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Obsah

Vplyv Ti na vybrané vlastnosti AlSi5Cu2Mg zliatiny

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Práca sa zameriava na skúmanie vplyvu Ti na vybrané vlastnosti podeutektickej hliníkovej zliatiny AlSi5Cu2Mg. Podeutektická zliatina AlSi5Cu2Mg nachádza uplatnenie v dôsledku optimálnej kombinácie mechanických, fyzikálnych a zlievarenských vlastností v oblasti produkcie vysokonamáhaných odliatkov hláv valcov určených pre automobilový priemysel. V komerčnej výrobe je výrobcom limitovaný max. obsah titánu (Timax. = 0,03 hm. %), čím sú výrazne obmedzené možnosti očkovania danej zliatiny očkovadlami na báze Ti. Z toho dôvodu je v práci posudzovaná možnosť navýšenia obsahu Ti nad rámec odporúčania výrobcu. Hlavným cieľom práce je hodnotenie vplyvu odstupňovaného prídavku Ti (0,1; 0,2; 0,3 hm. % Ti) na výsledné mechanické a fyzikálne vlastnosti zliatiny AlSi5Cu2Mg. Zároveň je posudzovaný vplyv zvýšeného obsahu Ti na mikroštruktúru zliatiny AlSi5Cu2Mg. Prísadový prvok bol do taveniny vnášaný vo forme predzliatiny AlTi5B1. V experimentálnej práci bol taktiež skúmaný vplyv tepelného spracovania T6 na výsledné mechanické a fyzikálne vlastnosti a mikroštruktúru nenormalizovanej podeutektickej zliatiny AlSi5Cu2Mg s odstupňovaným prídavkom Ti.

Selection of molding sands with inorganic binders for 3D printing - preliminary research

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The development of increasingly advanced technologies enables a broader application of additive manufacturing techniques in the production of foundry molds and cores. The use of binder jetting technology allows for achieving the necessary dimensional accuracy and surface roughness of the castings. Currently, knowledge regarding the application of organic binders is well-developed, and the technology is shifting from being used in the non-ferrous metal foundry industry towards the production of castings based on ferrous alloys. However, during the process of pouring molten metal into the mold cavity with organic binders, bond destruction occurs, resulting in the emission of environmentally harmful gases. A known solution is to replace resin binders with inorganic binders. Molding sands with inorganic binders, thermally cured, are successfully used in the production of aluminum castings for the automotive industry. In this study, an attempt was made to develop a binder that can be used in binder jetting technology for the production of molds and cores. Based on rheological studies of organic binders, the viscosity of the binder was determined and assigned to two new inorganic binders. The study aimed to develop an inorganic binder and select the appropriate curing technology. Curing conditions were simulated using a laboratory shooter and parameters were selected based on literature data. Tests were conducted on two types of molding sands: one with a traditional inorganic binder and one with a newly developed binder, from which the strength characteristics were created depending on the curing temperature. The next step involved studying the curing time. The final stage was the preparation of a comparative characteristic of traditionally used inorganic binders in the production of molds and cores, and the newly developed two binders in applied quantities - 2 parts by weight and 2.5 parts by weight. The obtained results allowed for determining the optimal curing parameters for the tested molding sands.

Optimalizace LPDC technologie pro odlévání kol ze slitiny AlSi7Mg

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Maxion Wheels Czech s.r.o.

V podmínkách slévárny společnosti Maxion Wheels Czech s.r.o. byla optimalizována technologie nízkotlakého odlévání slitiny AlSi7Mg do trvalých forem, za pomocí numerického modelování a virtuální optimalizace. Na odlitku automobilového hliníkového kola o surové hmotnosti cca 20Kg byla detekována vyšší nežli obvyklá, míra zmetkovitosti pro vadu "porozita ráfek". Úpravy již vyrobené trvalé formy představují nemalý finanční náklad, a proto je zde hojně využívána možnost optimalizovat design formy nejdříve v simulačním programu (MAGMA 5.5) a až po virtuálním ověření funkčnosti úpravy tuto úpravu provést na reálné formě. V tomto konkrétním případě se projevil potenciál simulací naplno neboť byla testována celá řada modifikací, než bylo dosaženo významného zlepšení.

Zygmunt vs. Zikmund

Bartocha, D.

Katedra Odlewnictwa, Politechnika Śląska

Opracowanie poświęcone zostało analizie porównawczej dwóch najsłynniejszych dzwonów Czech i Pollski; krakowskiego Zygmunta i praskiego Zikmunda. Analizowano geometrię profilu w oparciu o skanowanie 3D, widmo fali akustycznej czyli rozkład natężenia składowych dźwięku w zależności od częstotliwości tych składowych oraz własności materiału w oparciu o wyniki analizy modalnej. Badania prowadzone były we współpracy Katedry Odlewnictwa Politechniki Śląskiej w Gliwicach i Katedry Materiałów Wydziału Nauk Jądrowych i Inżynierii Fizycznej, Politechniki Czeskiej w Pradze. Dzwony tę są niemal rówieśnikami Zygmunt został odlany w 1520 roku, a Zikmund w 1549, często nawet nazywa się je bliźniaczymi. Jednak w świetle uzyskanych wyników stwierdzone zostały istotne między nimi różnice.

Manganese cast steel for railway industry manufactured in Huta Małapanew Sp. z o.o.

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[2]Huta Małapanew Sp. z o.o.

The paper presents the results of research obtained in the POIR.01.01.01-00-0060/21 project implemented by Huta Małapanew Sp. z o. o. as part of the competition of the National Center for Research and Development: Szybka Ścieżka and co-financed by the European Union from the European Regional Development Fund under the Smart Growth Operational Program 2014-2020. The research aimed to determine the impact of manganese cast steel technology on the usable properties of cast rail crossover elements such as monoblock crossing frogs R190, R300 and R500 with unit weight and length of 1400kg and 3790mm, 1500kg and 4145mm, 2000kg and 4746mm suitably. In conditions of Huta Małapanew Sp. z o. o. the above-mentioned monoblock crossing frogs are manufactured with the use of an automatic line of moulding, pouring and knocking-out of castings. In the paper, the influence of the chemical composition and the heat treatment of type hyperquenching in water on obligatory properties of manganese cast steel for the railway industry i.e. hardness and impact strength according to PN-EN 15689 are analysed.

High-Strength Teksid Ductile Iron for Special Applications

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Ductile iron is a material that has been extensively discussed in numerous books and articles. It continues to surprise in terms of mechanical properties, which can be shaped through methods such as changes in microstructure or heat treatment, thereby achieving suitable high mechanical properties parameters (Rm, R0,2) while ensuring adequate elongation A5. The yield strength plays a crucial role in the design of casting that is intended for use under specific conditions (under high load), defining the stress level at which permanent plastic deformations are likely to occur. Hence, alongside the tensile strength, yield strength is a critical parameter. This paper addresses the effects of chemical composition and microstructure on the mechanical properties (Rm, R0,2, A5) of castings designed for the automotive industry and intended for use under high loads. The production of such high-strength ductile iron castings requires a well-organized scrap management, high technological culture through all production stages. The research was conducted on castings with the wall thicknesses of 12.5 and 25 mm, respectively. Moreover, additional studies were conducted on a stepped model with wall thicknesses of 3 and 6 mm. The utilitarian goal of the research was to develop a new grade of ductile iron with a pearlitic matrix dedicated to specific applications (heavy-duty work), where high values of Rm, R0,2, A5 are required. As part of metallographic studies, graphite was analyzed in terms of the number of graphite nodules, nodularity, size distribution and homogeneity. The mechanical properties studies showed that the new grade of ductile iron produced in the as-cast state under production conditions of Teksid Iron foundry in Skoczow could compete with some grades of ADI iron.

