegradable medical implants. *Manufacturing technology*, 2012, 12(13), 201-206.

[16] LICHÝ, Petr, BEŇO, Jaroslav AND CAGALA, Michal Inoculant Addition Effect on Thermomechanical and Thermophysical Properties of Mg-Sr Magnesium Alloy. *Manufacturing technology*, 2013, 13(1), 64-67.

[17] YANG, M. B. AND PAN, F. S. Effects of Sn addition on as-cast microstructure, mechanical properties and casting fluidity of ZA84 magnesium alloy. *Materials & Design*, Jan 2010, 31(1), 68-75.

[18] LIU, Xianbin, SHAN, Dayong, SONG, Yingwei, CHEN, Rongshi, et al. Influences of the quantity of Mg2Sn phase on the corrosion behavior of Mg–7Sn magnesium alloy. *Electrochimica Acta*, 2011, 56(5), 2582-2590.

[19] NAYYERI, G. AND MAHMUDI, R. Effects of Sb additions on the microstructure and impression creep behavior of a cast Mg-5Sn alloy. *Materials Science and Engineering a-Structural Materials Properties Microstructure and Processing*, Jan 15 2010, 527(3), 669-678.

[20] GU, X., ZHENG, Y., CHENG, Y., ZHONG, S., et al. In vitro corrosion and biocompatibility of binary magnesium alloys. *Biomaterials*, Feb 2009, 30(4), 484-498.

[21] FENG, Y., WANG, R. C. AND PENG, C. Q. Influence of freezing rate on microstructure and electrochemical properties of Mg-2%Ga alloys. *Transactions of Nonferrous Metals Society of China*, May 2011, 21(5), 1047-1051.

[22] LIU, HongBin, QI, GuoHong, MA, YuTao, HAO, Hai, et al. Microstructure and mechanical property of Mg–2.0Ga alloys. *Materials Science and Engineering: A*, 2009, 526(1-2), 7-10.

[23] MELNIKOV, P., TEIXEIRA, A. R., MALZAC, A. AND COELHO, M. D. Gallium-containing hydroxyapatite for potential use in orthopedics. *Materials Chemistry and Physics*, Sep 15 2009, 117(1), 86-90.

[24] TANAKA, A., HIRATA, M., KIYOHARA, Y., NAKANO, M., et al. Review of pulmonary toxicity of indium compounds to animals and humans. *Thin Solid Films*, Mar 31 2010, 518(11), 2934-2936.

[25] GALE, W. F. AND TOTEMEIER, T. C. Smithells Metals Reference Book (8th Edition). In.: Elsevier.

[26] XIN, Y., HU, T. AND CHU, P. K. In vitro studies of biomedical magnesium alloys in a simulated physiological environment: A review. *Acta Biomaterialia*, 2011, 7(4), 1452-1459.

[27] ATRENS, Andrej, LIU, Ming AND ZAINAL ABIDIN, Nor Ishida Corrosion mechanism applicable to biodegradable magnesium implants. *Materials Science and Engineering: B*, 2011, 176(20), 1609-1636.

[28] BRATSCH, S. G. Standard Electrode-Potentials and Temperature Coefficients in Water at 298.15-K. *Journal of Physical and Chemical Reference Data*, 1989, 18(1), 1-21.

[29] HASSAN, S. AND GUPTA, M. Effect of different types of nano-size oxide particulates on microstructural and mechanical properties of elemental Mg. *Journal of Materials Science*, 2006, 41(8), 2229-2236.

[30] XU, D. K. AND HAN, E. H. Effects of icosahedral phase formation on the microstructure and mechanical improvement of Mg alloys: A review. *Progress in Natural Science-Materials International*, Oct 2012, 22(5), 364-385.

[31] JAMESH, M., KUMAR, Satendra AND SANKARA NARAYANAN, T. S. N. Corrosion behavior of commercially pure Mg and ZM21 Mg alloy in Ringer's solution – Long term evaluation by EIS. *Corrosion Science*, 2011, 53(2), 645-654.

[32] WANG, M. Y., XU, Y. J., JING, T., PENG, G. Y., et al. Growth orientations and morphologies of alpha-Mg dendrites in Mg-Zn alloys. *Scripta Materialia*, Oct 2012, 67(7-8), 629-632.

[33] ZHANG, X. L., CHEN, G. AND BAUER, T. Mg-based bulk metallic glass composite with high bio-corrosion resistance and excellent mechanical properties. *Intermetallics*, Oct 2012, 29, 56-60.

[34] ZUCCHI, F., GRASSI, V., FRIGNANI, A., MONTICELLI, C., et al. Electrochemical behaviour of a magnesium alloy containing rare earth elements. *Journal of Applied Electrochemistry*, 2006, 36(2), 195-204.

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Possibility of affecting the casting structure of magnesium alloys

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Magnesium alloys belong to materials, which are nowadays more and more often used for various technical applications. Their principal advantage consists in their low specific mass and high specific strength, while their drawbacks consist, among other, namely in low mechanical properties at higher temperatures. Obtaining of fine grained structure can be achieved by high cooling effect of the mould. This can be ensured by use of metallic mould, especially in combination for example with die casting, or with low-pressure casting or gravity casting. Some other casting procedures exist, however, such as casting into expendable moulds, the cooling effect of which is substantially weaker. In these cases it is necessary to achieve the fine grained structure in another way. In this case an important role can be played by inoculation of material, i.e. addition of suitable nuclei. This paper deals with the influence of the inoculation on microstructure and thermo-mechanical properties of castings based on selected magnesium alloys.

Keywords: magnesium alloys, thermo-mechanical properties, microstructure, inoculation

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References

[1] DRAPALA, J.; KUCHAR, L.; TOMASEK, K.; TROJANOVA, Z. (2004). Magnesium, its alloys and Mg – admixture binary system. VŠB –TU Ostrava, 2004, 172 p. ISBN 80-248-0579-0.

[2] MORDIKE, B. L.; EBERT, T. (2001). Magnesium properties - applications - potential. *Materials Science and Engineering A*, Vol. 30, No.1, pp. 37-45.

[3] ROSKOSZ, S.; ADAMIEC, J.; BLOTNICKI, M. (2007) Influence of delivery state quality on microstructure and mechanical properties of as cast AZ91 Mg alloy. *Archives of Foundry Engineering*, Vol. 7, No. 1, pp. 143-146.

[4] VOJTECH, D., KUBASEK, J., VODEROVA, M. (2012). Structural, mechanical and in vitro corrosion characterization of as temporary biodegradable medical implants. *Manufacturing Technology*, Vol. 12, No. 13, pp. 292-296.

[5] ZHANG, W., SHEN, Y., PAN, H., LIN, K., LIU, X., DARVELL, B. W., HUANG, W. (2011). Effects of strontium in modified biomaterials. *Acta Biomaterialia*, Vol. 7, No. 2, pp. 800-808.

[6] BŘUSKA,M. at al. (2013): Influence of repeated remelting of the alloy RR.350 on structure and thermo-mechanical properties, *Manufacturing Technology*, Vol. 13, No. 1, pp. 31-35.

[7] KUBOTA, K., MABUCHI, M., HIGASHI, K. (1999). Processing and mechanical properties of fine-grained magnesium alloys. *Journal of Materials Science*, Vol. 34, No. 10, pp. 2255-2262.

[8] ST JOHN, D. H.; QIAN, M.; EASTON, M. A.; PENG CAO; HILDEBRAND, Z. (2005). Grain Refinement of Magnesium Alloys, *Metallurgical and Materials Transactions A*, Vol. 36, No. 7, pp. 1669-1679.

[9] ZENG, X., WANG, Y., DING, W., LUO, A. A., & SACHDEV, A. K. (2006). Effect of strontium on the microstructure, mechanical properties, and fracture behavior of AZ31 magnesium alloy. *Metallurgical and Materials Transactions A: Physical Metallurgy and Materials Science*, Vol. 37, No. 4, pp. 1333-1341.

[10] LEE, Y. C., DAHLE, A. K., STJOHN, D. H. (2000). The role of solute in grain refinement of magnesium. *Metallurgical and Materials Transactions A: Physical Metallurgy and Materials Science*, Vol. 31, No. 11, pp. 2895-2906.

[11] LICHÝ, P., BEŇO, J., CAGALA, M. (2013). Inoculant Addition Effect on Thermomechanical and Thermophysical Properties of Mg-Sr Magnesium Alloy, *Manufacturing Technology*, Vol. 13, No. 1, pp. 64-67.

[12] GREER, A. L., BUNN, A. M., TRONCHE, A., EVANS, P. V., BRISTOW, D. J. (2000). Modelling of inoculation of metallic melts: Application to grain refinement of aluminium by Al-Ti-B. *Acta Materialia*, Vol. 48, No. 11, pp. 2823-2835.

