



# Global Casting Magazine

世界铸造

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JUNE 2019 VOLUME 9 NUMBER 2



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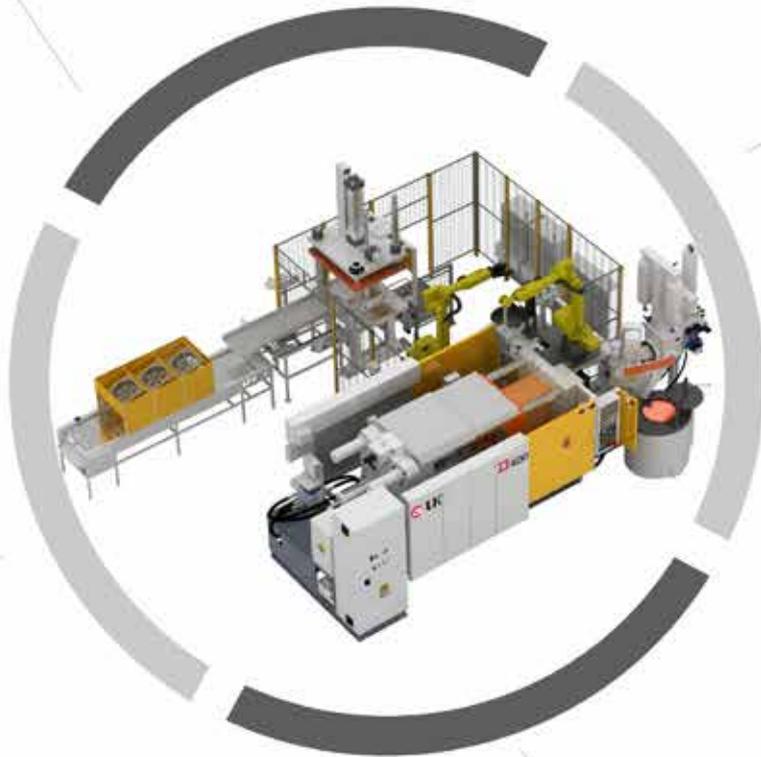
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# Finally GIFA Time – The Bright World of Metals!

## GIFA时间——闪亮的金属世界!

Every four years, experts from foundry, casting, metallurgy and thermo process technology meet with around 2100 exhibitors and thousands of trade visitors from all over the world in Düsseldorf in search of answers, innovations, trends and allies in the network.

Never before have there been so many questions and more opportunities for the foundry industry on the way to the digitally connected world of the Internet of Things.

As development cycles become faster, challenges more complex, and competition more global, a healthy level of self-confidence and openness to new thinking is a must.

A strong casting industry also finds its place as a problem solver in industry with changing mobility concepts. Additive manufacturing can also become an ally if foundries accept 3D printing as a supplementary offer.

The digitization and protection of our planet has become an integral part of the rigorous demands we must meet as a key industry, and given the diversity of processes and the innovative power of technology, we should optimistically embrace new possibilities.

GIFA 2019 comes at just the right time! Take advantage of the reunion with your customers and friends, the matchmaking, the discussion, the forums and the wonderful festivities at the fair.

Wishing you good luck and a lot of fun – we'll see you in Dusseldorf! ■

来自铸造、冶金和热处理行业的专业人士每四年将与来自世界各地的约2100家参展商和数万名专业观众汇聚在杜塞尔多夫，在沟通交流中寻找解决方案、创新技术、发展趋势和合作伙伴。

在通往物联网数字世界的道路上，铸造行业面临着前所未有的、更多的机遇和挑战。

随着研发周期变得更短、面对的挑战更加复杂、竞争更加全球化，必须拥有适度的自信和对新思想保持开放态度。

由于发展理念不断变化，强大的铸造行业也找到了问题解决方案。如果铸造企业可以接受3D打印技术作为补充，那么，增材制造也将有助于铸造业的发展。

数字化和环保已经成为铸造行业发展要求的重要组成部分。鉴于工艺多样性和技术创新能力的不断出现，铸造行业发展将有更多新的可能性，我们应该对此保持乐观。

Thomas Fritsch

GIFA 2019的举办恰逢其时！您可以通过一系列论坛和丰富多彩的活动与客户、朋友进行交流、对接和研讨。

祝各位展商及观众能够顺利且愉快地参加展会！杜塞尔多夫见！ ■



  
Thomas Fritsch  
Foundry-Planet Ltd., CEO

## Yxlon CT Solutions for Foundries — live at GIFA 2019

### YXLON 铸件X射线检测方案 ——出展GIFA 2019

As manifold as castings are, as diverse are the inspection solutions for the foundries industry. At this year's Gifa trade fair, Yxlon is presenting two of their most versatile radioscopic and computed tomography systems which are specially used in the automotive and aerospace industries.

Live demonstrations of YXLON MU60 AE, a universal industrial X-ray and CT inspection system designed for a broad range of aerospace and foundry (automotive) applications will probably impress visitors due to the size of the cabinet and the parts that can be inspected, either two- or three-dimensionally.

#### In a nutshell:

- Compact X-ray system for high-quality, dependable inspection results
- Optional CT scan functionality for three dimensional analysis
- Manual and programmable X-ray and computed tomography inspection
- TrueInspect ADR (automatic defect recognition) for foundry applications
- Responsive solution that can be adapted to customer's special application needs
- Compliant with current aerospace standards (DICONDE, ASTM, Guidelines by MAI, Nadcap)

The high-resolution industrial CT system YXLON FF35 CT for small and medium-sized parts is presented in its new version. The system is designed to achieve extremely precise inspection results for a wide range of applications. Available in a single or dual tube configuration, it is perfect for very small to medium-sized parts inspection in the automotive, electronics, aviation, and material science industries. Based on the intuitive software platform Gemini, FF35 CT provides best inspection results for specialists as well as unexperienced users.