Pevnost v ohybu litinových vedení ventilů po kryogenním zpracování

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Technická univerzita v Liberci

Funkce a namáhání vedení ventilů pístových spalovacích motorů. Konkurenceschopnost klasické litiny vůči moderním aditivním, neželezným a PM materiálům nutno vidět v izotermickém kalení a kryo zpracování. Dílčí experiment pevnosti v ohybu s vodítky ventilů z litiny s lupínkovým grafitem s matricí tvořené horníhm ausferitem po mražení v tekutém dusíku a popouštění. Vztah mezi tvrdostí HB a pevností Rmo. Mražení může zvýšit pevnost izotermicky kalené litiny (AGI) až o 25%. S růstem pauzy mezi kalením a mražením klesá efekt kryozpracování. Pauzy desítky hodin mohou přínos změnit v nevýhodu. Naznačené tendence bude třeba ověřit na statistick velkých souborech vzorků. Experimenty bude nutno doplnit metalografií a fázovými analýzami; tribologickými testy.

Material research of grey cast iron intended for large-size castings

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The literature contains a lot of information about the inoculation and microstructure of castings with wall thicknesses of up to 2 cm and weights of up to 100 kg. The novel element of this research is exploring the topic of inoculation and microstructure of cast iron with flake graphite of large-size castings with wall thicknesses of up to 10 cm, which are characterised by a long period of crystallisation and cooling. The research presents results for two experimental melts of grey cast iron where the overheat temperature was 1450^{o}C and 1500^{o}C. Metallographic analysis was performed using a LEICA optical microscope and Leica QWin computer software. The degree of eutectic saturation is 1.02 for each melt. Modification of the cast iron had almost no effect on the degree of saturation. Thermal analysis determined the degree of undercooling which, for the melt where the overheat temperature was 1450^{o}C, was ΔTm = 14.21°C for the starting material and ΔTm = 20.76°C for the for the melt where the overheat temperature was 1500°C. The research presents the effect of overheating temperature on the effects of inoculation with the Zircinoc inoculant, in which it was shown that increasing the temperature by fifty degrees increased the amount of eutectic grains by around 11–15%, reduced the proportion of undesirable D-type graphite and increased the proportion of A-type graphite. The research was developed during the implementation of the project RPMP.01.02.01-12-0055/18 project at the company Krakodlew S.A. financed from the funds of the Regional Operational Program of the Malopolska Voivodeship.

Opracowanie i uruchomienie technologii wytwarzania wysoko dokładnych odlewów żeliwnych dla sektora automotive z wykorzystaniem metodyki industry 4.0

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Chcąc sprostać aktualnym wyzwaniom stawianym wytwórcom odlewów, szczególnie przez odbiorców z branży automotive, producenci zmuszeni są do ciągłego rozwoju technologii z wykorzystaniem nowoczesnych rozwiązań z zakresu automatyzacji i robotyzacji procesów technologicznych, cyfryzacji oraz wykorzystania sztucznej inteligencji. Wdrożenie tego typu innowacji przekłada się na transformację przedsiębiorstwa w kierunku organizacji wpisującej się koncepcję nazywaną obecnie jako Przemysł 4.0. Odlewnia Kutno mając na uwadze powyższy trend podjęła wyzwanie wdrożenia w ramach zrealizowanego projektu nr POIR.01.01.01-00-0804/17 kilku rozwiązań ujmujących aspekty Przemysłu 4.0 takie jak: automatyzacja procesu przygotowania masy formierskiej, kontrola jakości wykonania formy z wykorzystaniem inteligentnego systemu wizyjnego, automatyzacja procesu odbioru wybijanych odlewów, robotyzacja procesu szlifowania i gratowania odlewów i innych.

W prezentacji zostaną przedstawione przykłady realizacji rozwiązań wraz z wynikami badań zastosowanych w działalności Odlewni Kutno, produkującej zaawansowane odlewy żeliwne oferowane przede wszystkim szeroko pojętemu rynkowi automotive. Wdrożenie wskazanych rozwiązań to szansa dla Odlewni na postrzeganie jej jako firmy dążącej w kierunku rozwoju technologicznego, a także stale poprawiającej jakość wytwarzanych produktów.

Studium termofyzikálních vlastností ocelí a strusek při zpracování technologií ESR

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Předkládaný článek se zabývá úvodní analýzou trhu a porovnáním termofyzikálních vlastností přetavovaných ocelí a dostupných struskových systémů při zpracování technologií ESR (Electro Slag Remelting) v rámci řešení projektu TA ČR pod názvem Optimalizace technologických parametrů elektrostruskového přetavování ocelí pro speciální použití v součinnosti VŠB-TUO a ŽĎAS, a.s. Struskové systémy v procesu ESR plní řadu důležitých metalurgických i procesních funkcí, kde mezi hlavní složky ESR strusek patří dle způsobu zpracování CaF2, CaO a Al2O3. Studium je zaměřeno na stanovení termofyzikálních vlastností přetavovaných ocelí a také strusek s využitím softwaru FactSage. Zkoumanými vlastnostmi byly teplota tání přetavovaných konstrukčních CrNiMoV ocelí a strusek a viskozita tavenin strusek pro různá chemická složení. Experimentální určování vlastností ocelí a strusek při procesu ESR je obtížné, a proto je vhodné pro jejich hodnocení využít různých termodynamických a simulačních softwarů, které mají uplatnění při simulaci metalurgických procesů v oblastech sekundární a terciární metalurgie.

Value creation by reduction of gating and feeding systém

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Gating and feeding system design are crucial parts of foundry engineering and necessary addition in most foundry techniques. They can be minimised by the use of modern additions - insulation, exothermal sleeves or ceramic foam filters. The lecture will cover cost reduction with use of adding external materials listed before. What is more, with the use of sleeves and filters it is possible not only to reduce the gross weight but also minimise scrap level, re-work time and finishing requirements.

Improved mechanical properties of casting made by new LPIC technology

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Nowadays, the emphasis is on improving the integrity of precision castings of Fe, Ni and Co alloys (improving the mechanical properties of the material and increasing process efficiency) more than ever before. For this reason, a technology has been developed which is a combination of low-pressure casting and investment casting. The premise of the combination of these technologies is that a high degree of automation should be achieved, based on low-pressure casting, while bottom filling will reduce reoxidation phenomena during filling. Mainly due to the higher purity of the melt, higher values of mechanical properties in conjunction with shape and geometric accuracy are expected, which guarantees the investment casting. For this purpose, an experimental casting machine has been designed, which is a combination of these two technologies, where we are able to eliminate the disadvantages of low-pressure casting, which include, for example, the low variability of the usable materials, as well as the disadvantages of investment casting, which include the low automation of the process. Using an experimental machine, tensile and impact test samples were cast and subsequently tested. From the initial experiments, it can be said that using this technology we are able to cast materials based on Fe alloys, Ni alloys and Co alloys with mechanical property values that are even close to or within the range of mechanical properties of the formed materials.