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Evaluation of vibration on technological devices

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Keywords: Vibration, Grinding, Surface quality, Roughness

Research paper discuss the possibility of vibration detection on production machine and also presents devices and methodology for evaluation of vibration amplitude using non-contact laser interferometer and contact piezoelectric vibration sensors. Experimentally determines the influence of technological conditions on the quality of functional surfaces. Furthermore, paper evaluates the influence of technological conditions during planar grinding on the vibration amplitude of the grinding spindle and presents correlation between grinder vibration amplitude and quality of the product.

References

[1] BÍLEK, O., LUKOVICS, I. Model of Dynamics within Highspeed Grinding Process. In DUSE, D.M. ; BRINDASU, P.D.; BEJU, L.D. (eds.). *MSE 2009: Proceedings of the Manufacturing Science and Education.* Sibiu, Romania, June 4-6. Sibiu: Lucian Blaga University of Sibiu, 2009, p. 11-14. ISSN 1843-2522.

[2] HOLEŠOVSKÝ, F., NOVÁK, M., MICHNA, Š. Studium změn broušené povrchové vrstvy při dynamickém zatěžování. *Strojírenská technologie*. s. 73-76. ISSN 1211-4162.

[3] JURKO, J., LUKOVICS, I. *Obrábateľnosť materiálov*. 1.vyd, Zlín: UTB, 2008. 144p. ISBN 978-80-7318-736-1.

[4] KUNDRÁK, J. Alternative machining procedures of hardened steels. *Manufacturing technology*. 2011, vol 11, no. 11., pp. 32-39, ISSN 1213-2489.

[5] LUKOVICS, I., BÍLEK, O. High Speed Grinding Process. *Manufacturing Technology*, 2008, 8, 12-18. ISSN 1213248-9.

[6] LUKOVICS, I., BÍLEK, O. Precise Grinding. *7th International Tools Conference*. Zlín, 3.-4.2.2009. ISBN 978-80-7318-794-1.

[7] MONKA, P., MONKOVA, K., ZAJAC, J. Multi Variant Process Plans. In. *DAAAM International Scientific Book 2009*, Vienna : DAAAM Int., 2009, ISBN 978-3-901509-69-8.

[8] NOVÁK, M. Možnosti hodnocení kvality obrobených povrchů. *Strojírenská technologie*. 2010, zvl. vydání, Ústí n. Labem : FVTM UJEP, s. 195-198. ISSN 1211-4162.

[9] NOVÁK, P., MÁDL, J. Effective Evaluation of Measured Dynamic Values of Cutting Forces and Torques. *Manufacturing Technology*, vol. I, 2001, pp 56-62, ISSN 1213248-9.

[10] PANDA, A., JURKO, J., KURILOVSKÝ, T. Výroba pre automobilový priemysel. In *15th International scientific conference: Quality and reliability of technical systems*. 2010. pp. 377–382. ISBN 978-80-552-0390-4.7

[11] KUNDRAK, J., MAMALIS, A. G., GYANI, K., BANA, V. Surface layer microhardness changes with high-speed, *The International Journal of Advanced Manufacturing Technology.* Volume 53, Issue 1-4 (2011), pp.105-112 DOI: 10.1007/s00170-010-2840-y

[12] LUKOVICS, I., ROKYTA, L. Influence of the Technological Conditions on Quality by Grinding. *Strojírenská technologie*, 2010, roč. 14, s. 151-154. ISSN 1211-4162

[13] LUKOVICS, I., BÍLEK, O., HOLEMÝ, S., Development of Grinding Wheels for Tools Manufacturing. *Manufacturing Technology*, 2010, č.10, s.10-16. ISSN 1213-2489

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The Effect of Chemical Elements on the Machinability of Aluminium Alloys

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Machinability of materials is evaluated by different criteria. The basic evaluative criteria are based on tool wear. However, there are other criteria, for instance chip formation, cutting temperature, forces of cutting, etc. Machinability for different criteria depends on many factors, of which the most important is the chemical composition of the material. It is possible to divide machinability tests into two groups: Long-term tests and short-term tests. Short-term machinability tests are less objective than long-term ones, but they have the advantage of short duration and lower material consumption. This paper is focused on the experimental determination of the effect of chemical composition on the machinability of aluminium alloys. For testing three different short-term tests were used. The results were evaluated by correlation coefficients. All used tests led to the same results.

Keywords: machinability, aluminum alloys, chemical elements, machinability tests

References

[1] MÁDL, J. *Experimentální metody v obrábění*. ČVUT: Praha, 1988.

[2] KOCMAN, K., PROKOP, J. *Technologie obrábění*. 2. vyd. Brno: Akademické nakladatelství CERM, 2005. 270 s. ISBN 80-214-2068-0.

[3] BAMBULA, M. *Hodnocení obrobitelnosti slitin hliníku - kritéria hodnocení* Brno: VUT, FS, ÚST. 2008. 27 s.

[4] HUMÁR, A. *Technologie I, Technologie obrábění – 1. část* [online] VUT v Brně, FS, 2003. 138 s. Avaible on WWW: <http://ust.fme.vutbr.cz/obrabeni/opory-save/TI_TO-1cast.pdf>.

[5] MÁDL, J., SCHUBERT, V. *Experimentální metody a optimalizace v teorii obrábění*. Praha: ČVUT, 1985.

[6] MICHNA, Š., LUKÁČ I., OČENÁŠEK V. et al. *Aluminium materials and technologies from A to Z.* Přerov: Adin, s. r. o., 2007. 632 s. ISBN 978-80-89244-18-8.

[7] MICHNA, Š. et al. *Encyklopedie hliníku.* 1. vyd. Prešov: Adin, 2005. 700 s. ISBN 80-89041-88-4.

[8] Čep, R.; Hatala, M.; Orlovský, I. Metody zkoušek obrobitelnosti materiálů. *Automobil industry* , 2009, č. 3.

[9] DAVIS, J. R. & Associates. *Aluminium and aluminium alloys*. USA: ASM International, Handbook Committee, 1993. 5th edition, 784 s. ISBN 9780871704962.

[10] Sunil steel, Victoria Over Bridge Road 286, Opp. Britania Industries, Darukhana, Mumbai, India [online]. [cit. 19.3.2013]. Avaible on WWW: <http://www.sunilsteel.com/influence.htm>.

[11] TUMLÍK, Metal Cutting Technologies. *Vliv jednotlivých prvků na vlastnosti ocelí* [online]. [cit. 19.3.2011]. Avaible on WWW: <http://www.tumlikovo.cz/vliv-jednotlivych-prvku-na-vlastnosti-oceli/>.

[12] KLAPSIA, J., *Vývoj v automatových ocelích, zvyšování obrobitelnosti bismutem, olovem v TŽ,* a. s., Trinecké železárny, a.s., Trinec, Czech Republic, 2006.

[13] ACSteel a.s., Strojnická 374, 737 01 Český Těšín, Zlepšení obrobitelnosti ocelí – akt. 4.11.2008 [online]. [cit. 19.3.2013]. Avaible on WWW: <http://www.acsteel.cz/down/obrobitelnost.oceli.pdf>.

[14] MAEKAWA, K.; OBIKAWA, T.; YAMANE, Y. *Metal Machining: Theory and Applications*. Butterworth-Heinemann; London : ARNOLD, 2000. 408 s. ISBN 0-340-69159-X.

[15] STRNAD, T. *Obrobitelnost austenitické ocele.* Plzeň, ZČU – FS, KTO, 2011.

[16] KŘÍŽ, A., et al. Obrábění slitiny AlSiMg0,5Mn nástroji s progresivními tenkými vrstvami [online]. In*: 5th international konference Aluminium,* 2007. Staré Splavy. 21 s. Avaible on WWW: <http://www.ateam.zcu.cz/download/prispevek_Aluminium07.pdf>

[17] KOURIL, M., SPÁCILOVÁ, J. Nástroje pro obrábění hliníkových slitin s mikroleštěným povrchem. *MM Prumyslové spektrum č. 4., 2002. 61s.* Avaible on WWW: <http://www.mmspektrum.com/clanek/nastroje-pro-obrabeni-hlinikovych-slitin-s-mikrolestenym-povrchem>

[18] Aluminium Taschenbuch, Aluminium-Verlag, Duseldorf, 1988.

[19] NOVAK, M. Surfaces with High Precision of Roughness after Grinding. In *Manufacturing Technology*, Vol.

12., No. 12., pp. 66-70, ISSN 1213-2489.

[20] MADL, J., Surface Proprieties in Precise and Hard Machining. In *Manufacturing Technology*, Vol. 12., No. 13., pp. 158-166. ISSN 1213-2489.

[21] MADL, J., NAPRSTKOVA, N. Research into the causes cracking of aluminum alloys of Al – Cu during mechanical Machining. In *Manufacturing Technology*, Vol. 12., No. 12., pp. 47-51, ISSN 1213-2489.