#### In a nutshell:

- Single or dual tube configuration for the highest versatility
- 2D detail visibility of up to 150 nm with water-cooled 190 kV transmission tube

由于铸件种类的繁多，铸造厂的检测解决方案也千差万别。在今年的2019年德国杜塞尔多夫国际冶金技术展(GIFA2019)上，YXLON将展示两款通用型X射线和计算机断层扫描(CT)系统，这两种系统已专门用于汽车和航空航天行业。



我们将在现场演示 YXLON MU60 AE XL, 一台紧凑型工业x射线和CT检测系统, 为航空航天和铸造(汽车)应用而设计。此次展出设备的铅房尺寸和可检测样本尺寸的大小一定会让您印象深刻, 不论二维或者三维检测, 都能呈现在您的眼前。

#### 铅房中:

- 紧凑的X射线系统, 提供高品质扫描及可靠的检测结果
- 选配的CT扫描功能, 专为三维分析打造
- 手动及自动可编程的X射线及计算断层扫描(CT)检测
- TrueInspect ADR (自动缺陷识别) 功能专为铸件检测而生
- 响应式解决方案服务于客户的特殊应用需求
- 符合当前的航空航天标准 (DICONDE, ASTM, Guidelines by MAI, Nadcap)

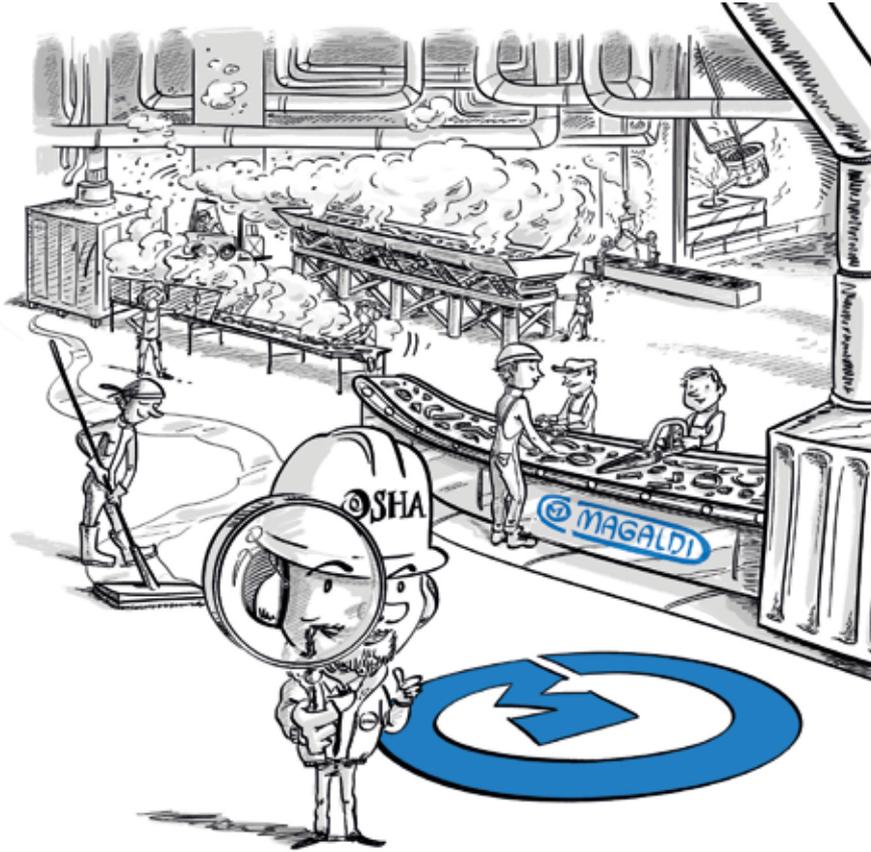
高分辨率工业CT检测系统 YXLON FF35 CT 适用于中小型部件, 配置最新1.5版软件。该系统旨在为广泛的应用实现极其精确的检测结果。可采用单管或双管结构, 适用于汽车、电子、航空和材料科学等行业的中小型零部件检测。基于先进的软件平台Gemini, FF35 CT不仅能够为行业专家提供了最佳的检查结果, 同样也能够使从未接触过X射线检测的用户轻松获得高品质的可靠检测结果。

#### 铅房中:

- 单射线管或双射线管配置, 以达到最高灵活性
- 190kV透射型水冷射线管配置, 二维图像细节最高可达150纳米
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# YXLON

- Temperature stability with granite-based manipulation
- Innovative touchscreens and graphic symbols for intuitive operation
- Application flexibility using trajectories such as helical CT scan, horizontal field-of-view extension, virtual rotation axis, and standard Quick/QualityScan
- Precise metrology  $MPE_{SD} = 8 \mu m + L/75$ , measured as a deviation of sphere distance referring to VDI 2630-1.3

**Inline Computed Tomography** is the next step toward Industry 4.0, gathering comprehensive data about every single object in production for reliable product quality and continuous process optimization. Inline solutions for individual customer requirements supplement the Yxlon product portfolio. At the Gifa trade fair, the Yxlon inline CT solution powered by Microvista will be introduced to interested visitors. ■

- 革命性触摸屏操作提高检测效率，适用于快速扫描
- 多种功能实现应用灵活性，如螺旋CT扫描、水平视场扩展、虚拟转轴、以及快速/高品质扫描
- 提供精确计量功能  $MPE_{SD} = 8 \mu m + L/75$ ，以球距偏侧测量，参照VDI 2630-1.3标准

在线计算机断层扫描（CT）系统，迈向工业4.0的下一步，它将收集生产中每一个对象的综合数据，以获得可靠的产品质量和持续的流程优化。针对单个客户需求的在线解决方案补充了YXLON产品组合。在2019年德国杜塞尔多夫国际冶金技术展（GIFA2019）展会中，这个概念将被介绍给感兴趣的参观者。 ■



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»LE<sup>+</sup> Technology helps us reduce both the BTEX emissions from green sand molding, as well as the consumption of additives. An optimization of the molding performance, the reduction of BTEX emissions and green sand molding additive are the results of partnering with Clariant.« PSA Groupe, Site de Sept-Fons, France



Visit us at **GIFA 2019**, Dusseldorf, Germany  
25–29 June 2019, Hall 12, Booth C13

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what is precious to you?

## Fit for the future – A foundry invests in an integrated solution. 适应未来发展——铸造企业投资综合解决方案



ConviTec GmbH based in Offenbach delivered an integrated solution for a foundry in the south of Europe. This foundry reaffirms its confidence in ConviTec not least because the equipment previously delivered has been operated most reliably for many years. In the past ConviTec delivered two fluid-bed sand cooler and one sorting conveyor.

There were the following difficulties before the modernization, e.g. the used sand was too hot. The existing cooling drum was no longer sufficient for an increase in production.

Furthermore the castings were too hot for the shot blasting process. Therefore, the shot blasting could be done in the off-line process only.