Numerical estimation of the fatigue life of ingot mould - heavy cast iron castings operating under conditions of low-cycle thermal loading

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The ingot mould is a large cast iron casting, operating under conditions of unilateral cyclic thermal loading, subject to thermal fatigue. Thermal fatigue is a phenomenon resulting from the formation of significant thermal stresses in the walls of the casting, especially during the initial period of the operating cycle. This leads to a sudden thermal load on the inner wall of the ingot mould by liquid steel, accompanied by an extreme temperature difference between the inner and outer walls, reaching over 1600°C. Initially, the ingot mould heats up very quickly, and after reaching the maximum temperature, a prolonged cooling period begins. To illustrate the phenomena occurring in the launder walls during the operating cycle, a series of analyses were performed using CAE numerical tools. Thermal-static analyses were carried out over time, adjusting the time step to the rate of changes occurring during the operating cycle. As a result of the simulation, distributions of half temperature were obtained, and components of the strain and stress tensor were determined for each time step. The correctness of the results obtained from numerical analyses was verified on a research ingot mould overflow stand, where temperature changes and displacements of characteristic points on the ingot mould walls were recorded during a full operating cycle. Conducting the aforementioned verification allowed the results obtained with the participation of numerical tools to be considered reliable. The determined values of the strain and stress tensor components allowed for the identification of dangerous locations prone to initiating cracks, as well as for the numerical and analytical determination of the ingot mould fatigue life, expressed as the number of filling cycles until complete failure and withdrawal from service.

Optimalizace 3D tištěných modelů pro hybridní technologii přesného lití

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V současné době je kladen důraz na výrobu tvarově složitých odlitků. Hybridní technologie přesného lití využívající modely tištěné na 3d tiskárnách nám otevírá nové možnosti ve výrobě takto složitých a tenkostěnných odlitků. Motivací práce bylo vyřešit problém s praskáním keramických skořepin během fáze vypalování 3D tištěných modelů. Hlavními faktory ovlivňující praskání skořepiny je teplotní dilatace materiálu modelu a skořepiny a nově uvažovaný tlak uzavřeného plynu v dutině keramické skořepiny.

Nejprve byly provedeny termické analýzy materiálu používaného pro 3D tisk modelů - Polymaker PolyCast™. Z naměřených charakteristik vyplynula teplota skelného přechodu, teplota samovznícení a průběhy vývinu plynu hořením modelu. Dále byly navrženy vhodné experimentální modely ve tvaru pyramid na kterých byla provedena řada experimentů. Tyto testy ověřily, že k praskání během šokového vytavování dochází výhradně u modelů tištěných technologií FFF s 0% výplně. Jako řešení pro další experimenty bylo navrženo cílené odvzdušnění modelů. Optimalizace byla ověřena i v praxi. Zároveň bylo provedeno měření prostupu tepla skořepinou po vložení do žíhací pece.

Analýza vnútornej kvality vysokotlakového odliatku pri zmene média prúdiaceho v termoregulačnom okruhu vysokotlakovej formy

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Cieľom príspevku bolo posúdiť vplyv média prúdiaceho v termoregulačnom okruhu vysokotlakovej formy na zmenu vnútornej kvality odliatkov v dvoch geometrických variantoch výšky tuby odliatku. Procesné parametre vysokotlakového odlievania všeobecne priamo ovplyvňujú výslednú kvalitu odliatkov ako je prítomnosť pórov v odliatku alebo mikroštruktúra. V experimentálnej časti sa pracovalo s vodou a teplonosným olejom použitých ako médium pre reguláciu teploty formy, konkrétne jadrovej časti. Vnútorná kvalita vysokotlakových odliatkov sa hodnotila kombináciou analýzy pórovitosti a štruktúrnou analýzou vybraných kritických miest na odliatku. Na experimentálne účely bol použitý odliatok s označením Statorbuchse EC 112/75 a Statorbuchse EC 112/55. Odliatky sú súčasťou motora EC (elektronicky komutovaný). Jedná o synchrónny motor s permanentnými magnetmi a vonkajším obežným kolesom, ktorý je napájaný z meniča. Zo získaných výsledkov vyplýva, že temperácia jadra prostredníctvom teplonosného oleja mala zásady vplyv na vznik pórovitosti v kritickej časti. Na druhú stranu chladenie vodou malo priaznivejší účinok na mikroštruktúru kritickej oblasti odliatku. Okrem zmeny termoregulačného média sa preukázal aj vplyv rozmerovej zmeny tuby.

Analysis and evaluation of the influence of the HPDC biscuit on the stability of the high pressure die casting process

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The die-casting process is inextricably linked to the manufacture of mass production. This type of production has not only advantages. High production efficiency guarantees the production of a large number of parts, both conforming and non-conforming, in a short period of time. Unnoticed small changes, incidents in the casting process can have undesirable quality effects with high intensity. Disturbances in the process lead to a loss of control over the process, so that its stability is disturbed. Such incidents definitely increase the risk of increased operating costs related to sorting, scrapping of products, implementation of additional detection activities. High repeatability is therefore the most desirable/key feature. All peripheral equipment, as well as the casting machine itself, have some deviations/tolerances that create 'natural process variability'. The biggest problem, however, is those variables that cause the nature of the equipment operation to exceed its 'natural variability', i.e. systematic variability appears. Detailed analyses are then required to identify the causes of the disturbances, which takes a lot of work, but above all time and data. In the case of high-volume production, preventive measures are necessary. If the product is to be viewed as a set/collection of characteristics that the manufacturer must ensure to satisfy the customer, the technologist should view his process as a product. The casting is the result/outcome of the entire process team, and product control can often provide information too late - after the fact. The pressure of production forces immediate mitigation/correction actions, which often do not remove the root cause of the problem, but subtly cover it up. Continuous process change causes gradual disruption, which is the opposite of the desired repeatability. The direction to be taken by the process designer is to monitor process parameters, define their tolerances, plan their control, organise early replacement/overhaul of peripheral equipment. This type of approach makes it possible to react early to deviations / incidents, and analytical activities can be carried out while still producing quality compliant products (when the process is in tolerance, under control).

This article deals with the very important subject of the HPDC biscuit. It is the first element in the casting chain, with a diameter equal to the diameter of the casting chamber and a height that depends on many process and mould characteristics. Its diameter value is fixed, while its "thickness" can vary. The nominal value and thickness tolerances of the HPDC biscuit are defined by the process designer based on simulations and calculations.

The thickness of the HPDC biscuit does not affect the geometry of the finished product, but it does affect properties such as porosity or coldshot. This paper discusses the influence of HPDC shell parameters on the stability of the die casting process.

Vliv moderních anorganických pojiv na bentonitovou formovací směs

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** SAND TEAM, spol. s r.o.

Ve spolupráci SAND-TEAM a KERAMOST, jsme se pokusili zjistit vliv podílu ostřiva z anorganických jader na vlastnosti bentonitových směsí. Jako kritérium jsme zvolili pokles pevnosti v tahu v kondenzační zóně. Obvykle se uvádí, že kritický je pokles o 20 % proti hodnotám bez přídavku zkoumané složky směsi. Pokusili jsme se také hodnotit otěr bentonitové formovací směsi.