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Properties of metallic nanocrystalline powders

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Nanocrystalline metals are advanced materials with structural constituents smaller than 100 nm. With respect to structure, they are characterized by high strength and hardness, gas absorption capability, high specific surface area, catalytic activity or magnetic properties. These properties predispose them for using in wide spectrum of possible applications, namely advanced structural and functional applications, biomedicine, catalysis or electronics. Many methods have been developed for producing nanocrystalline metals or nanocrystalline metallic powders including precipitation from supersaturated liquids, severe plastic deformation, cryo-melting, or inert gas condensation. In this work, another promising method - selective dissolving of aluminium alloy was successfully appliedfor preparation of nanocrystalline copper powder and this powder was consequently used for producing of bulk nanocrystalline material with enhanced hardness and strength.

Keywords: nanocrystalline metals, metallic powders, structure, hardness

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References

[1] LU, K. (1996). Nanocrystalline metals crystallized from amorphous solids: nanocrystallization, structure, and properties.*Materials Science and Engineering R*, Vol. 16, pp. 161-221.

[2] LIN, H.-M., HSIEH, S.-H., LEE, P.Y., LAI, M.-S., WU, J.S. (1993). Synthesis and characterization of nanocrystalline powders of pure nickel and copper.*Material Chemistry and Physics*, Vol. 34, pp. 205-213.

[3] BIRRINGER, R. (1989). Nanocrystalline materials.*Materials Science and EngineeringA*, Vol. 117, pp. 33-43.

[4] TJONG, S.C., HAYDN, Ch. (2004). Nanocrystalline materials and coatings. *Materials Science and Engineering R*, Vol. 45, pp. 1-88.

[5] MEYERS, M.A., MISHRA, A., BENSON, D.J. (2006). Mechanical properties of nanocrystalline materials. *Progress in Materials Science*, Vol. 51, pp. 427-556.

[6] SANDERS, P.G., EASTMAN, J.A., WEERTMAN, J.R. (1997). Elastic and tensile behavior of nanocrystalline copper and palladium. *Acta Materialia*, Vol. 45, No. 10, pp. 4019-4025.

[7] CHEN, S.-J., LI, X.-B., NIU, G., YI, Z., CHEN, Y., LUO, J.-S., TANG, Y.-J., SUN, W.-G. (2012). Synthesis and characterization of single-phase nanocrystalline Ag_2Al particles. *Transactions of Nonferrous Metals Society of China*, Vol. 22, pp. 134-138.

[8] KUMAR, K.S., VAN SWYGENHOVEN, H., SURESH, S. (2003). Mechanical behavior of nanocrystalline metals and alloys. *Acta Materialia*, Vol. 51, pp. 5743-5774.

[9] HANLON, T., KWON, Y.-N., SURESH, S. (2003). Grain size effects on the fatigue response of nanocrystalline metals. *Scripta Materialia*, Vol. 49, pp.675-680.

[10] SURYANARAYANA, C., KOCH, C.C., (2000). Nanocrystalline materials – Current research and future directions. *Hyperfine Interactions*, Vol. 130, pp. 5-44.

[11] GLEITER, H. (1989). Nanocrystalline materials. *Progress in Materials Science*, Vol. 33, pp. 223-315.

[12] GUTMANAS, E.Y., TRUSOV, L.I., GOTMAN, I. (1994). Consolidation, microstructure and mechanical properties of nanocrystalline metal powders. *NanoStructured Materials*, Vol. 4, No. 8, pp. 893-901.

[13] HUANG, Y.K., MENOVSKY, A.A., de BOER, F.R. (1993). Electrical resistivity of nanocrystalline copper. *NanoStructured Materials*, Vol. 2, No. 5, pp. 505-513.

[14] DREIZIN, E.L. (2009). Metal-based reactive nanomaterials. *Progress in Energy and Combustion Science*, Vol. 35, pp. 141-167.

[15] CHAMPION, Y., BIGOT, J. (1998). Synthesis and structural analysis of aluminium nanocrystalline powders.

NanoStructured Materials, Vol. 10, No. 7, pp. 1097-1110.

[16] SURYANARAYANA, C. (1995). Nanocrystalline materials. *International Materials Reviews*, Vol. 40, No. 2, pp. 41-64.

[17] MICHALCOVA, A., VOJTECH, D. (2012). Structure of rapidly solidified aluminium alloys. *Manufacturing Technology*, Vol. 12, pp. 166-169.

[18] NOVA, I., MACHUTA, J. (2012). Squeeze casting results of aluminium alloys. *Manufacturing Technology*, Vol. 12, pp. 73-79.

[19] VOJTECH, D., MICHALCOVA, A., KNOTEK, V., MAREK, I. (2012). Study of nano-crystalline metals prepared by selective chemical leaching. *Manufacturing Technology*, Vol. 12, pp. 292-296.

[20] MEYERS, M.A., CHAWLA, K.K. (2009). Mechanical behavior of materials. CAMBRIDGE UNIVERSITY PRESS.

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Preparation of Metallic Nanoparticles

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Nanomaterials are substances with high application potential. It this article, the preparation technique are reviewed with aiming on selective leaching method. This method is based on preparation of conviniet binary alloy in form of supersaturated solid solution and consequent matrix dissolution. In the same time, the minor element forms nanoparticles. The need of rapid solidification of binary precursor before leaching is explained. Nanoparticles from Ni and Ag prepared by selective leaching form AlNi20 and MgAg10 alloys, were characterized by X-ray diffraction and by electron microscopy (SEM and TEM).

Keywords: nanomaterials, metallic nanoparticles, selective leaching

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References

[1] Adlim (2006). Preparations and application of metal nanoparticles. Indo. J. Chem 6 (1), pp. 1-10

[2] RUSZ S., et al. (2008). Increase of efficiency of the ECAP technology at grain refinement of the alloy AlMn1Cu. Archives of Materials Science and Engineering 34 (1), pp. 52-56

[3] http://en.wikipedia.org/wiki/Severe_plastic_deformation (31/08/2013)

[4] VOJTĚCH D. (2012). Prášková metalurgie jako metoda zpracování hliníkových odpadů s vysokými obsahy železa. Strojírenská technologie 17, pp. 127-132.

[5] INOUE A., TAKEUCHI A. (2004). Recent progress in bulk glassy, nanoquasicrystalline and nanocrystalline alloys. Materials Science and Engineering: A 375 – 377, pp. 16–30

[6] GALANO M. et al. (2010). Nanoquasicrystalline Al–Fe–Cr-based alloys with high strength at elevated temperature. Journal of Alloys and Compounds 495, pp. 372–376

[7] MICHALCOVÁ A., et al. (2010). Structure and mechanical properties of AlCr6Fe2Ti1 alloy produced by rapid solidification powder metallurgy method. International Journal of Materials Research 101 (2), pp. 307-309

[8] TAPAN, K. et al. Complex-Shaped Metal Nanoparticles, Wiley-Verlag, 1. Edition, Weinheim, Germany, 2012

[9] TAO, A.R. et al. (2008). Shape Control of Colloidal Metal Nanocrystals. Small 4, pp. 310 – 325

[10] ZHENMENG, P. et al. (2009). Designer platinum nanoparticles: Control of shape, composition in alloy, nanostructure and electrocatalytic property. NanoToday 4, pp. 143‑164

[11] SARDAR, R. et al.(2009). Gold nanoparticles: Past, present, and future. Langmuir 25, pp. 13840-13851

[12] http://water.usgs.gov/wrri/08grants/progress/2008RI75B.pdf (21/06/2012)

[13] POZO PEREZ D., Silver Nanoparticles, In-Teh, , 1 edition Vukovar, Croatia, 2010

[14] KOTLÍK P., proceedings of Nanomateriály v památkové péči, Společnost pro technologie ochrany památek, 17. května 2012 Praha, pp. 4-9

[15] ŽOUŽELKA R., proceedings of Nanomateriály v památkové péči, Společnost pro technologie ochrany památek, 17. května 2012 Praha, pp. 38-43

[16] KALER, A. et al.(2010). Green synthesis of silver nanoparticles. Current Research and Information on Pharmaceutical Sciences 11, pp. 68-71

[17] STOBRAWA, J.P.et al., (2007). Structure and properties of dispersion hardened submicron grained copper.Journal of Achievements in Materials and Manufacturing Engineering 20 (1-2), pp. 195-198

[18] DE STEFANO D. Et al. (2012). Nanomaterials Toxicity and Cell Death Modalities. Journal of Drug Delivery, pp. 1-14

[19] VOJTECH D., (2012). Study of nano-crystalline metals prepared by selective chemical leaching, Manufacturing technology 12, pp.292-296.