The really big challenge for this project is to insert the new plant components into the already existing plant. Modern tools such as a 3D scan were used there. The plant consists of three modules and ensures an automatic run-through of the casts from cooling to shot blasting. The first module is the separation of cast and sand, the second one the cast handling and as third module a modern sand regeneration system is installed. The mould size is 740x600x500 mm and the moulding line has a feed rate of 160 moulds per hour. In the first plant section, the hot cast-sand mixture is fed by means of an eccentric conveyor to a shake-out feeder after a rotary drum. 16 tonnes per hour of cast iron and 70 tonnes per hour of sand are transported. Controlled cooling of the cast is reliably ensured by a casting cooler from 250 to 70°C. After that, the cast and recycled material can be separated and sorted by hand. The advantage here is that the conveying speed can be regulated. It is also possible to work on both sides of the sorting conveyor, which was not possible before.

The connection between sorting conveyor and shot blast machine is provided by means of a belt conveyor and the altitude gain required for inflow into the shot blast machine is created.

The vibratory equipment of the shot blast machine consists of a loading conveyor, an unloading conveyor with steps and a return chute with screening of the blasting abrasive.

Here it was especially important to establish a constructive cooperation of the project teams during project processing. The delivered feeders and conveyors were designed, made and installed exactly in accordance with the requirements of the shot blast machine. The onward transport of the blasted casts is enabled by an eccentric conveyor, which is specifically designed as required for sorting the cast.

总部位于奥芬巴赫的ConviTec有限公司为欧洲南部的一家铸造厂提供了综合的解决方案。这家铸造厂再次表明对ConviTec公司的信任，尤其是以前交付的设备多年来的运行非常可靠。过去，Coni Tec公司提供了两台设备，流化床砂冷却器和分选输送机。

在现代化改造前存在以下困难：旧砂太热、现有的冷却滚筒无法满足产量增加的需求。

此外，由于铸件太热，无法进行喷丸清理。因此，喷丸清理只能在铸件离线后进行。

这个项目真正的最大挑战是将新的设备插入到已经存在的设备当中。那里使用了诸如3D扫描之类的现代化设备。新的设备由3个模块组成，确保铸件从冷却到喷丸的自动贯通。第一个模块是铸件与砂的分离模块，第二个模块是铸件处理模块，第三个模块是安装现代化的砂再生系统。铸型尺寸为740x600x500mm，造型线的进给速度为每小时160整型。在第一阶段，热铸件和砂的混合物是通过偏心式输送机在旋转滚筒后送至振动给料机。每小时运送16吨铸铁和70吨砂子。铸件冷却器从250°C到70°C可靠地保证了铸件的冷却控制。在此基础上，将铸造材料和再生材料进行手工分离和分类，优点是可以调节输送速度。也可以在分选输送机的两端工作，这在以前是不可能的。

分选输送机与喷丸设备之间的连接通过带式输送设备，并产生了进入喷丸机所需的高度增益。

喷丸机振动设备由装载输送机、带台阶卸料输送机和带爆破磨料筛分的返槽组成。

在这方面，特别重要的是在项目处理过程中与项目小组建立建设性的合作关系。送料器和输送机的设计、制造和安装完全符合喷丸机的要求。喷丸处理过的铸型的运输是由偏心输送机提供的，这是专门为铸件分类而设计的。

The new sand regeneration system is integrated and technologically incorporated in the already existing plant. In addition to a polygonal screen and fluid-bed sand cooler, some other conveyor components will be delivered here. The used sand is cooled from 90°C with 0,5 percent moisture to 40 °C with 2,5 percent moisture. They include conveyor belts and bucket elevators. Using the fluid-bed sand cooler, the operator obtains a reliably high sand quality in terms of temperature and moisture so that the cast quality and efficiency of the foundry is sustainably ensured. The feed rate of the sand plant is 70 tonnes per hour. The mixing times are shorter due to the very good homogenization of the sand through the vibrating fluid bed. Furthermore, the sand is not subject to mechanical stress, which results in high efficiency and low operation costs with high availability and a long service life.

Compared to a mixer cooler a ConviTec sand cooler only needs one third of the electric connected load, and mixers do not only show higher ventilator power but also a considerably higher power for the drive.

ConviTec's scope of delivery also includes the new electrical switch and control system which meets the modern requirements of future-proof equipment such as e.g. a ProfiNet connection to other plant components.

This project represents an outstanding example for a complete solution covering everything from planning to manufacture, assembly and commissioning and clearly shows ConviTec's competence in the foundry industry. ■

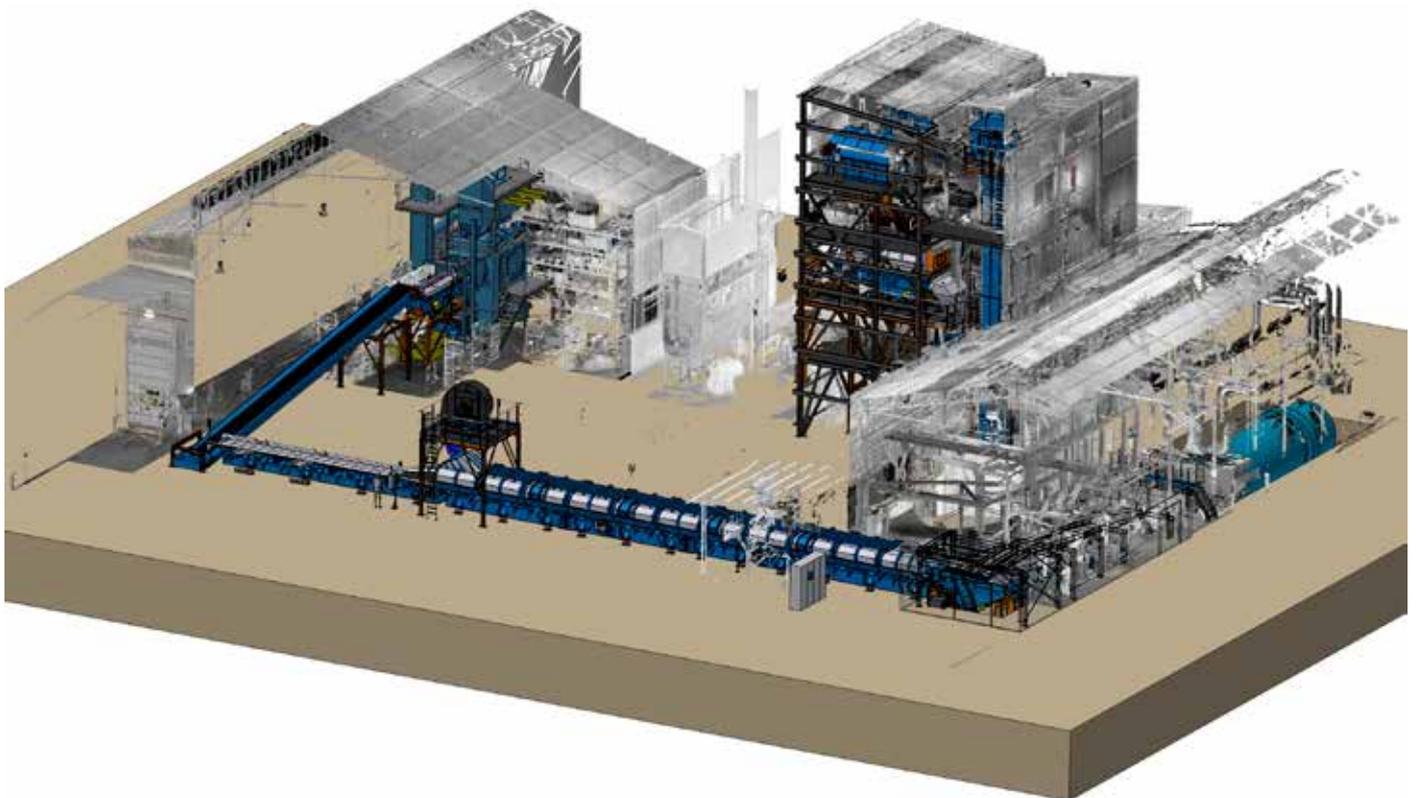
新的砂再生系统是在结合现有设备基础上集成新的部件与技术。除了多边形筛网和流化床砂冷却器，一些其他的输送部件将运到工厂安装。旧砂的冷却从90°C、湿度0.5%冷却到40°C、湿度2.5%。设备包括传送带和提升料斗。使用流化床砂冷却器，可以稳定控制砂的温度和湿度，确保型砂的高砂质量，从而持续地保证铸件的质量和生产效率。该设备的进料速率为每小时70吨。由于砂在振动流化床中的均匀性很好，使得混合时间较短。此外，砂体不受机械应力的影响，具有效率高、运行成本低、利用率高、使用寿命长等优点。