Jako pravděpodobný zdroj písku z jader do bentonitových směsí byly zvoleny jádrové směsi s těmito pojivy:

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Při zkouškách otěru byl zjištěn jen minimální negativní vliv písku z jader.

Graphite nucleation on (Al, Si, Mg)-nitrides: Elucidating the chemical interactions and turbostratic structures in spheroidal graphite cast irons

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The ubiquitous (Al,Si,Mg)-nitride has been the focus of recent investigations of spheroidal graphite irons. In particular, because they have been systematically found in the nucleus of graphite spheroids. Despite having a similar crystal structure as graphite, their lattice parameter is vastly different. Since the crystallographic match is mainly used to justify the potential of nucleation sites, challenges have been encountered to explain the mechanism of graphite nucleation in this type of inclusion (microparticle). The present work reports the structure, composition, and interactions of these (Al,Si,Mg)-nitrides with graphite and other compounds, such as (Zr,Ti, Nb)-carbonitrides. The latter were the only inclusions with Zr that could be found, while the former inclusion could also be found in the core of graphite. The results confirm that the graphite layers close to the surface of the (Al,Si,Mg)-nitrides have a turbostratic structure. Organized graphite layers are only observed far away from the nitride nucleus. Density functional theory simulations of this interface showed that the interaction between the first graphene layers and the (Al,Si,Mg)-nitrides has a covalent nature, which could explain the turbostratic structure of the inner part of the graphite nodule. Therefore, nucleation of graphite on nuclei with a large lattice mismatch (low planar misfit) may be facilitated by the covalent bonding of carbon atoms on this substrate. These results explain the observed disorder at the interface as well as the deformation of the graphene layers.

What is the right way? Inorganic or organic? A review

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SAND TEAM, spol. s r.o.

Although the green sand system (basically an inorganic bentonite based binder system) is the most widespread binder system for castings production, organic binders are very popular for higher weight castings or for core production. Their technological advantages, however, face to ecological limits with regard to the environment and the working environment. In this case, the way is opening up for inorganic binders, which present new challenges for foundries in their adaptation to the production process. The aim of this article is to present the advantages and disadvantages of different binder systems based on inorganic and organic binders and their application in the foundry practice for the production of moulds and cores especially in technology of gravity casting.

Optimalizácia procesných parametrov výroby hybridných odliatkov s využitím jadier s penovou štruktúrou

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Žilinská univerzita v Žiline

V snahe o uhlíkovú neutralitu sa automobilový priemysel usiluje rôznymi technologickými spôsobmi zabezpečiť znižovanie hmotnosti výrobkov za účelom úspory energie a vznikajúcich emisií. Z tohto hľadiska sú predmetom vývoja nové ľahké materiály s vyhovujúcimi vlastnosťami. V článku sa autori venujú realizácii hybridných hliníkových odliatkov technológiou zalievania. Ide o progresívnu a sľubnú technológiu na zabezpečenie odľahčovania s využitím princípu zaliatia jadra s pórovitou bunkovou štruktúrou, ktorá je vytvorená ohrevom lisovanej zmesi prášku zliatiny AlSi10 a napeňovadla TiH2, roztavenou zliatinou AlSi7. Na výslednú pórovitosť majú zásadný vplyv procesné parametre vo fáze vypeňovania materiálu. V článku sa autori zameriavajú na kontrolu vplyvu procesných parametrov – teplota a tlak pri procese vypeňovania – na výslednú pórovitosť využitím röntgenového tomografu a meraním priedušnosti. Výzvou tejto technológie je zabezpečenie adekvátneho prepojenia kovov na rozhraní pevného bunkového jadra a stuhnutého kovu. Z tohto dôvodu je potrebné vytvorenie tranzitnej vrstvy na povrchu bunkového jadra povlakovaním ľahkotaviteľnými kovmi. V rámci experimentu bola navrhnutá vtoková sústava pre realizáciu skúšobných hybridných odliatkov.

Pouring systems for large-size iron castings without ceramic fittings - a proposal for a new solution

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Krakodlew S.A.

The paper presents research results on a new solution for the construction of gating systems for large-size molds made of furan masses. In the classic/existing solution, gating systems are made of ceramic shapes placed in the mold during its production. This technology is burdensome for several reasons: the laying of the shapes is time-consuming, the main sprues do not have technological convergence, ceramics are an expensive component of the molds, and moreover, after removing the casting from the mold, the cracked ceramics must be separated and sent to a landfill as waste, which further increases the costs. The new solution concerns the production of main sprues without the use of ceramic fittings. The main sprue is demolded from the casting model and its internal surface is reinforced with a hybrid coating, which in its structure contains mineral glass nonwoven fabric according to the solution (P.435747). A technology for producing a hybrid coating in the main sprue channel has been developed. Validation of the solution was carried out on ingot mold castings for which the main sprues are high, which results from the siphon pouring method. Very good test results were obtained, the mold surface within the main sprue remained intact. The effects of "blurring" the main sprue channel surface were not recorded, which was initially feared. The implementation of the solution brings measurable economic benefits resulting from the elimination of ceramic shapes as elements from which the main sprues are manufactured.

Behaviour of high-density aluminium briquette during melting in laboratory conditions

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AL INVEST Břidličná, a. s.

The aluminium industry is one of the most energy-intensive industrial fields and is associated with severe environmental impact mainly due to GHG emissions. Aluminium recycling is one of the best ways to eliminate this impact and to achieve better economic viability of aluminium production. Piece size and contamination of aluminium scrap are two of the most important factors that affect recyclability of aluminium and its alloys. Scrap with large piece size is relatively easy to recycle because it is associated with lower metal loss and fewer undesired inclusions introduced into the molten metal during remelting. Unfortunately, a large portion of scrap generated by industrial sector and by end-users is of small piece size. Despite its high importance, recycling of these types of scrap is often overlooked by contemporary literature. The aim of this work is to describe melting behaviour of high-density aluminium briquette prepared from thin aluminium foils and to provide metallographic observation of inclusions introduced into the molten metal during melting of the briquette. Melting is performed in laboratory conditions. The inclusions are analysed using optical microscopy in combination with SEM and EDX analysis. The results indicates that despite fast immersion of aluminium briquette, high portion of oxide films were introduced into the melt. Carbide like particles were also observed in microstructure, probably as a result of burning of organic contamination of the briquette. However, melting process in real industrial conditions differs from laboratory experiment which is a topic for further study.