[20] MASSALSKI T. B.: Binary alloy phase diagrams. ASM International, (1990)

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Analysis of Causes of Al_2MgO_4-Type Spinel Inclusions Formation in Al-Mg Alloys during Low-Pressure Casting

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The aim of the research was to identify and analyze the nature and causes of black inclusions formation on a cast surface of AlMg3 alloy. Forms used in tires production are made of AlMg3 alloy by low-pressure casting technology. Four areas with the same shape and coloring of inclusions are marked on the figure Fig. 1. These areas underwent macroscopic and microscopic analysis. In regions of inclusions appearance several surface EDS analyzes were performed with the aim to determine chemical composition of the inclusions. EDS analyzes showed that the inclusions are in fact Al_2MgO_4-type spinel inclusions which appear for Al-Mg alloys with higher amount of Mg (above 1 – 2 %). As far as the theory of the problem is concerned, possible causes of spinel inclusions formation are described in the literature [1, 2, 3, 4]. Other possible causes of spinel inclusions formation considering low-pressure casting of AlMg3 alloy found during long-term research of low-pressure casting of Al-Mg type alloys are mentioned in [5].

Keywords: spinel inclusions, low-pressure casting, AlMg3 alloy, EDS analysis, macroscopic and microscopic analysis

References

[1] BOLIBRUCHOVÁ, D., TILLOVÁ, E.: *Zlievárenské zliatiny* Al-Si, ŽU v Žiline – EDIS, 2005, ISBN 80-8070-485-6.

[2] MICHNA, S., LUKÁČ, I. a kol.: *Encyklopedie hliníku*, 720 str., Adin s.r.o., Prešov SR, 2005, ISBN 80-89041-88-4.

[3] MICHNA, S., LUKÁC, I.: *Barevny kontrast, struktury a vady u hliniku a jeho slitin*, 214 str. Delta Print, Děčín, ČR, ISBN 80-239-1636-X.

[4] LUKÁČ, I.; MICHNA, S.: *Colour Contrast, Structure and Defects in Aluminium and Aluminium Alloys*, pp. 168, September 2001, Cambridge International Science Publishing GB, ISBN 1-898326-70-3.

[5] MONDOLFO, L. F.: *Aluminium Alloys, Structure and Properties*, Butterworths, London 1979.

[6] MICHNA, S., KUŚMIERCZAK, S.: *Praktická metalografie*, UJEP v Ústí nad Labem 2012, ISBN 978-80-7414-503-2.

[7] NOVÁ, I., SOLFRONK, P., NOVÁKOVÁ, I.: *Vliv množství dislokací na tvařitelnost slitin hliníku*, Strojírenská technologie, XVI/2, r. 2011, str. 28-34, ISSN 1211-4162.

[8] VAJSOVÁ, V.: Structural inhomogeneity by Al-Cu alloys casting into metal and bentonic form. *Transactions of the Universities* of Košice, r. 2009, č. 1. ISSN 1355-2334.

[9] MICHNA, Š., NÁPRSTKOVÁ, N., LUKÁČ I. : Mechanical Properties Optimization of AlSi12CuMgNi Alloy by Heat Treatment. *Metallofizika i Noveishie Teknologii*, 11 / 2011, ISSN 1024-1809.

[10] VAJSOVÁ, V., MICHNA, Š.: Optimization of AlZn5,5Mg2,5Cu1,5 Alloy Homogenizing Annealing, *Metallofizika i Noveishie Teknologii*, Volume 32, No 7, July 2010, str. 949 – 959, ISSN 1024-1809.

[11] MICHNA, Š., MAJRICH, P.: An analysis of the Process of Melting Food Packaging and Acquiring the Aluminium Alloy, *Металлург*, 11/2012, ISSN 0026 – 0827 (IMPACT).

[12] MICHNA, S., NÁPRSTKOVÁ, N.: Research into the causes cracking of aluminum alloys of Al – Cu during mechanical machining, *Manufacturing Technology*, vol. 12, No. 12, June 2012, pp. 47-51, ISSN 1213-2489.

[13] WEISS, V., STŘIHAVKOVÁ, E.: Influence of the homogenization annealing on microstructure and mechanical properties of AlZn5,5Mg2,5Cu1,5 alloy, *Manufacturing Technology*, vol. 12, No. 13, December 2012, pp. 297-302, ISSN 1213-2489.

[14] WEISS, V., KVAPILOVÁ, I.: Assessment of the effect of temperature and annealing time homogenization AlCu4MgMn alloys in terms of microstructure image analysis methods and EDX, *Manufacturing Technology*, vol. 13, No. 1, March 2013, pp. 123-127, ISSN 1213-2489.

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Influence of strontium in AlSi7Mg0.3 alloy on the tool wear

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Al-Si alloys are leading casting alloys based on aluminum. Machining of aluminum alloys is currently frequently used and it is an important area of production. The paper deals with an experiment that was conducted at the Faculty of Production Technology and Management, University of Jan Evangelista Purkyně in Ústí nad Labem, where was machined alloy AlSi7Mg0,3. Samples were made for processing from the master alloy AlSi7Mg0,3, subsequently unmodified and modified of strontium Sr. This paper describes the evaluation of tool wear in terms of how or strontium modification may affect (reduce) the tool wear.

Keywords: modification, machining, tool, silumin, cutting insert

References

[1] BILÍK, O. *Obrábění I – 1. díl*. Ostrava : VŠB-TU Ostrava, 2001. 136 s. ISBN 80-7078-811-9.

[2] MICHNA, Š., LUKÁČ, I., OČENÁČEK, V., KOŘENÝ, R., DRÁPALA, J., SCHNEIDER, H., MIŠKUFOVÁ, A. a kol. *Encyklopedie hliníku*. Adin, Prešov, 2005, ISBN 80-89041-88-4.

[3] MICHNA, Š., KUŚMIERCZAK, S. *Technologie a zpracování hliníkových materiálů*., UJEP. Ústí nad Labem, 2008, ISBN 978-80-7044-998-1.

[4] BOLIBRUCHOVÁ, D., TILLOVÁ, E.. *Zlievarenské Zlatiny Al – Si*. Žilinská universita, Žilina. 2005. ISBN 80-8070-485-6.

[5] ČSN EN 1796 - *Hliník a slitiny hliníku - Odlitky - Chemické složení a mechanické vlastnosti.*

[6] ČAPEK, J. *Analýza vlivu titanu na opotřebení nástroje při obrábění hliníkových slitin*., Bacelor thesis, FVTM UJEP. 2011.

[7] BILÍK, O.; MÁDL, J. Trvanlivost břitu a provozní spolehlivost obráběcího nástroje. Ústí nad Labem : UJEP Ústí nad Labem, 2001. 78 s. Knihovnička *Strojírenská technologie*, sv. 1. ISBN 80-7044-398-8.

[8] CZÁN, A., STANČEKOVÁ, D., ĎURECH, L., ŠTEKLÁČ, D., MARTIKÁŇ, J. Základy opotrebenia pri suchom tvrdom sústružení. Nástroje 2006 - ITC 2006, 5. - 6. september 2006, Zlín.

[9] NOVÁK, M., HOLEŠOVSKÝ, F. 2009. Problematika broušení hliníkových slitin. *Transactions of the University of Košice*, No.4, 2009, Košice, pp. 284-291. ISSN1335-2334.

[10] MÁDL. J., Surface properties in Precise and Hard Machining. *Manufacturing Technology*, Vol 12, No.13, 2012, pp. 158-166, ISSN 1213-2489.

[11] KALINCOVÁ, D. Skúšanie mechanických vlastností materiálov - prehľad meracích metód a zariadení. In *Zvyšovanie efektívnosti vzdelávacieho procesu prostredníctvom inovačných prostriedkov*. KEGA 3/6370/08., TU vo Zvolene, Zvolen. 2010, pp. 13-26.

[12] *ISO 3685* Tool-life testing with single-point turning tools, 1993.

[13] DUGIN, A., POPOV, A. Increasing the accuracy of the effect of processing materiále and cutting tool wear on the ploughingforce values. *Manufacturing Technology*, Vol 13, No.2, 2013, pp.169-173, ISSN 1213-2489.

[14] DUGIN, A., POPOV, A. Effect of the cutting tool wear on the ploughing force value, *Strojirenska technologie*, vol. XVII, No.1,2, 2012, pp. 19-23. ISSN 1211-4162.

[15] SUCHANEK, D., DUŠAK, K. Impact of cutting conditions on tool wear. *Strojirenska technologie*, Vol. XVI, 2011, No.5, pp. 33-37, ISSN 1211-4162.

[16] NAPRSTKOVA, N. Vliv očkovani slitiny AlSi7Mg0,3 očkovadlem AlTi5B1 na opotřebeni nastroje při jejim obraběni, *Strojirenska technologie*, vol. XVII, 2012, No. 5,6, pp. 330-338. ISSN 1211-4162.

[17] MADL, J., KOUT, V., RAZEK, V., STRANSKY, R., DUFEK, V. Metoda pro simulaci zkoušek opotřebeni slinutych karbidů. *Strojirenska technologie*, Vol. IX, No. 1, 2004, pp. 28-32. ISSN 1211-4162.