与混合冷却器相比，ConviTec公司的砂冷却器只需要1/3的电力，混合器不仅显示出更高的通风机功率，而且在驱动器上也显示出更高的功率。

Confiitec公司的供货范围还包括新的电气开关和控制系统，满足永不过时的设备的现代要求，例如，通过ProfiNet与其他设备的连接。

该项目是完整解决方案很好的案例，涵盖从设计到制造、装配和调试，并彰显了ConviTec公司在铸造行业的优势。 ■

ConviTec GmbH,  
Mühlheimer Straße 231, D 63075 Offenbach  
www.convitec.net  
GIFA 2019 – Hall 19 A09



## MAUS Presents the ReadyGrind™ Revolution Maus推出 ReadyGrind™ Revolution

# MAUS

ACTIVE IN TECHNOLOGY

MAUS Group, leader company in automatic grinding and vertical turning solutions, thanks to the acquisition of FRITZ HANSBERG and FOUNDRY AUTOMATION, specialized in the design and manufacturing of coreshooting machines, has become a full global solution partner for foundries.

The exhibition GIFA 2019 represents the opportunity to introduce and launch the new ReadyGrind™ to the foundry world.

MAUS has been successfully designing and manufacturing automatic grinding machines for 33 years and over that period of time has built a brand that is known throughout the worldwide foundry industry for quality, reliability, dependability, consistency, accuracy, speed, efficiency and the delivery of an overall robust product.

Over the last couple of years MAUS decided to reassess the new market demands and challenge itself to meet the new needs of the foundry customer adapting the product to the realities of today's global marketplace. The end goal was to develop a new automatic grinding machine that would provide more flexibility, with user friendly programming capabilities, an ease of operation and maintenance, lower delivery costs, reduced operating costs and a more attractive price tag that when combined with all the value-added features would provide a much lower cost of total ownership. ReadyGrind™ offers the foundry customer a very reasonable ROI, making it a practical investment that improves productivity, quality and profitability.

MAUS集团是一家全球技术领先的致力于生产制造铸件自动打磨清理及立车加工磨削解决方案的公司,自重组整合FRITZ HANSBERG造型及制芯公司和 FOUNDRY AUTOMATION 造型制芯公司以后, MAUS集团成为一家能够为全球铸造企业提供完整铸造解决方案的集团公司。

MAUS将于在德国杜塞尔多夫举办的GIFA 2019展览会期间为全球铸造业界介绍和推出新型号机器ReadyGrind™

MAUS全身心专注于设计及制造全自动打磨机器33年以来, MAUS已经成为为客户产品提供了在铸件打磨的质量控制, 机器的可靠性, 机器打磨铸件的一致性, 机器打磨铸件的准确性方面而享誉全球的知名品牌, 同时MAUS在打磨速度, 整体打磨产品的稳定交付效率及机器整体的稳定性在全球也是首屈一指的。

在过去几年以来, MAUS通过充分的市场调研, 重新评估了新的市场需求, 并且勇于挑战自己以满足铸造客户的新需求, 从而使产品适应当今全球铸造市场的现状。因此MAUS开发出新的自动打磨机床, 它将提供适

用于客户铸件产品更加大的灵活性, 具有让客户更加容易操作的编程功能, 更易于客户操作及维护, 降低了交付成本, 大大降低了客户的运营成本以及更有吸引力的价格。以上所有增值功能相结合, 将会是客户获得更低的设备总拥有成本。ReadyGrind™就是为了全球铸造客户提供非常合理的投资回报率而开发设计的打磨机床, 它将成为客户一项非常实用的设备投资, 同时能够大大提高客户的生产效率, 达到并提高客户产品的品质控制和客户产品的盈利能力。



It is a grinding machine that is programmable either inside the machine with a joystick or off-line using a programming bench. It is capable of grinding iron, aluminum, brass/bronze or steel part plus fixture up to 70 kg with maximum dimensions of 700 mm swing by 300 mm high. The machine has one rotating electro-spindle with two tools, one attached to each side of the spindle with a laser measurement system, a tailstock, a two position pallet changer and Fanuc controls. ReadyGrind™ has a small footprint allowing it to fit inside a 20 ft. container and it weighs only 6000 kg, so it can be picked up and moved using a forklift.

ReadyGrind™ requires less floor space, has significantly lower air and power requirements, weighs less which reduces freight charges and it can be handled using a forklift.