The impact of Ti added to a zinc bath on the structure and the character of Zn-Fe-Ti phases assembled on a steel surface in the immersion metalization process

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The idea of applying coatings to steel products to protect them from corrosion has been present in science and literature for decades. One of the methods is the immersion metallization technology, which has been widely used in industry due to its low production cost and effectiveness in corrosion protection. Obviously, the demand for zinc necessary for production has increased, and its resources have been successively decreasing. For this reason, technologies are currently being developed to reduce Zn consumption in the process. This effect can be achieved by modifying the process and achieving crystallization of the thinnest possible Fe-Zn alloy layer on the surface of the substrate. In addition, it is possible to use alloying additives that can provide longer protection against corrosion of the coating. Ti is an element that potentially combines mentioned two effects. The purpose of the study was to observe and analyze the microstructure of zinc coatings obtained in baths with 0.01%Ti-0.5%Ti at 450°C and 550°C. The coatings were obtained on steel substrates after machining. Before entering the bath, the surface was cleaned, degreased in alcohol, etched and fluxed. Zinc bath immersion times of 60, 180 and 360s were used, followed by cooling in water to freeze crystallization. For the microstructure analysis, metallographic scrapings were made on the cross-section of the coating. Using a SEM, images of the coating's microstructures were taken, and an EDS detector was used to analyze the chemical composition. Detailed TEM analysis allowed the identification of Fe-Zn intermetallic phases in the coating. The methods used outlined the differences in the crystallization of zinc coatings when the parameters of temperature, incubation time and composition of the zinc bath were changed. It also turned out that there is Ti segregation in the coating, and we can observe nanostructure between the separations of the high-titanium phase in the coating.

The boron solubilty in Al-Mg-B alloys

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In almost all industries, including the nuclear power industry, there is a constant drive to reduce the weight of a wide range of products. Materials in the nuclear power industry have specific requirements for mechanical properties, neutron absorption and the ability to resist degradation by radiation. Today, among other things, boron steels are widely used for the storage and transport of nuclear fissile material and products in the energy industry because of their good neutron properties. The drive to reduce the weight of products and components in use today is often made possible by a change in the materials used towards lighter non-ferrous alloys (aluminium, titanium, etc.). Boron enriched aluminium alloys appear to be promising in this context. This study deals with the effect of magnesium content in Al-Mg-B alloy (with a boron content of about 5 wt. %) on the formation of intermetallic phases and elimination of inclusions in the form of boron powder particles in the final structure. At first look, the high melting temperature difference between pure aluminium (660 °C) and boron (2 076 °C) appears to be a potential problem. Moreover, boron has a very limited solubility in aluminium (0.055 wt.%) and the liquidus temperature increases very rapidly with increasing boron content (liquidus temperature approx. 1 160 °C at 5 wt.% for Al-B binary alloy). Alloying with magnesium results in the transformation of the intermetallic phases AlB12 and AlB2 to the (Al, Mg)B2 phase and has a significant beneficial effect on the formation of intermetallic boron phases in the aluminium alloy without residual boron powder particles.

Metalurgické spracovanie vysoko-entropickej zliatiny CoCrFeNi

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Vysoko-entropické zliatiny (angl. High-entropy alloys – HEA) je skupina kovových materiálov, ktorá v súčasnosti zažíva v materiálovej vede veľký rozvoj. Zatiaľ čo konvenčné zliatiny sú založené na väčšinovom obsahu primárneho prvku s nejakým množstvom pridaných legúr, HEA sú na báze viacerých (obvykle vyše 5) prvkoch, ktoré dosahujú ekvimolárny/ekviatómový obsah. Pri správnej kombinácii prvkov možno dosiahnuť vlastnosti, ktoré by mohli predurčovať HEA pre praktické aplikácie.

Pri výrobe HEA v doterajších výskumoch boli ako vsádzka v prevažnej miere používané čisté kovy. Pre ekonomicky výhodnejšie použitie vysoko-entropických zliatin v priemysle je však kľúčové použitie bežnej priemyselnej vsádzky s obmedzenou čistotou. Takáto vsádzka môže obsahovať sprievodné prvky, ktoré môžu mať nežiaduci vplyv na vlastnosti zliatiny. Ide predovšetkým o prítomnosť nekovových prvkov tvoriacich v materiáli inklúzie. Pre dosiahnutie optimálnych vlastností zliatiny je potrebné metalurgickými procesmi minimalizovať ich obsah.

Cieľom tejto práce je vyhodnotiť možnosti dezoxidácie a odsírenia zliatiny CoCrFeNi tavenej z kovového odpadu vo vákuovej indukčnej peci. Na dosiahnutie tohto cieľa bola použitá uhlíková reakcia pod vákuom, dezoxidácia hliníkom, odsírenie horčíkom a kovmi vzácnych zemín.

Casting of aluminium foam with defined porosity using DOE.

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Closed cell aluminium foam offers an interesting combination of properties such as high energy absorption, stiffness, strength and low density. These properties give it great potential as an impact absorbing material which can be used in the automotive industry, military, civil engineering and others. To achieve these properties, the structure of the foam is important. The number, shape, regularity and distribution of pores are of great importance. A major disadvantage of aluminium foam is its low viscosity and consequently poor castability.

Casting of aluminium metal foam is achieved by a thermally activated chemical reaction of the foaming agent calcium carbonate ($CaCO_3$). Different amounts of foaming agent and reaction times have been used to achieve defined porosity. With regard to process stability and manufacturing cost, optimal parameters to achieve defined porosity were found using DoE methodology. As a result, longer agitation times were found to produce more homogeneous foams as the calcium carbonite powder was better distributed, consequently more calcium carbonite powder needs to be added as it reacts and is consumed when in contact with the melt. Experiments were performed using gravity casting and simple shapes can be made this way. Efforts are currently being made to establish a manufacturing process that can be used to produce castings with defined geometry.

Lost-PLA precision aluminium casting for thin-walled structures for heat transfer enhancement in thermal energy storage.

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Thin-walled cast aluminum structures are gaining interest as promising solutions for thermal energy storage (TES) applications due to their favorable properties, such as high thermal conductivity, low weight and flexibility to fabricate complex shapes. The use of these structures enables efficient heat transfer in thermal energy storage applications, contributing to the development of renewable energy integration and sustainable energy systems. The design, fabrication and performance testing of aluminum spatial structures for heat energy storage systems will be discussed.

Research of fluidity for new LPIC technology

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Today, the emphasis is on rapid development and research of new technologies in all technical fields. In most cases, research and development involves practical experiments, which can be very costly to carry out. Some experiments may not even work and can waste time and money, which are crucial for fast and high-quality research. In order to avoid these problems before conducting a practical experiment, we can use numerical simulation software, which is very reliable when the correct input parameters are given. Numerical simulation of the process can reveal how the practical experiment may turn out even before its implementation. The paper deals with the use of numerical simulations in investigating the problem of fluidity abilities in a new pressure investment casting technology, where the output is the agreement between the simulation and the practical experiment. The practical experiment consisted in the design of a filling ability test for stainless steels cast using the pressure investment casting technology and the simulation was carried out in NovaFlow&Solid.

hodnotenie náchylnosti zliatiny AlSi10MnMg na vznik trhlín za tepla v závisloti od teploty formy

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Žilinská univerzita v Žiline

Práca sa zameriava na hodnotenie miery náchylnosti zliatiny AlSi10MnMg na vznik trhlín za tepla. Zliatiny na báze AlSi10MnMg, vzhľadom na ich optimálnu kombináciu vlastností, nachádzajú uplatnenie najmä v oblasti vysokotlakových odliatkov pre automobilový priemysel. Cieľom práce bolo skúmať vplyv odstupňovanej teploty formy na náchylnosť zliatiny AlSi10MnMg na vznik trhlín za tepla. Pre experimentálnu prácu boli vybrané tri teploty formy 100 °C, 140 °C a 180 °C. Na základe výsledkov experimentov je možné konštatovať, že experimentálna zliatina AlSi10MnMg nevykazovala správanie indikujúce zvýšenie náchylnosti praskania za tepla. Pri procese vysokotlakového liatia, najmä pri rozmerných odliatkoch, je dochladzovanie formy problematické. Dochladzovanie formy predlžuje medzioperačné časy, čo ma za následok zníženie efektivity výroby. Z toho vyplýva, že zliatiny vhodné pre aplikáciu vysokotlakového liatia, by nemali podliehať zvýšenej náchylnosti na praskanie za tepla a to v čo možno najväčšom intervale teplôt. Potvrdilo sa že AlSi10MnMg je jednou z najvhodnejších zliatin pre aplikácie vysokotlakého liatia a nepodlieha zvýšenej náchylnosti na praskanie za tepla v intervale teplôt formy 100 – 180 °C.