[18] ŠEBELOVÁ, E., CHLADIL, J. Tool wear and Machinability of wood-based material dutiny Machining Process. *Manufacturing Technology*, Vol 13, No. 2, 2013, pp.231-236, ISSN 1213-2489.

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Modification of AlSi7Mg0.3 alloy by strontium

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Alloy modifying is common practice for improving the structure of the material. One of often used material, where the modification is used is AlSi7Mg0.3 alloy. And modification of AlSi7Mg0.3 is often realized by strontium. The paper deals with an experiment that was realized at the Faculty of Production Technology and Management of Jan Evangelista Purkyně University in Ústí nad Labem, which dealt with the effect of modifications by strontium on the structure of AlSi7Mg0.3. In frame of its experiment were analyzed metallographic samples and were observed structures of unmodified and modified material on the microscope. Was evaluated result of modification on the structure.

Keywords: alloy, modification, silumin, Sr

References

[1] BOLIBRUCHOVÁ, D., TILLOVÁ, E. *Zlievarenské zliatiny Al-Si*. ŽU, Žilina: EDIS – vydavatelstvo ŽU, 2005. ISBN 80-8070-485-6

[2] MICHNA, Štefan, LUKÁČ, Ivan, OČENÁČEK, V., KOŘENÝ, R., DRÁPALA, J., SCHNEIDER, H., MIŠKUFOVÁ, A. a kol. *Encyklopedie hliníku*. Adin, Prešov, 2005, ISBN 80-89041-88-4.

[3] MICHNA, Š., KUŚMIERCZAK, S. *Technologie a zpracování hliníkových materiálů*. UJEP. Ústí nad Labem, 2008. 152 p.

[4] MICHNA, Š., NOVÁ, I. *Technologie a zpracování kovových materiálů*. Adin, Prešov, 2008, ISBN 978-80-89244-38-6

[5] MICHNA, Š. NAPRSTKOVÁ, N. The Mechanical Properties Optimizing of of Al - Si Alloys Precipitation Hardening and the Effect on the Character of the Chip, *Acta Metallurgica Slovaca*, 3/2011, ISSN-1335-1532

[6] TILLOVA, E., FARKAŠOVA, M., CHALUPOVA, M. The Role of Antimony in Modifying of Al-Si-Cu Cast Aloy, Manufacturing Technology, 2013, Vol.13, No.1, pp. 109-114, ISSN 1213-2489

[7] TILLOVA, E., CHALUPOVA, M., HURTALOVA, L., ĎURINIKOVA, E. Quality control of microstructure in recycled Al-Si cast alloys, *Manufacturing Technology*, 2011, Vol.11, No.11, pp. 70-76, ISSN 1213-2489

[8] ČSN EN 1796 - Hliník a slitiny hliníku - Odlitky - Chemické složení a mechanické vlastnosti

[9] KALINCOVÁ, D. Skúšanie mechanických vlastností materiálov - prehľad meracích metód a zariadení. In proceedings *Zvyšovanie efektívnosti vzdelávacieho procesu prostredníctvom inovačných prostriedkov*, KEGA 3/6370/08., TU vo Zvolene, Zvolen. 2010, pp. 13-26.

[10] LIPINSKI T. Microstructure and Mechanical Properties of the AlSi13Mg1CuNi Alloy with Ecological Modifier. *Manufacturing Technology*. 2011, Vol. 11, pp 40-44.

[11] TILLOVA E., CHALUPOVA M., HURTALOVA L., DURINIKOVA, E. Quality Control of Microstructure in Recycled Al-Si Cast Alloys. *Manufacturing Technology*, 2011, Vol. 11, No. 11, pp. 70-76. ISBN 1213-2489

[12] LIPIŃSKI T. Microstructure and Mechanical Properties of the AlSi13Mg1CuNi Alloy With Ecological Modifier, *Manufacturing Technology*, 2011, Vol. 11, No. 11, pp.40-44 ISBN 1213-2489, 2011, ISSN 1213-2489

[13] MICHALCOVA, A., VOJTĚCH, D. Structure of rapidly solidified aluminium alloys. *Manufacturing Technology*, 2012, Vol. 12, No. 13, pp. 166-16, ISSN1213-24891

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The Effect of Modification by Strontium of the AlSi7Mg0.3 Alloy on the Surface Roughness

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Al-Si Alloys are a leading casting alloys based on aluminum. Machining of aluminum alloys is currently frequently used and it is an important area of production. The paper deals with an experiment, that was realized at the Faculty of Production Technology and Management, University of Jan Evangelista Purkyne in Ústí nad Labem, where was machined alloy AlSi7Mg0.3. Samples were made for machining because of the master alloys of AlSi7Mg0.3, where part of the castings was left in its original condition and part of the castings was modified by strontium. This paper describes the evaluation of surface roughness obtained after machining of these castings in terms of how the modification by strontium can affect this.

Keywords: modification, surface roughness, silumin, machining

References

[1] BILÍK, O. *Obrábění I – 1. díl*. Ostrava: VŠB-TU Ostrava, 2001. 136 s. ISBN 80-7078-811-9.

[2] MICHNA, Š., LUKÁČ, I., OČENÁČEK, V., KOŘENÝ, R., DRÁPALA, J., SCHNEIDER, H., MIŠKUFOVÁ, A. a kol. *Encyklopedie hliníku*. Adin, Prešov, 2005, ISBN 80-89041-88-4.

[3] MICHNA, Š., KUŚMIERCZAK, S. *Technologie a zpracování hliníkových materiálů.* UJEP. Ústí nad Labem, 2008. 152 p.

[4] BOLIBRUCHOVÁ, D., TILLOVÁ, E. *Zlievarenské zliatiny Al-Si*. ŽU, Žilina: EDIS – vydavatelstvo ŽU, 2005. ISBN 80-8070-485-6

[5] ČSN EN 1796 - Hliník a slitiny hliníku - Odlitky - Chemické složení a mechanické vlastnosti

[6] ČAPEK, J. Analýza vlivu titanu na opotřebení nástroje při obrábění hliníkových slitin., Bacelor thesis, FVTM UJEP. 2011

[7] ČSN EN ISO 4287 Geometrické požadavky na výrobky (GPS) - Struktura povrchu: Profilová metoda - Termíny, definice a parametry struktury povrchu

[8] MICHNA, Š. NAPRSTKOVÁ, N. The Mechanical Properties Optimizing of of Al - Si Alloys Precipitation Hardening and the Effect on the Character of the Chip, Acta Metallurgica Slovaca, 3/2011, ISSN-1335-1532

[9] MÁDL. J., HOLEŠOVSKÝ, F. Integrita obrobených povrchů z hlediska funkčních vlastností. 1.vyd. Ustí nad Labem, FVTM UJEP, 2008, 230 pp. ISBN 978-80-7414-098-2

[10] KALINCOVÁ, D. Skúšanie mechanických vlastností materiálov - prehľad meracích metód a zariadení. In Zvyšovanie efektívnosti vzdelávacieho procesu prostredníctvom inovačných prostriedkov. KEGA 3/6370/08., TU vo Zvolene, Zvolen. 2010, pp. 13-26.

[11] MADL, J. Surface Properties in Precise and Hard Machining, *Manufacturing Technology*, Vol. 12, 2012, pp. 158-166. ISSN 1213-2489

[12] NOVAK M. Surface quality of hardened steels after grinding. *Manufacturing Technology*, Vol. 11, pp. 55-59, ISBN 1213-2489

[13] NOVAK, M. Surfaces with high precision of roughness after grinding. *Manufacturing Technology*, vol. 12, 2012, pp. 66-70, ISSN 1213-2489

[14] VALÍČEK, J., RUSNÁK, J., MÜLLER, M., HRABĚ, P., KADNÁR, M., HLOCH, S., KUŠNEROVÁ, M. Geometrické aspekty drsnosti povrchu klasických a netradičních technologií. *Jemná mechanika a optika*, 2008, Vol. 53, No 9, pp. 249-253. ISSN 0447-6441.

[15] NOVÁK, M., HOLEŠOVSKÝ, F. 2009. *Problematika broušení hliníkových slitin*. *Transactions* of the Universities of Košice, No.4, 2009, Košice, pp. 284-291. ISSN1335-2334

[16] CZÁN, A., STANČEKOVÁ, D., ĎURECH, L., ŠTEKLÁČ, D., MARTIKÁŇ, J. Základy opotrebenia pri suchom tvrdom sústružení. *Nástroje 2006* - ITC 2006, 5. - 6. september 2006, Zlín

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Monitoring of the microstructure and mechanical properties of the magnesium alloy used for steering wheel manufacturing

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The article presents the microstructure and mechanical properties of magnesium steering wheels. These steering wheels are manufactured by high pressure die casting. High-pressure die casting (HPDC) is a very good process for making complex mechanical parts out of light metals like magnesium and aluminium alloys. However, in recent times, another light metal has come to the forefront in the quest for lighter vehicles and improved fuel economy. The most commonly used magnesium alloy for die casting automotive components is of the Mg-Al-Mn type. MgAl5Mn is a good purity magnesium alloy with good corrosion resistance, very good mechanical properties and good castability. Mg-Al-Mn based alloys such as MgAl5Mn and MgAl6Mn have better elongation and impact strength than MgAl9Zn, and they are mainly used for auto safety systems like wheel rims and steering wheels. Alloy MgAl5Mn is an alloy with outstanding ductility and energy absorbing properties combined with good strength. This alloy, in the solid state, contains a solid solution α and the intermediate phase Mg17 Al12.