The next generation of MAUS machines for the foundry industry begins with the new ReadyGrind™ that represents a game changer. ■

它是一种打磨CNC机床，机床自带了一个易于操作的由控制手柄操作的拥有编程功能的显示器，同时机床也适用于离线编程台进行编程，机床能够打磨铁铸件，铝铸件，铜/青铜铸件或者钢铸件，它能够打磨的工件重量（包含夹具）为70KG，工件回转半径为700 MM，工件高300 MM；这机床拥有一个旋转电主轴及两个刀具，一套连接到电主轴的激光测量系统，一套底座系统，双托盘转换系统和FANUC控制系统。ReadyGrind™机床占地面积小，可以安装在20英尺的集装箱大小的空间内，重量仅为6000公斤，可以用叉车轻易快速的搬动及迁移。

ReadyGrind™需要的更少的占地面积，对于压缩空气及电力的配置要求很低，重量更轻，从而降低了搬运安装成本，能够使用叉车进行处理。

用于铸造行业的新一代MAUS打磨机的代表Ready-Grind™将开始像打电脑游戏一样易于操作。 ■



Visit us at : GIFA 2019 , Hall 17, Booth C02

[WWW.MAUS.IT](http://WWW.MAUS.IT)



[WWW.HANSBERG.COM](http://WWW.HANSBERG.COM)

## Focus on overall efficiency in core-making: lowest costs per core thanks to digitization

Hall 17 Stand B40

## 得益于数字化技术，专注于高效率&低成本的砂芯制造： 欢迎莅临17号展馆B40展位



As the world's leading supplier of core-making technology, Laempe Mössner Sinto will present its product portfolio at GIFA. Under the motto „Discover the true potential of the modern core shop“, the company from Barleben (Saxony-Anhalt) will focus on data transparency, digitization and overall efficiency this year. With state-of-the-art technology in the areas of core production, data analysis and visualization, as well as automatic visual inspection, Laempe Mössner Sinto demonstrates the combination of total core shop efficiency for lowest costs per core at GIFA.

Laempe Mössner Sinto will be exhibiting several core shooting machines and other equipment. Among the exhibited core shooters will be, for example, an LHL40, which has already been sold to the Jiangsu Wencan foundry in China, where the machine is used for the production of electric motor housings. The exhibit will also introduce a range of innovations to interested GIFA professionals. In addition to the LHL, also smaller core shooting machines will be exhibited on the Laempe area.

The topics of data transparency, visualization and digitization in the core shop are covered by a demonstration on the LHL machine and two special presentation desks. At one of these stations, Laempe Mössner Sinto will present the „Digital Cockpit“, which was developed jointly with INACORE and has been in use for more than a year. INACORE, a joint venture between Laempe Mössner Sinto and R. Scheuchl GmbH, has been producing inorganic sand cores under the most modern conditions since the beginning of 2018. The efficiency gain (for example lowest unit costs) through the implementation of a consistent digitization strategy can thus be demonstrated in practice using the example of INACORE – the results and realization will be presented with the „Digital Cockpit“ at GIFA. The visualization software can be used to display the most important key figures in the core shop, such as machine parameters, productivity, standstill detection, energy consumption and much more.

[www.laempe.com](http://www.laempe.com) ■

作为全球制芯行业的领航人，Laempe Mössner Sinto 将在GIFA展会上展示最前沿的技术及设备。以“挖掘现代制芯工厂的真正潜力”为己任，来自巴尔莱本（Barleben）的我们在这一年中专注于数据交换、数字化技术和高效性。通过运用制芯生产、数据输送以及包含自动化检测在内的可视化等领域的世界最先进的技术，Laempe Mössner Sinto实现了通过最低成本获得最高效率的制芯生产模式。

Laempe Mössner Sinto 将展示具有代表性的制芯机和相关设备。例如LHL40型制芯机，中国江苏文灿铸造公司已订购了该设备用于生产电机壳。我们也会向各位GIFA的参展专家介绍我们在制芯领域的创新成果。除了LHL型设备外，兰佩还会展出一些小巧的制芯设备。

数据传输、可视化以及数字化技术在制芯工厂的综合应用在LHL型设备上得到了完美的体现，同时您也可以从两个专门的展示台中获取相关介绍。Laempe Mössner Sinto 将在展台展示和INACORE 共同开发并且已投入使用超过1年的“数码舱”。INACORE 作为Laempe Mössner Sinto 和 R. Scheuchl GmbH合资的企业，自2018年起一直从事现代化无机制芯生产。持续的数字化战略的实施以及INACORE不断的实践，达成了高效率低成本的目标，GIFA的“数码舱”将展示这一系列的成果。可视化软件将用于展示制芯工厂的核心数据，例如设备参数、生产能力、智能检测以及能源消耗等等。

欢迎访问我们的网站：[www.laempe.com](http://www.laempe.com) ■

**Transparency is the Prerequisite ...**  
... for core production: i.o. With Laempe Mössner Sinto's Digital Cockpit data becomes intelligent information. The result: higher production capacity with less downtime, real-time error analysis and 100% transparency of machine performance.

GIFA 25.-29. Juni 2019  
Düsseldorf, Germany  
Hall 17 / Booth B40

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## Elkem Foundry Products takes casting iron to the next level at GIFA 2019

### 埃肯将携提升铸铁件水平的产品亮相2019GIFA展

From 25 until 29 June Elkem Foundry Products will be present at GIFA, the world's leading trade fair for casting technology, in Dusseldorf, Germany. There, Elkem will highlight its all-round competence to improve the metallurgical iron foundry process.

GIFA is the international exhibition for foundry, foundry products and foundry technology and one of the world's largest and most comprehensive fairs of this kind. The focus of GIFA is on foundry equipment, raw materials and supplies, die-casting technology, foundry chemicals, suppliers and processing technology. This exhibition provides an excellent stage for Elkem Foundry Products to highlight its capabilities and most current innovations.

Elkem Foundry Products has evolved to being an all-round solution provider for the metallurgy of iron foundries, supporting its customers globally with highly specialised alloys and excellent advice, which results in premium castings. Elkem innovates constantly and supports its customers with new, digital and automated solutions for analysis and alloy dosing.

One of these solutions is the new Dynamic Dosing System, which enables foundries to precisely and automatically calculate, dose and position the treatment alloys into a dedicated pocket in the treatment ladle, for high quality ductile iron production.