Rozdílné principy mísení a jejich vliv na vlastnosti bentonitové směsi

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Bentonitové směsi jsou rozšířené po celém světě a stále si udržují svou popularitu, která má potencionál v budoucnosti ještě růst. Vzhledem k rostoucím požadavkům na snižování emisí v průmyslu patří tyto směsi mezi možnosti, jak tyto podmínky splnit. Důležitým faktorem je, že tyto směsi splňují vysoké požadavky na kvalitu odlitků. V současné době je důraz kladen na kvalitu surovin na úkor mísení, které často bývá opomíjeno. Cílem této práce je popsat rozdíly ve vývoji vlastností směsi během míchání na dvou typech mísičů. Sledované směsi jsou mezi sebou porovnávány na základě měřených vlastností, především vlhkosti a pevnostních charakteristik.

3D tisk zkušebního dílu a měření rozměrové přesnosti pomocí mikroskopu a 3D skeneru.

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Aditivní výroba je v dnešní době již běžně používanou technologií. Tento trend se ve výrobě intenzivně zaměřuje na zvýšení produktivity a kvality výroby. Jedná se o proces výroby komponentů vrstvením materiálů, který se liší od klasických procesů výroby např. modelových zařízení. Tato technologie nabízí řešení mnohých nevyrobitelných tvarů a konstrukcí běžně používanými technologiemi. Dalším benefitem je minimální odpad při výrobě.

3D skenování, které je v dnešní době markantně využíváno v mnoha oborech. Tato technologie umožnuje analýzu a zpracování 3D dat z různých zdrojů. Používá se například na detailní a kvantitativní porovnání povrchu a měření vzdálenosti na předmětech. Velké využití je tak u průmyslových výrobků, kde je kladen důraz na rozměrovou přesnost. Hlavní z výhod je skenování předmětů, které nemají například dohledatelnou geometrii či 3D data.

Tento článek se zabývá popisem technologie aditivní výroby, dále popisem vybraných materiálů. Je také poukázáno na jejich vlastnosti, které mohou hrát roli při procesu měření. Následuje postup výroby modelu, který je dále skenován a zjišťuje se povrchová vzdálenost a linková drsnost jednotlivých materiálů, jejichž vlastnosti a výsledky jsou rozebrány v diskuzi. Podstatou experimentu/výzkumu je vybrat materiál s nejlepšími vlastnostmi, tedy materiál, který má nejoptimálnější povrch tisku, aby mohl být dále použit např. v technologii přesného lití na vytavitelný model.

Odeznívání očkovacího účinku u litin s lupínkovým grafitem

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Vysoké učení technické v Brně - Fakulta strojního inženýrství - Odbor slévárenství

Příspěvek se zabývá problematikou očkování litiny s lupínkovým grafitem. Jedním z faktorů ovlivňujícím výslednou jakost struktury a výskyt nežádoucích forem grafitu je odeznívání očkovacího účinku. To je způsobeno časovou prodlevou mezi okamžikem očkování a odlitím kovu. V práci byl sledován grafitizační účinek v závislosti na době odeznívání pro dvě různá očkovadla. Po očkování byly v časových intervalech provedeny odběry vzorků pro zákalkovou zkoušku, termickou analýzu a analýzu chemického složení pomocí optického spektrometru. U odlitých vzorků bylo následně provedeno metalografické hodnocení mikrostruktury a její kvantifikace pomocí obrazové analýzy grafitu.

Vliv tvaru a rozložení grafitu na fyzikální a mechanické vlastnosti LLG

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Vysoké učení technické v Brně - Fakulta strojního inženýrství - Odbor slévárenství

Problematika výskytu degradovaných forem grafitu v odlitcích se řeší především ve spojitosti s litinou s kuličkovým grafitem. Nicméně je výrazně spojená i s výrobou litiny s lupínkovým grafitem a je tedy třeba zabývat se příčinami, které způsobují vznik nežádoucích struktur a hledat řešení, jak jim předcházet nebo je řídit. Cílem tohoto příspěvku je ověřit vliv vybraných stopových prvků na morfologii grafitu, změnu struktury a s tím spojené mechanické a fyzikální vlastnosti litin s lupínkovým grafitem. A následně zhodnotit možnosti využití takto změněných vlastností v technické praxi.

Testing the Veining Elimination using Pressure Changes using one Type of Additive in a Cold-box-amine Core Mixture

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FMMR Technická univerzita v Košiciach

This article focuses on the analysis of the effect of different amounts of a specific additive in the core mixture and the change of the shooting pressure in order to eliminate defects on the casting surface, especially the veinings. These defects are often located in hard-to-reach places and it is impossible to remove them by sanding or other processing. This is precisely why the modification of the used core mixture is important. Additives are often added to the core mixture, which are currently part of the production of the core mixture. For the effectiveness of the core mixture, it is not only important to know the type of additive, but it is equally crucial to accurately determine the amount of added additive and also to correctly set other parameters related to the production of cores, e.g. correct choice of shooting pressure. Test cores were produced using cold-box technology. For the needs of the tests, 3 test cores were made out of each selected composition at pressures of 2 and 4 bars. The cores were placed in molds, the two best cores from each group were selected and subsequently casted. After cleaning, the defects of the castings were evaluated. The last step was mutual comparison of the individual castings. The best test casting with the best surface quality and the least occurrence of veinings was the test casting with cores made with Antifin content of 1%, at a working pressure of the equipment of 4 bars.

The influence of T6 heat treatment on the microstructure and mechanical properties of zirconium-modified aluminum alloys

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Sieć Badawcza Łukasiewicz - Krakowski Instytut Technologiczny

The main goal of this study was to determine the effect for T6 heat treatment on the microstructure and strength properties of the AlSi9Mg casting alloy with Zr addition.

A important disadvantage is the tendency of silumins to form a coarse-grained structure that adversely affects the mechanical properties of castings. To improve the structure and properties, modification processes and alloying additives are used, both of which can effectively refine the structure and thus increase the mechanical properties. Recently, there has been has been a growing interest in adding zirconium to aluminum alloys. The proposed addition of zirconium as an alloying element has a beneficial effect on the structure and properties of silumins, inhibiting grain growth.

The starting material for the tests was a foundry aluminum-silicon alloy: EN AC-AlSi9Mg (AK9). Zirconium (Zr) was added to the alloy in an amounts of 0.1%, 0.2%, 0.3 and 0.4% by weight. After verifying the chemical composition, samples were cast into sand moulds based on an inorganic binder. The samples were subjected to a two-stage heat treatment (T6).