Keywords: magnesium alloy MgAl5Mn, high pressure die casting, structure, mechanical properties

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References

[1] FRIDRICH, E. H., MORDIKE, L.B.: *Magnesium Technology*. Springer-Verlag Berlin – Heidelberg 2006, ISBN -10 3-540-20599-3.

[2] AVEDSIAN, M., IAKER, H.: Magnesium and Magnesium Alloys, *ASM Specialty Handbook*. ISBN 0-87170-657-1.

[3] FRIDRICH, H., SCHUMANN, S.: Research for a "new age of magnesium" in the automotive industry, *Journal of Material Processing Technology*, 117, (2001), p. 276-281.

[4] RAGHAVAN, V.: Al-Mg-Mn (Aluminum-Magnesium-Manganese) *Journal of Phase Equilibrium and Diffusion* Vol. 31 No. 1, 2010, p. 46.

[5] BROWN, J.R.: Foseco *Non - Ferrous*. Foundryman´s Handbook. 11th Butterword, Oxford.

[6] GUPTA, M., SHARON, N.M.L. Magnesium, *Magnesium Alloys*, Magnesium Composities. Published by John Wiley in Canada, 2011.

[7] ŻYDEK, A., KAMIENIAK, J., BRASZCYŇSKA, K.N.: Evolution of Mg-5Al-0.4Mn microstructure after rare earth elements addition. *Archives of Foundry Engineering*. ISSN (1897-3310), Volume 11, Issue 2/2011 pp. 157 – 160.

[8] KIELBUS, A., RZYCHOŇ, T., CIBIS, R.: Microstructure of AM50 die casting magnesium alloy. *Journal of Achievements* in Materials and Manufacturing Engineering. Volume 18, Issue 1-2, September–October 2006.

[9] *ASM Handbooks* Online, Volume 2, Properties and Selection: Nonferrous Alloys and Special Purpose Materials.

[10] MICHNA, Š. Strukturní analýza a vlastnosti předslitiny AlCa10.(Structural analysis and properties pre-alloy AlCa10), *Strojírenská technologie*, 2010, s. 175-176. (in Czech).

[11] VOJTĚCH, D., KUBÁSEK, J., VODĚROVÁ, M. Structural, mechanical and in vitro corrosion characterization of as cast magnesium based alloy for temporary biodegradable medicial implants. *Manufacturing Technology*. Vol. 12, No 13 p. 285-292. ISSN 1213-2489.

[12] Promotional *Materials Comparation training documents*. ANDREAS STIHL AG & Company, Germany.

[13] SLÁDEK, A, FABIAN, P., PASTIRČÁK, R., BREZNIČAN, M.: The Roundness and Microstructure of Thin-wall Bearing Rings. *Manufacturing Technology*. Vol. 12, No 13 p. 237-241. ISSN 1213-2489.

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Preparation of aluminium-based quasicrystals

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This paper describes the methods that are applicable for the preparation of aluminium-based quasicrystals. Application of rapid solidification of the melt, mechanical alloying and reactive sintering of metallic powders are presented. Based on the conducted experiments, mechanical alloying seems to be the most promising technology, since it enables to yield nearly pure quasicrystalline powder in Al-Fe-Cu alloy system.

Keywords: quasicrystal, aluminium, reactive sintering, mechanical alloying, rapid solidification

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References

[1] A. MICHALCOVÁ, Kvazikrystaly aneb za co byla v roce 2011 udělena Nobelova cena, *Chemické Listy*, 106 (2012) 51-57.

[2] R.J. SCHAEFER, Metallurgy of quasicrystals, *Scripta Metallurgica*, 20 (1986) 1187-1192,.

[3] D. Pavlyuchkov, S. Balanetskyy, W. Kowalski, M. Surowiec, B. GRUSHKO, Stable decagonal quasicrystals in the Al-Fe-Cr and Al-Fe-Mn alloy systems, *Journal of Alloys and Compounds*, 477 (2009) L41-L44.

[4] R.W. CAHN, P. HAASEN, E.J. CRAMER, *Materials Science and Technology*, vol. 15: Processing of metals and alloys, VCH, Weinheim, 1991.

[5] F. ZUPANIČ, T. BONČINA, B. ŠUŠTARŠIČ, I. ANŽEL, B. MARKOLI, Microstructure of Al–Mn–Be melt-spun ribbons, *Materials Characterization*, 59 (2008) 1245-1251.

[6] A. MICHALCOVÁ, D. VOJTĚCH, Structure of rapidly solidified aluminium alloys, *Manufacturing Technology*, 12 (2012) 166-169.

[7] P. NOVÁK, A. MICHALCOVÁ, J. ŠERÁK, D. VOJTĚCH, T. FABIÁN, S. RANDÁKOVÁ, F. PRŮŠA, V. KNOTEK, M. NOVÁK, Preparation of Ti–Al–Si alloys by reactive sintering, *Journal of Alloys and Compounds*, 470 (2009) 123-126.

[8] P. NOVÁK, D. ŠOTKA, M. NOVÁK, A. MICHALCOVÁ, J. ŠERÁK, D. VOJTĚCH, Production of NiAl-matrix composites by reactive sintering, *Powder Metallurgy*, 54 (2011) 308-313.

[9] P. NOVÁK, V. KNOTEK, J. ŠERÁK, A. MICHALCOVÁ, D. VOJTĚCH, Synthesis of Fe-Al-Si intermediary phases by reactive sintering, *Powder Metallurgy*, 54 (2009) 167-171.

[10] Š. MICHNA, P. MAJRICH, Possible ways of obtaining an aluminium alloy by non-traditional waste processing of aluminium beverage containers, *Manufacturing Technology*, Vol. 12, No. 13 (2012), 169-174.

[11] M. POKOVÁ, M. CIESLAR, JACQUES LACAZE, TEM *Investigation of Precipitation in Al-Mn Alloys with Addition of Zr*, *Manufacturing Technology*, Vol. 12, No. 13 (2012) 212-217.

[12] P. NOVÁK, A. MICHALCOVÁ, M. VODĚROVÁ, I. MAREK, D. VOJTĚCH, Thermal stability of Al-Cu-Fe quasicrystals prepared by SHS method, *Materials Engineering*, 20 (2013) 77-82.

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Magnesium Alloys for Implants

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Extraordinary properties of magnesium alloys, biodegrability and low density guarantee that these alloys are suitable for using in medicine as bone implants. So far there have been used alloys of titanium, cobalt and stainless steel for this purpose. Among the mentioned materials the magnesium alloys are winning because of their mechanical properties, which are more similar to human bones and at the same time there is the possibility to reduce the number of surgeries because of the spontaneous implant disintegration. Pure magnesium reaches neither the requested mechanical properties nor the corrosion resistance. That is why people are searching for elements, whose supplement would improve these magnesium properties to acceptable values. In this paper there was examined the influence of alloying elements (zinc, yttrium) on mechanical properties, the shape and the size of pores in the structure of magnesium alloys. Apart from alloying elements, a pores creating agent was also added to create pores with the diameter of more than 200 μm in the structure of magnesium alloys. Pores of this size allow the bone cells to grow in the implant and enable its gradual replacement by the bone. All samples were prepared by the method of powder metallurgy.

Keywords: implant, magnesium alloys, biomaterial, porous

References

[1] J. ČAPEK, J. KUBÁSEK, V. KNOTEK, D. VOJTĚCh, Hořčík - kov pro medicínu i skladování vodíku, in: *Chemické listy*, http://www.chemicke-listy.cz/docs/full/2011_09_678-683.pdf, 2011, pp. 678-683.

[2] N. LI, Y. ZHeng, Novel Magnesium Alloys Developed for Biomedical Application: A Review, *Journal of Materials Science & Technology*.

[3] H. ZHUANG, Y. HAN, A. FENG, Preparation, mechanical properties and in vitro biodegradation of porous magnesium scaffolds, *Materials Science and Engineering: C*, 28 (2008) 1462-1466.

[4] J. ČAPEK, D. VOJTĚCH, Properties of porous magnesium prepared by powder metallurgy, *Materials Science and Engineering: C*, 33 (2013) 564-569.

[5] C.E. WEN, Y. YAMADA, K. SHIMOJIMA, Y. CHINO, H. HOSOKAWA, M. MABUCHI, Compressibility of porous magnesium foam: dependency on porosity and pore size, *Materials Letters*, 58 (2004) 357-360.