6月25-29日，埃肯公司将参加在德国杜塞尔多夫举办的世界领先的铸造展览会GIFA。期间，埃肯将全面展示其产品竞争优势，以改善和提升铸铁冶金工艺。

GIFA是铸件、铸造设备和原辅材料以及铸造技术行业的国际展览会，也是世界上最大和最全面的行业展会之一。- GIFA的展品包括铸造设备、原材料和制品、压铸技术、铸造化工品、加工技术。展会为埃肯铸造公司产品提供了极好的展示舞台，突出其生产能力和创新。

埃肯公司已发展成为一家全面的铸铁件及冶金解决方案供应商，为客户提供高度专业化的合金和优良的咨询服务，最终生产出优质铸件。埃肯不断创新，为客户提供新的、数字化、自动化分析和合金定量配给的解决方案。

解决方案之一是新的动态定量给料系统，使铸造厂能够精确、自动地计算和添加合金，将其放置在处理包中的专用袋中，以生产高质量的球墨铸铁。





This customised equipment calculates the alloy addition rates based on the chemical analysis of the iron and other important parameters before and after each treatment. This self-learning equipment stabilises and documents the treatment process, reduces cycle time, improves the iron quality and avoids human error.

Another example of Elkem's improvements is Elkem's EPIC®, an important process control tool based on thermal analysis of cast irons. The EPIC® system provides real-time information on the condition of cast iron that can be used at any point in the liquid state production process. EPIC® enables the foundry to acquire, record and evaluate a considerable amount of relevant data, which helps to improve the castings.

#### Sustainability

Increased efficiency in alloy treatment not only results in increased process stability for Elkem's customers, but it also leads to less consumption and emissions, supporting Elkem's focus on sustainability.

#### GIFA 2019

Elkem invites visitors at GIFA to its stand C50 in hall 13, where Elkem's sales team and technical staff are available for discussions. ■

该定制设备基于在每次添加合金前和之后对铁和其它重要参数进行化学分析来计算合金的添加速率。该自学习设备稳定并记录了工艺过程、缩短生产周期、提高了铁的质量，避免了人为操作失误。

埃肯公司另一个解决方案是EPIC®产品，这是基于铸铁热分析的重要过程的控制工具。EPI C®系统提供关于铸铁状况的实时信息，可在液态过程中的任何点使用。EPI C®使铸造厂能够获取、记录和评估大量相关数据，从而有助于提升铸件质量。

#### 可持续性

合金处理效率的提高不仅提高了埃肯客户的工艺稳定性，而且减少了消耗和排放，彰显了埃肯公司对可持续性发展的重视。

#### GIFA 2019

埃肯公司诚邀您到13号馆C50展位与公司的销售团队和技术人员交流。 ■



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## Advanced ceramics from CeramTec: efficient and durable in harsh environments

### CeramTec的先進陶瓷：在惡劣環境中高效耐用

# CeramTec

T H E C E R A M I C E X P E R T S

Components for metalworking must be particularly robust and wear-resistant even under the harshest conditions. Due to their properties, advanced ceramics from CeramTec guarantee unsurpassed performance in a wide variety of metalworking processes, for example in machining of metal or working with molten metals.

#### High performance for foundry and temperature measurement technology

Aluminum titanate from CeramTec effortlessly masters challenging conditions in the non-ferrous molten metals industry – even in aggressive melting processes, at maximum temperatures of 1,000 degrees Celsius and with temperature differences of several hundred degrees. It is therefore perfect for components like risers for low-pressure die casting, intake pipes, fill tubes, break rings, nozzles, stoppers and closing plates in aluminum foundries. Its low thermal conductivity saves energy and its outstanding chemical and abrasive resistance ensures high melt purity. Excellent electrical insulation and high mechanical

用於金屬加工的部件即使在最惡劣的條件下也必須特別堅固耐磨。CeramTec的先進陶瓷因其特性在各種金屬加工工藝中保證了無與倫比的性能，例如，金屬加工或熔融金屬加工。

#### 為鑄造和溫度測量技術提供高性能

CeramTec的鈦酸鋁可以毫不費力地滿足有色金屬熔融行業的挑戰性條件——即使在最高溫度為1000攝氏度，溫度差為幾百度的腐蝕性很強的工藝中。因此，它非常適用於鋁鑄造廠的低壓鑄造立管、進氣管、填充管、斷環、噴嘴、塞子和封板等部件。其低導熱性可節省能源，其出色的耐化學性和耐磨性確保了高熔體純度。出色的電絕緣性和高機械強度使其非常適用於測量和控制溫度的設備——例如，保護管或熱電偶管和RTD元件。



ALUTIT products for foundry applications

应用于铸造的钛酸铝产品

strength make it also perfect for devices used to measure and control temperatures – e.g. protection or thermocouple tubes or RTD elements.

Reliable **protection against wear, high temperatures or corrosion** needed? ALOTEC® ceramic linings ensure a safe long-term performance of your machines and systems even under harshest conditions.

**PERLUCOR®** is an ideal material e.g. for monitoring equipment in abrasive media. The transparent, almost indestructible ceramic enables an unobstructed view of the manufacturing process at any time.

CeramTec also offers a variety of high-performance cutting materials and tool systems, covering the entire machining spectrum such as turning, hard turning, grooving, milling and boring. For high productivity, quality and maximum safety!

**Water-soluble, salt-based cores** to produce complex casting components in foundry technology, e.g. for piston casting, round up the CeramTec portfolio. ■

CeramTec GmbH, Germany  
www.ceramtec.com  
b.mueller@ceramtec.de

需要可靠的防磨損、高溫或腐蝕保護？ALOTEC® 陶瓷內襯即使在最惡劣的條件下也能確保機器和系統的長期安全性能。

PERLUCOR® 是一種理想的材料，例如，可用於監測研磨介質中的設備。透明、幾乎堅不可摧的陶瓷可以隨時順利地觀察製造過程。

CeramTec還提供各種高性能切削材料和刀具系統，涵蓋整個加工範圍，如車削、硬車削、切槽、銑削和鏜孔。保障高生產率、高質量和最高安全性！

水溶性鹽基芯，用於在鑄造技術中生產複雜的鑄造部件，例如，用於活塞鑄造，是CeramTec產品組合的完美補充。 ■

CeramTec GmbH, 德國  
www.ceramtec.com  
b.mueller@ceramtec.de



The transparent and scratch-proof ceramic PERLUCOR® guarantees extra-safe process monitoring

透明、防划伤的陶瓷材料PERLUCOR®可确保更加安全的过程监测。

## Performance data for additive manufacturing for sand cores in the foundry

A conversation with Tobias Tuffentsammer, ExOne

### 增材制造铸造砂芯的性能数据 对ExOne公司Tobias Tuffentsammer先生的访谈



**FP: Mr. Tuffentsammer, please briefly explain the principle of Additive Manufacturing of Sand Cores with ExOne 3D Printers.**

Our 3D printing systems use the binder jetting process, sand is applied in conjunction with binder (resin) in the interplay, so as to produce cores and molds without tools.