Analysis of the phase composition of the produced alloys, microstructural and strength tests enabled determination of the impact of the heat treatment process on the AK9 alloy with the addition of zirconium.

Geometry conversion of cast components operating at elevated temperatures

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The reliability and continuous operation of heating devices largely depend on the durability of their components. Examples of commonly used components in such devices include castings such as grates and deflectors. The components of this type, operating at elevated temperatures, are subject to the effects of cyclic fatigue processes, leading to detrimental changes in the material structure. Adverse operating conditions can result in the formation of cracks and deformations in the shape of castings, rendering them unusable.

The main goal of the conducted research was to determine the impact of applied shaped conversion on the elimination of areas of concentration of thermal stresses causing fatigue cracking mechanisms during the casting and operation stages. Elimination of hot spots also allowed for extending the lifespan of the components. As part of the study, an analysis of the shapes of currently used constructions was performed, and multi-variant simulations were conducted to optimize the shape in terms of hot spots occurrence. Reinforcing sections and relieving areas were employed to reduce critical stresses.

Tungsten pseudo-alloys sintering process

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VŠB-TUO, FMT

Tungsten heavy pseudo-alloys are prepared by powder metallurgy together with other alloying components such as nickel, cobalt, iron, or copper in protective atmospheres or under vacuum and at defined temperature profiles. The sintering process of these materials has an influence on the initial properties of the material. The mechanical properties studied include hardness, yield strength and ductility for the starting semi-finished products and the subsequent products that are used in various industries such as medical, aviation or military. Recently, the use of recycled waste chips from the production of individual components in the life cycle assessment of tungsten and their further use for the production of other components, such as energy components, has also been considered. The environmental aspect is also very important at present. All of these mechanical properties are carefully investigated to ensure that the resulting material meets the required conditions, that there is no damage to the material both inside and on the surface during its final use and that the various sintering processes also have an effect on the resulting material structure.

Use of inorganic binders based on alkaline silicates for automotive castings

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Technická Univerzita v Košiciach, Fakulta materiálov, metalurgie a recyklácie

Inorganic binders have been gaining renewed prominence in recent years, and their manufacturers have been developing processes that are gradually beginning to replace organic binder systems. This article focuses on the possibilities of using inorganic binders based on alkali silicates for aluminium alloy castings cast in metal moulds intended for the automotive industry. We will describe trends in the development and use of new alkaline silicate-based binders. We will compare the properties of new generation organic and inorganic binder systems. Last but not least, we will describe the problems associated with the use of new inorganic binders, the influence of different inorganic binder systems on the technological properties of the cores such as strength, disintegration, shelf life on the resulting surface quality of the casting.

Analysis of the Quality of the Mould Part Produced by Additive Technology

Pinta, M., Socha, L., Gryc, K., Sviželová, J., Mohamed, A., Koza, K., Sellner, T., Dvořák, M., Roh, M.

Vysoká škola technická a ekonomická v Českých Budějovicích

The paper deals with the monitoring of the quality of the shaped part of the mould produced by additive technology from H13 tool steel. The shape part of the mould is a key element in the casting of aluminium alloys by HPDC technology and has a major influence on achieving the desired quality of the casting. The aim of this paper is to present the developed evaluation methodology, which includes the results of surface quality analysis and dimensional accuracy and stability of additively printed parts. These analyses were carried out from the production of the mould part to its application in the foundry operating conditions. Comprehensive analyses offer an overall view of the changes in the individual technological operations. These operations represent additive printing, heat treatment, machining and final coating before being put into the operating conditions of the foundry. The paper also involved monitoring the quality of the form part in regular cycles within the production of aluminium castings. This methodology and results provide new insights in the field of engineering metallurgy.

Dimensional and Shape Analysis of Additively Manufactured Shaped Parts of DIEVAR Steel Moulds

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Vysoká škola technická a ekonomická v Českých Budějovicích

The paper presents the results of dimensional and shape analysis of additively manufactured shaped parts of foundry moulds. Specifically, the shaped slide inserts made of DIEVAR material used in the die casting process of aluminium alloys are analysed. The aim of this paper is to provide a comprehensive overview of dimensional and shape analysis in the context of the production of mould parts prior to their application to foundry operating conditions. The individual manufacturing operations are additive printing, heat treatment, machining and application of protective coating. On the basis of these technological operations, the required component accuracy is achieved before application to the operating conditions. The dimensional and shape analysis was measured by 3D scanning and 3D measuring methodology on a coordinate measuring machine. The ROMER ABSOLUTE ARM 3D scanning arm and the THOME PRÄZISION coordinate measuring machine were used for the measurements. The results of the paper present findings in the development and application of additive manufacturing technologies in engineering metallurgy.

Design of Conformal Cooling of an Additively Printed Aluminium Die-Casting Mold Component

Sviželová, J., Sellner, T., Socha, L., Gryc, K., Mohamed, A., Koza, K., Pinta, M., Dvořák, M., Roh, M.

Vysoká škola technická a ekonomická v Českých Budějovicích

The paper describes the design of conformal cooling of an aluminium die-casting mold component using numerical simulations. The subject of modifications was the insert (core). The insert comes into direct contact with the metal during the filling of the mold and solidification of the casting and determines the internal shape of the casting. The aim was to optimize the operating temperatures of the insert, reduce thermal stress in the most exposed area, achieve a more even distribution of temperatures in its volume, and maintain the casting quality. Shape modifications were made by topology optimization to reduce the volume of the insert and achieve material savings. 3D printing was chosen as the production technology due to the wider possibilities regarding the variability of the shape of the internal cooling channels. Three geometric designs of the insert were created, and numerical simulations of the temperature field of the mold were carried out in ProCAST software for each variant. Based on the results, the final design D was selected, for which a complete numerical simulation was performed, including the filling and solidification of the castings. The results were compared with the original variant A. By adjusting the cooling, temperatures were reduced in the most temperature-exposed area of the insert. The new insert variant D showed higher temperatures in the rest of the volume, resulting from material volume reduction. However, the temperatures became even, and the temperature gradients in the original insert variant A were reduced. The simulation also showed that changes in the temperature field of variant D would not negatively affect the quality of the castings. The component will be manufactured and tested in operational conditions in the next research phase.

Ścieżka krystalizacji stopu kobaltu zawierącego węgliki (Crystallization Route of Cobalt based Alloy Containing Carbides)

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W artykule przedstawiono metodykę doboru składu chemicznego stopu kobaltu w celu maksymalizacji udziału węglików przy założonej zawartości dodatków stopowych przy użyciu oprogramowania komputerowego. W kolejnym etapie wytworzono stop i poddano go szczegółowej analizie chemicznej i strukturalnej. Wyniki badań eksperymentalnych oraz symulacji przemian fazowych przy założonych warunkach termofizycznych wykorzystano w szczegółowym opisie przebiegu krystalizacji stopu.