[6] N.T. KIRKLAND, I. KOLBEINSSON, T. WOODFIELD, G.J. DIAS, M.P. STAIGER, Synthesis and properties of topologically ordered porous magnesium, *Materials Science and Engineering*: B, 176 (2011) 1666-1672.

[7] D. VOJTECH, J. KUBÁSEK, M. VODĚROVA, Structural, mechanical and in vitro corrosion characterization of as temporary biodegradable medical implants *Manufacturing Technology*, 12 (2012) 285-292.

[8] BENO, J., LICHY P., CAGALA M., Inoculant addition effect on thermomechanical and thermophysical properties of Mg-Sr magnesium alloy. *Manufacturing Technology*, 13 (2013) 64-67.

[9] E. STŘIHAVKOVÁ, V. WEISS, The Identification of the structures new type Al-Si-Mg Ca alloys with different Ca content using of the color metallography, *Manufacturing Technology*, 12 (2012) 248-251.

[10] K.U. KAINER, P. BALA SRINIVASAN, C. BLAWERT, W. DIETZEL, 3.09 - Corrosion of Magnesium and its Alloys, in: J.A.R. Editor-in-Chief: Tony (Ed.) Shreir's *Corrosion*, Elsevier, Oxford, 2010, pp. 2011-2041.

[11] V. WEISS, E. STRIHAVKOVA, Influence of the homogenization annealing on microstructure and mechanical properties of AlZn5,5Mg2,5Cu1,5 alloy, *Manufacturing Technology*, 12 (2012) 297-302.

[12] F. WITTE, N. HORT, C. VOGT, S. COHEN, K.U. KAINER, R. WILLUMEIT, F. FEYERAbend, Degradable biomaterials based on magnesium corrosion, *Current Opinion in Solid State and Materials Science*, 12 (2008) 63-72.

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Coefficient Thermal Expansion of Fe_3Al and FeAl – type iron aluminides

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The iron aluminides appear to be suitable materials for use in high temperature applications. Knowledge of thermal expansion of the machine parts is prerequisite for their use in industrial applications. The study of expansion properties of iron aluminides in temperature range 400 – 1200 °C is the subject of this article. There were investigated four FeAl – type alloys, four Fe3Al – type alloys and two reference materials. Tests were carried out in the furnace on a horizontal dilatometer on cylindrical or cuboidal specimens with a length of approximately 15 mm. An absolute and relative expansion was measured. The coefficients of thermal expansion (CTE) for temperature 400, 600, 800, 1000 and 1200 °C were calculated from the measured data. The effect of heat treatment on the expansion properties of selected alloys was also verified. The results were tabulated.

Keywords: Coefficient Thermal Expansion (CTE), High – temperature dilatation, Fe_3Al and FeAl – type iron aluminides

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References

[1] MC KAMEY, C. G. Iron Aluminides. In Physical Metalurgy and processing of Intermetallic Compounds, eds. STOLOFF N. S. – SIKKA V. K., 1994, 351 – 391 p.

[2] KRATOCHVÍL, P., KARLÍK, M. Intermetalické sloučeniny, fyzikální vlastnosti a použití. Praha: Výzkumná zpráva pro VÚK Panenské Břežany, 1989

[3] BAKER, I., MUNROE, P. R. Mechanical properties of Fe-Al. International Material Reviews. 1997, vol. 42, No. 5.

[4] LEE, D. B., KIM, G. Y., KIM, J. G. The oxidation of Fe_3Al - (0, 2, 4, 6%) Cr alloys at 1000°C. Materials Science and Engineering. Elsevier, 2003, vol. 339, No. 1-2, 109-114 p. ISSN 0921-5093.

[5] ŠVEC, M., VODIČKOVÁ, V., HANUS, P., The effect of heat treatment on the structure of Nb and C doped Fe_3Al iron aluminides, Manufacturing Technology, 2012, vol.12, No. 13, 254-259 p. ISSN 1213-2489.

[6] KEJZLAR, P., Structure and mechanical properties of Fe-25Al-5Zr and Fe-30Al-5Zr intermetallic alloys, Manufacturing Technology, 2012, vol.12, No. 13, 131-135 p. ISSN 1213-2489.

[7] LIU, Y. C., SOMMER, F., MITTEMEIJER, E. J. Calibration of the differential dilatometric measurement signal upon heating and cooling; thermal expansion of pure iron. Thermochim Acta. Elsevier, 2004.

[8] Watanabe, H., YAMADA, N., OKAJI, M. Laser Interferometric Dilatometer Applicable to Temperature Range from 1300 to 2000 K. International Journal of Thermophysics. Kluwer Academic Publishers-Plenum Publishers, 2001, vol. 22, No. 4, 1185-1200 p. ISSN 0195-928X, doi: 10.1023/A:1010616309804.

[9] KANAGARAJ, S., PATTANAYAK, S. Measurement of the thermal expansion of metal and FRPs. Cryogenics. Elsevier, 2003, vol. 43, No. 7, 399-424 p. ISSN 0011-2275, doi: 10.1016/S0011-2275(03)00096-1.

[10] NETSCH. DIL 402 PC - Horizontal pushrod dilatometer - product brochures. Netsch.com [online]. ©2013 [cit. 2012-10-30]. Available from:

[11] http://www.netzsch-thermal-analysis.com/uploads/tx_nxnetzschmedia/files/DIL_E_0313_10.pdf

[12] DOBROVINSKAYA, E. R., LYTVYNOV, L. A., PISHCHIK, V. Sapphire Material, Manufacturing, Applications. New York (USA): Springer, 2009 [online]. ISBN 978-0-387-85694-0, doi: 10.1007/978-0-387-85695-7.

[13] DAW, J. E., REMPE, J. L., KNUDSON, D. L., CONDIE, K. G., CREPEAU, J. C. Viability of Pushrod Dilatometry Techniques for High Temperature In- Pile Measurements. INL-Idaho National Laboratory, 2008.

[14] GEDEVANISHVILL, S., DEEVI, S. C. Processing of iron aluminides by pressureless sintering through Fe+Al elemental route. Materials Science and Engineering. Elsevier, 2002, vol. 325, No. 12, 163-176 p. ISSN 0921-

5093, doi: 10.1016/S0921-5093(01)01442-3.

[15] MONTEALEGRE, M. A., STREHL, G., GONZÁLEZ-CARRASCO, J. L., BORCHARDT, G. Oxidation behaviour of novel ODS FeAlCr intermetallic alloys. Intermetallics. Elsevier, 2005, vol. 13, No. 8, 896-906 p. ISSN 0966-9795, doi: 10.1016/j.intermet.2005.02.003.

[16] PORTER, W. D., MAZIASZ, P. J. Thermal expansion data on several iron-and nickel-aluminide alloys. Scripta Metallurgica et Materialia. Pergamon Press Ltd., 1993, vol. 29, No. 8, 1043-1048 p. ISSN 0956-716X, doi: 10.1016/0956-716X(93)90175-R.

[17] KANTHAL. Kanthal super electric heating element HANDBOOK. Hallstahammer Sweden: Primatryck, 1999. ISBN 91 86720 08-2

[18] HANUS, P. Unpublished results.

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Research of Corrosion Properties of Al-Si Alloys Antimony Alloyed

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This paper evaluates the influence of different amounts of antimony addition on the corrosion resistance of the alloy Al-Si. The corrosion of aluminium alloys, methods of testing and evaluation of corrosion and the influence of antimony in alloying of Al-Si alloys is described in the introduction of the paper. The alloy Al-Si specifically AlSi7Mg0.3 alloyed by 0; 0.001; 0.005; 0.01 and 0.05 wt. % of antimony was chosen for the experiment. The prepared alloys were subjected to the two types of corrosion tests in the environment - atmosphere and corrosion chamber. The corrosion attack of experimental samples was evaluated from both the macroscopic and the microscopic point of view. The aim of this paper is to assess the influence of antimony on the corrosion resistance of the alloy AlSi7Mg0.3 which was alloyed with different amount of antimony and compared to the alloy without alloying.

Keywords: aluminium alloys, corrosion, antimony alloying, corrosion testing

References

[1] MICHNA, Š., LUKÁČ, I., OČENÁŠEK, V., KOŘENÝ, R., DRÁPALA, J.,SCHNEIDER, H., MIŠKUFOVÁ, A. a kol.(2005). *Encyklopedie hliníku, 1*., ISBN 80-89041-88-4. Vyd. Adin s.r.o.,Prešov.

[2] CAIS, J.(2012). *Ovlivňování struktury a vlastností Al-Si slitin pomocí antimonu*, pp. 99. Diplomová práce, Ústí nad Labem.

[3] TILLOVÁ, E., FARKAŠOVÁ, M., CHALUPOVÁ M. (2013). *The Role of Antimony in Modifying of Al-Si-Cu Alloy*. In: Manufacturing Technology, Vol. 13, No. 1, pp. 109-114. ISSN 1213-2489.