**FP: Compared with classic core making, what advantages does additive manufacturing have?**

An advantage of 3D printing is the possibility to produce complex geometries in a very short time. You have geometric freedom in the production, which is difficult or impossible in the conventional production. In addition, 3D printing reduces costs and increases performance.

**FP: Tuffentsammer先生, 请简要说明使用ExOne 3D打印设备生产砂芯的原理。**

我们的3D打印设备采用粘结剂喷射工艺, 砂与粘结剂(树脂)相互作用, 从而不需要模具就可以生产砂芯和铸型。

**FP:与传统的砂芯制造相比, 增材制造有哪些优势?**

3D打印的优点是可以在非常短的时间内产生几何形状复杂的产品。这种生产方式不受几何形状的限制, 而使用传统的生产方式是困难的或不可能的。此外, 3D打印可以降低成本并提升性能。



**ExOne**<sup>®</sup>  
DIGITAL PART MATERIALIZATION

**FP: Complex geometries at a reduced cost, what does that mean?**

The level of complexity of 3D printed core does not affect the cost. Very difficult components, such as water jacket cores or cores for hydraulic applications, can be produced cost-effectively. In the case of simple castings, however, it is worth considering whether it pays off for the foundry in question in terms of conventional production methods and the associated manual work, as well as the possible rejects.

**FP: For prototypes, this technology is already being used worldwide. How far along is series production?**

Since the delivery of the first printer in 2001, we have been able to sell over 170 3D Core and Form printers in 21 countries, with the initial focus on prototype production. Over the last few years, we have been able to increase the productivity of our systems and more customers are now successfully using 3D printers in the production of small and medium-sized series. We are constantly working on the further development for mass production.

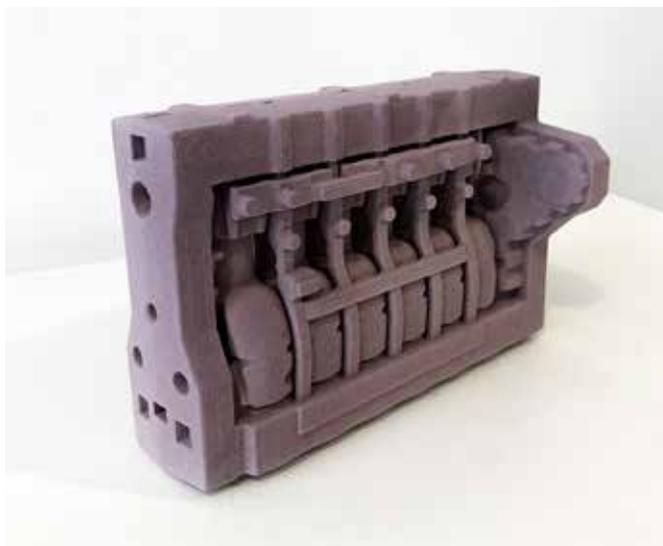
**FP: Let's talk numbers. As far as productivity is concerned, what is the performance data of your machines?**

With pleasure. We differentiate between two machine types for ExOne - S-Print and S-Max. The S-Print is used by foundries primarily for the production of prototypes, while the S-Max is also used in the series. The difference lies in the available space. While the S-Print has a capacity of 160 liters (installation space 800 x 500 x 400 mm), the S-Max offers 1260 liters (installation space 1800 x 1000 x 700 mm).

But it is not just the volume of space that differentiates the systems from one another; of course, productivity is crucially important. While the S-Print realizes a printing capacity of approx. 20 liters per hour, we can offer with the S-Max a machine which can produce 100 and more liters per hour.

I would like to clarify this with reference to the cycle times:

In a 4 cylinder water jacket core, printed on a serial machine in inorganic, we produce 24 cores in 90 minutes. In Furan, up to 168 cores can be produced in under 9 hours. The printing time in 3D printing always depends on the process and layer height. Currently, layer times to print a shift in 15 seconds are possible.



**FP:如何理解降低复杂几何形状产品的生产成本?**

3D打印砂芯的复杂程度不影响成本。非常复杂的芯子,如水套芯或液压铸件用芯,可以获得很好的成本效益。然而,对于形状简单的铸件,就传统的生产方法和相关的手工作业以及可能的废品而言,是否对铸造厂有利值得考虑。

**FP: 对于原型制造, 这一技术已经在世界范围内使用。距离批量生产应用还有多久?**

自2001年第一台打印设备交付以来,我们已在21个国家销售超过170台3D打印设备,主要用于原型生产。在过去的几年中,我们已经尽可能提高系统的生产效率,现在越来越多的客户正在成功地使用3D打印设备生产中、小批量的产品。我们不断为进一步开展大批量生产而努力。

**FP:我们来讨论一下数据吧。就生产力而言,设备的性能数据是什么?**

很愿意为您介绍,ExOne有两种设备类型:S-Print和S-Max。S-Print主要用于铸造厂的原型生产,而S-Max可以用于批量产品生产。不同之处在于可用的空间,S-Print的容量为160升(安装空间800 x 500 x 400 mm),S-Max的容量为1260升(安装空间1800 x 1000 x 700 mm)。

不过,不仅仅是空间的体积将系统彼此区分;生产效率至关重要。S-Print打印能力约20升/小时,S-Max目前可以实现打印能力为100升/小时或更多一些。

我想就生产周期进行说明:

例如用批量生产的无机粘结剂打印设备生产4缸的水套芯,可以在90分钟内生产24个芯子。用呋喃树脂,可在9小时内生产168个芯子。3D打印设备的打印时间始终取决于打印过程和层高。目前,在15秒内打印1层是可以实现的。

**FP: Speaking of inorganic, do you have systems successfully in operation here and which other binders can be operated on ExOne machines?**

Yes, ExOne offers an inorganic solution based on silicates for 3D printing. Together with two German car manufacturers, we have put a lot of effort into development over the past couple years and have successfully put four systems into operation. In the future, we want to focus on aluminum casters, which have the highest demands on complexity and surface of castings, coupled with an environmentally friendly production.

Of course, for other applications and casting materials we also have furan- and phenol-based binders. We also have focused on additives and can thus offer a broader portfolio of solutions.

**FP: 3D printing is a technology of the future. How do you convince undecided foundries of the advantages of Additive Manufacturing?**

Very easily. Every interested party, ie every foundry, can obtain cores or form packages through our service center at our location in Gersthofen near Augsburg, Germany, whether in the classical service over a longer period of time or only once to test and verify the technology. It is important to convince potential customers and to understand customer needs. In order to offer customer-specific solutions, we have a customer application team to offer support, advice and practical help to specialists from the foundry.