The effect of addition of the natural zeolite on the microstructure and mechanical properties of sintered iron matrix composite

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The paper presents results of research on manufacturing technology and application of iron - zeolite composite obtained by powder metallurgy technology. The quality of the zeolite bonding with the matrix and the influence of zeolite particles on the sinter properties were evaluated. Before the sintering process, morphology and chemical composition of the zeolite was investigated, which was obtained from a rock called zeolite tuff, extracted from the quarry in Kucin (VSK PRO-ZEO s.r.o, Slovakia). The test rock was supplied as a powdered fraction of 0.0-0.2 mm. Surface analysis of SEM EDS and XRD XRD was performed. Prior to the sintering process, one-sided pressing on a hydraulic press was applied at a press pressure of 400 MPa. The sintering process was carried out in a laboratory tubular furnace at 950°C under dissociated ammonia. The sintering time was 60 minutes. The sintered materials were subjected to the following tests: density, hardness, porosity. Compression test the microstructure and analysis of the EDS chemical composition on metallographic specimens made from the investigated sinterings using scanning electron microscope were also carried out. Zeolite was added to the iron matrix at 5, 10, 15% by weight.

Introducing the zeolite particles into the reinforcing phase has increased the porosity and hardness of the sinter, while decreasing the density.

Predicted hardness of Austempered Vermicular Graphite Iron

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The Jacob of Paradies University

The article assessed the parameters of the heat treatment of vermicular cast iron on the hardness of the obtained alloy. Austenitization was performed at the temperatures of 890°C, 925°C and 960°C, and austempering at the temperatures of 290°C, 340°C and 390°C. Both the austenitization and austempering times amounted to 90, 120 i 150 minutes. The experiment was carried out based on factor planning and a central composition plan was used, which resulted in 27 experiments (heat treatments). Taking the heat treatment parameters as input variables and hardness as the output variable, it allowed to obtain a correlation between the variables at the level of about 95%. The proposed of a mathematical model, which was influenced mainly by parameters such as austempering temperature, the square of the austenitization time and the product of the austenitization temperature and time, validates the experimental results at 93%.

The influence of thermal shocks on the ausferritic matrix of cast iron with lamellar graphite cast iron

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The importance of heat treatment parameters of lamellar graphite cast iron on thermal shocks was initially determined. The tested cast iron was heat treated according to four variants differing in austenitization temperature (900ºC or 960ºC) and austempering temperature (290ºC and 390ºC). The time of both treatments was constant and amounted to 90 minutes. To determine the resistance to thermal shocks, a stand was used that allowed for repeated heating of samples in a given temperature range and their cooling. The samples were induction heated to a temperature of 500ºC-600ºC and then cooled in water at a constant temperature of approx. 30ºC. Depending on the heating temperature, 2000 and 1000 cycles were carried out. The tests used flat samples with a length of 70 mm and a thickness of 5 mm, with "point" ends on both sides at a distance of 15 mm. The total length of cracks formed on the tested wedge surfaces of some samples was adopted as a characteristic value inversely proportional to the material's resistance to thermal shocks. The tests showed that the best resistance to sudden temperature changes was found in cast iron subjected to austenitization at 960ºC and isothermal hardening at 290ºC. In the sample with the longest crack length, at the edge of the blade of the tested sample, a reconstruction of the austenitic structure is visible, associated with the occurrence of ferrite needles, granular pearlite, and cementite.

The investigation on abrasive wear behavior of high vanadium cast iron

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High-vanadium cast iron is a type of white cast iron characterized by the absence of graphite in its microstructure. The carbon content in this alloy, combined with vanadium, leads to the formation of thermodynamically stable carbides. Depending on their chemical composition, these carbides can take on various shapes.

Both the morphology of the crystallized carbides (both primary and eutectic) and the type of matrix significantly influence the properties of vanadium cast iron, including its resistance to abrasive wear. Research literature confirms the growing interest in casting materials with exceptionally high tribological properties.

The study presented in the paper examines vanadium cast iron with different microstructures, focusing on the shape of the carbides and the type of metal matrix. The research employs Scratch analysis as a method to assess the scratch resistance of vanadium cast iron. The primary goal is to understand the wear mechanisms specific to this material. Additionally, hardness tests using the Vickers method and tensile strength measurements are conducted, along with a metallographic analysis of the obtained cast iron.

Based on the tests carried out, it can be concluded that the highest hardness is achieved by vanadium cast iron with a matrix in the form of lamellar pearlite; Vanadium cast iron with a hypoeutectic structure and a pearlitic matrix has the best scratch resistance, while vanadium cast iron with a ferritic matrix with spheroidal vanadium carbide precipitates has the worst scratch resistance.

'Biography of bronze' as an interdisciplinary approach to foundry technology

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The aim of the study is the complex analysis of bronze–working practices and strategies adopted by the Late Bronze Age and the Early Iron Age communities inhabiting the area within the historical boundaries of Greater Poland. The Late Bronze Age and the Early Iron Age (13th–7th cent. BC) in Greater Poland are the richest periods in terms of sources for the study of bronze–working. The complex issues of the past technology require the combination of specialist knowledge in terms of archaeology, materials engineering, casting technology, geology, and analytical methods including optical microscopy and scanning electron microscopy, spectrometry, X–ray imaging, as well as 3D visualisations, and computer simulations. The results of investigations carried out within the frameworks of the project will have a great significance for the issues related to the exchange of ideas, knowledge and raw materials and the emerging of specialisation, and the innovativeness of prehistoric foundrymen. Numerous traces of foundry activities (bronze products and casting moulds) have been discovered, among others, at the settlement in Biskupin. Contemporary interdisciplinary new insights and modern non-destructive research methods will assess the extent and specificity of Bronze Age production activities.

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Studies of crystallization process, structure and properties of tin bronzes with variable additions of other elements

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The group of copper-tin alloys is well-known and used in modern industry, however, tin, as the main alloying additive, is counted among the so-called critical elements that must be reduced. The realized research concerns the possibility of replacing the tin additive in tin bronzes with other elements, while maintaining the existing properties of these alloys. Among tin bronzes, there are binary alloys (CuSn) with variable tin content and multi-component copper-tin alloys with variable additions of elements such as zinc, lead, phosphorus, iron and others in smaller amounts. The poster will present the results of research implemented in the area of tin bronzes, taking into account the limitation of the proportion of tin, with variable additions of selected elements. Due to the significant role of the solidification and crystallization conditions of this group of alloys, the research includes the analysis of cast alloys made in sand and metal molds. The results presented will include experimental and theoretical thermal analysis (DTA, Thermocalc), optical and scanning metallography (OM, SEM), as well as the results of selected mechanical and technological properties of the analyzed alloys.

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Barbotage refining system with the possibility of introducing powder mortars into aluminum alloys

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This paper presents and describes a prototype experimental barbotage refining rig with the ability to implement powder mortars deep into the liquid metal. The device combines two methods of refining liquid aluminum alloys, gas refining and refining with salts in powder form. The innovation of the design of the station and the treatment of liquid metal with powdered additives is the dosing of the preparation deep into the metal bath through a channel made in the axis of the rotor and in the head. The powdered mordant dispensing system is fully automated, and tests of the completed stand confirmed the correct functioning and effectiveness of this method of introducing mordants and refiners in powder form. The performed tests showed that the complex refining: barbotage + refining with salts blown into the lower parts of the liquid metal allows reducing the hydrogen content in the liquid metal to a level that cannot be achieved by gas refining alone.

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