[4] MICHNA, Š., NÁPRSTKOVÁ, N. (2011). *Kvalita očkovací slitiny AlTi5B1 a optimalizace očkování při odlévání hliníkových slitin*. In: Slévárenství, Vol. LIX, No.7-8., pp. 227-229. ISSN 0037-6825.

[5] KUŚMIERCZAK, S., MICHNA, Š. (2011). *Analýza korozního poškození povrchu hliníkových materiálů dlouhodobým skladováním*. In: Strojírenská technologie, Vol. XVI, No. 4, pp. 32-36.

[6] MICHNA, Š., NÁPRSTKOVÁ, N. (2009). *Vliv vnějších faktorů na korozní poškození hliníkových polotovarů*. In: Strojírenská technologie, Vol. XIV, No. 2, pp. 17-21. ISSN1211-4162.

[7] WEISS, V. (2012). *Vliv slévárenských forem na kvalitu povrchu a strukturu slitiny AlZn5,5Mg2,5Cu1,5*. In: Strojírenská technologie, Vol. XVII, No. 1, 2, pp. 132-136.

[8] MICHNA, Š., KUŚMIERCZAK, S., NÁPRSTKOVÁ, N. (2009). *Výskyt koroze u eloxovaných hliníkových polotovarů*. In: Transaction of the Universities of Košice, pp. 268-274.ISSN 1335-2334.

[9] KUŚMIERCZAK, S., SVOBODOVÁ, J., BITTNER, M. (2011). *Analýza příčin vzniku zhoršené tvářitelnosti u slitiny typu AlMg*. In: Strojírenská technologie, Vol. XVI, No. 4, pp. 37-41.

[10] WRÓBEL, T. (2013). Te *Efficiency of Differnt Types of Inoculation of Pure Al and AlSi2 Alloy*. In: Manufacturing Technology, Vol. 13, No. 1, pp. 127-133. ISSN 1213-2489.

[11] NÁPRSTKOVÁ, N., MICHNA, Š. (2010). *Analysis of the inoculant AlTi5B1 effect on some qualitative parameters of the AlSi7Mg0,3*. In:Engineering and duality production, pp. 177. Monography Dnipropetrovsk. ISBN 978-966-1507-34-9.

[12] KUŚMIERCZAK, S. (2011). *The Usage of Confocal Laser Microscope by Solving Student Projects*. In: international multidisciplinary conference, pp. 4. Baia Mare – Nyiregyhaza, Romania – Hungary: Baia Mare – Nyiregyhaza.

[13] MATVIJA, M., FUJDA, M., KVAČKAJ, T., ZUBKO, P. (2011). *Změna mikrostruktury a mechanických vlastností tepelně zpracované podeutektické slitiny AlSi7Mg0,3 aplikací technologie ECAP*. In: Strojírenská technologie, Vol. XVI, No. 4, pp. 47-53.

[14] STŘIHAVKOVÁ, E., WEISS, V. (2012). *The Identification of the Structures New Type Al-Si-Mg-Ca Alloys with Different Ca Content using og the Color Metallography.*In: Manufacturing Technology, Vol. 12, No. 13, pp. 248-251. ISSN 1213-2489.

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Corrosion properties of the superelastic shape memory Ni-Ti alloy for medical implants

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The Ni-Ti alloy (Nitinol, approx. 50 at. % Ni) is a biomaterial showing the shape memory and superelasticity effects. These characteristics make this material of interest for biomedical applications, especially for manufacture of stents, i.e., tubular implants for restoring damaged blood vessels, oesophageus etc. The corrosion resistance in the human body environment is a very important factor determining the life time of implants. An insufficient corrosion resistence may lead to fractures of implants, formation of dangerous fragments and to serious health problems for patients. The corrosion behavior is influenced mainly by the surface structure and chemistry of a material. But the surface state is strongly modified by chemical and heat treatment processes used in the implant manufacture. Therefore, in this study the relationships between chemical treatment and heat treatment regimes, surface state of Nitinol and its corrosion resistance in simulated physiological solution are demonstrated. It is shown that, unlike chemical pre-treatment, heat treatment used in the manufacture of stents generally negatively influences the corrosion resistance. The findings are discussed in relation to the surface state and chemistry of the material.

Keywords: Ni-Ti alloy, Nitinol, corrosion, structure, surface, heat treatment

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References

[1] DAVIS, J.R. (1990). ASM Handbook, Volume 2, Properties and Selection: Nonferrous Alloys and Special-Purpose Materials, *ASM International*, Materials Park.

[2] DAVIS, J.R. (2003). Handbook of materials for medical devices. *ASM International*, Materials Park.

[3] KHALIL-ALLAFI, J., DLOUHÝ, A., EGGELER, G. (2002). Ni_4Ti_3-precipitation during aging of NiTi shape memory alloys and its influence on martensitic phase transformations. *Acta Materialia*, 50, 17, pp. 4255-4274.

[4] BORN, P. (2009). Multiple breakage of a covered esophageal stent. *Endoscopy*, 41, pp. 34.

[5] GOENKA, A.H., GARG, P. K., SHARMA, R., SHARMA, B. (2009). Spontaneous fracture of an uncovered enteral stent with proximal migration of fractured segment into cervical esophagus: first report. *Endoscopy*, 41, pp. 204-205.

[6] WIEDMANN, M., HELLER, F., ZEITZ, M., MOSSNER, J. (2009). Fracture of a covered self-expanding antireflux stent in two patients with distal esophageal carcinoma. *Endoscopy*, 41, pp. 129-130.

[7] ZHU, L., FINO, J.M., PELTON, A., DUERIG, T. (2004). Proceedings of the International Conference on Shape Memory and Superelastic Technologies, SMST. *ASM International*, Materials Park.

[8] KIM, J.I., MIYAZAKI, S. (2005). Effect of nano-scaled precipitates on shape memory behavior of Ti-50.9 at. % Ni alloy. *Acta Materialia*, 53, 17, pp. 4545-4554.

[9] MIYAZAKI, S., OTSUKA, K. (1986). Deformation and transition behavior associated with the R-phase in Ti-Ni alloys. *Metallurgical Transactions*, 17A, 1, pp. 53-63.

[10] ZHOU, Y., ZHANG, J., FAN, G., DING, X., SUN, J., REN, X., OTSUKA, K. (2005). Origin of 2-stage R-phase transformation in low-temperature aged Ni-rich Ti–Ni alloys. *Acta Materialia*, 53, 20, pp. 5365-5377.

[11] FRICK, C.P., ORTEGA, A.M., TYBER, J., MAKSOUND, A.E.M., MAIER, H.J., LIU, Y., GALL, K. (2005). Thermal processing of polycrystalline NiTi shape memory alloys. *Materials Science and Engineering*, A405, 1-2, pp. 34-49.

[12] PELTONEN, M., LINDROOS, T., KALLIO, M. (2008). Effect of ageing on transformation kinetics and internal friction of Ni-rich Ni–Ti alloys. *Journal of Alloys and Compounds*, 460, 1-2, pp. 237-245.

[13] CHROBAK, D., STROZ, D. (2005). Two-stage R phase transformation in a cold-rolled and annealed Ti–50.6 at.%Ni alloy. *Scripta Materialia*, 52, 8, pp. 757-760.

[14] ZHOU, Y., FAN, G., ZHANG, J., DING, X., REN, X., SUN, J., OTSUKA, K. (2006). Understanding of multi-stage R-phase transformation in aged Ni-rich Ti–Ni shape memory alloys, *Materials Science and Engineering*, A438-440, pp. 602-607.

[15] KIM, J.I., LIU, Y., MIYAZAKI, S. (2004). Ageing-induced two-stage R-phase transformation in Ti–50.9 at.% Ni, *Acta Materialia*, 52, 2, pp. 487-499.

[16] FILIP, P., MAZANEC, K. (2001). On precipitation kinetics in TiNi shape memory alloys. *Scripta Materialia*, 45,

6, pp. 701-707.

[17] JONES, D.A. (1996). Principles and Prevention of Corrosion. Prentice Hall, Upper Saddle River.

[18] HURTALOVÁ, L., TILLOVÁ, E. (2013). Elimination of the negative effect of Fe-rich intermetallic phases in secondary (recycled) aluminium část alloy In: *Manufacturing Technology*, No. 1, Vol. 13, pp. 44-50.

[19] POKOVÁ, M., CIESLAR, M., LACAZE, J. (2012). TEM Investigation of Precipitation in Al-Mn Alloys with Addition of Zr. In: *Manufacturing Technology*, No. 13, Vol. 12, pp. 212-217.

[20] MICHALCOVÁ, A., VOJTĚCH, D. (2012). Structure of rapidly solidified aluminium alloys In: *Manufacturing Technology*, No.13, Vol. 12, pp.166-169.

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