**FP: How do you see the potential of 3D printing on the market?**

The market is growing fast. According to our estimates, the growth potential is 25% annually. While there were 5 machines sold in 2015, it jumped to over 30 in 2018. We are thus looking forward to a positive future.

Visit us at GIFA in Hall 15 A 11 to experience ExOne's vision of the foundry of the future and the integration of 3D printing in mass production. ■

**FP: 说到无机材料，你们有成功运行的系统吗？在ExOne设备上还有哪些粘合剂可以使用？**

是的，Exone公司为3D打印开发了基于硅酸盐的无机解决方案。在过去的几年里，我们与两家德国汽车制造商一起进行了大量的研发工作，并成功地在4个系统投入使用。未来，我们想把重点放在铝合金铸件，它对铸件的复杂性和表面以及环保生产要求最高。

当然，对于其他铸造材料的应用，我们也有呋喃和苯酚粘结剂。我们还专注于开发添加剂，因此可以提供更广泛的解决方案选择。

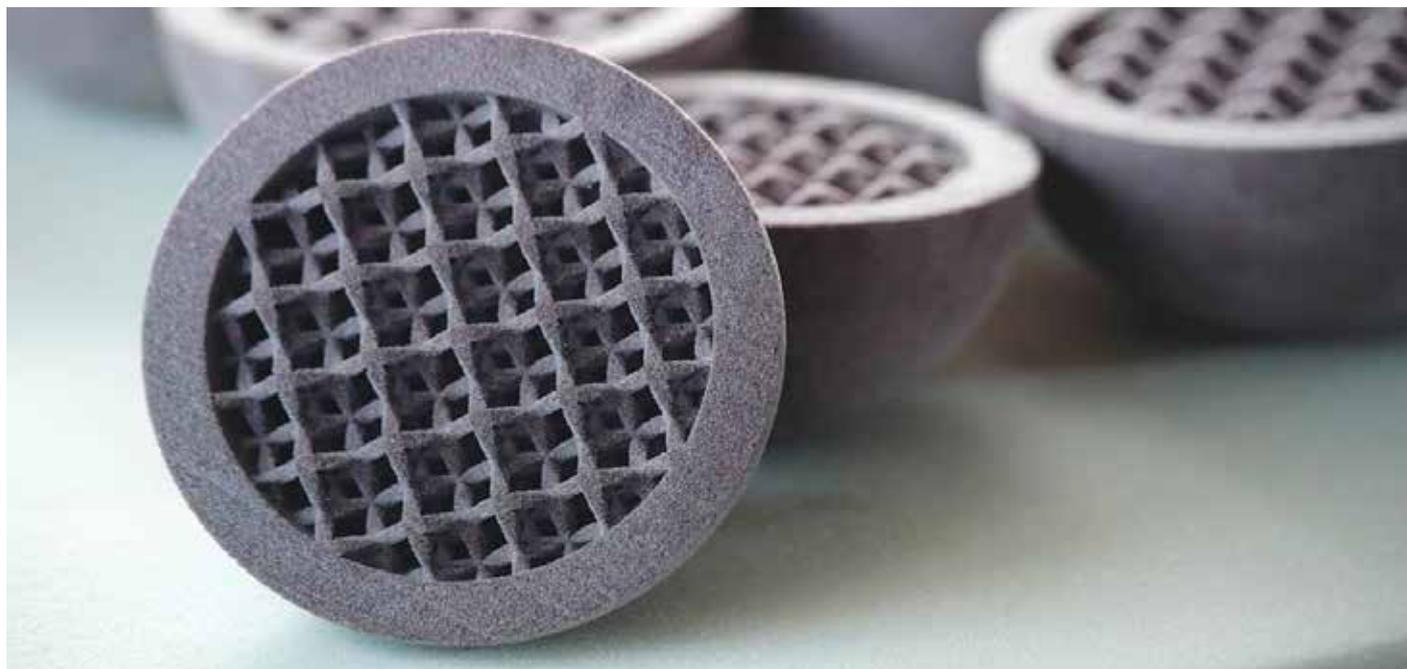
**FP: 3D打印是一项未来的技术。您如何说服铸造厂，使他们相信增材制造的优势？**

这很容易，每个感兴趣的企业，例如某个铸造厂，无论是在较长时间内进行常规服务，还是只进行一次测试和验证，都可以通过我们位于德国奥格斯堡附近的格尔索芬服务中心获得砂芯或铸型。要想说服潜在客户，了解客户需求是很重要的。为了给客户提供有针对性的解决方案，我们有专门的团队为铸造公司的专家提供支持、建议和实际帮助。

**FP: 您如何看待3D打印的市场潜力？**

市场增长很快，据我们统计，每年的潜在增长约25%。2015年，我们售出了5台设备，到2018年已超过30台。因此，我们期待着更好的未来。

欢迎光临我们在GIFA展会的15号馆A11展位，您将可以体验Exone的发展前景、铸造的未来和3D打印在批量生产中的应用。 ■



**GIFA 2019**  
Hall 12 A 19/20  
25 - 29 June



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Experience

**MAGMASOFT®**  
The Digital **Foundry Process**



## “The Digital Foundry Process” 数字化铸造工艺



“The Digital Foundry Process” – at GIFA 2019, MAGMA GmbH presents a new generation of trendsetting solutions for virtual casting, tooling and process optimization.

### Simulation Evolves into Autonomous Engineering

In Hall 12 at Booth A19/20, MAGMA will demonstrate how Autonomous Engineering is replacing conventional casting process simulation. MAGMASOFT® autonomous engineering supports casting design, robust process layout and optimized casting evaluation even before the first part is produced. By making use of the fully integrated capabilities of virtual Design of Experiments and genetic optimization, MAGMASOFT® easily and reliably finds the best solutions – from the first casting design to improvement of a running production layout.

As a world premiere, visitors will experience Autonomous Engineering live in 4D in a captivating Holo-Theater performance.

### “MAGMASOFT® - The Digital Foundry Process!”

MAGMA has been developing powerful solutions for digitizing foundry processes for over 30 years. With the “Virtual Core Shooting Machine”, the company showcases an innovative Industry 4.0 application together with leading industry partners. A direct coupling between process simulation, core box design, molding material and core shooting machine enables the real-time optimization of the complete core shooting system for the first time.

MAGMA将在2019年GIFA上展示其“数字化铸造工艺”，展示最新的虚拟铸造技术、模具及工艺优化解决方案。

### 模拟技术进化到自主设计

MAGMA的展位在12号馆A19/20展台，将展示自主设计的方式如何取代传统的铸造模拟方式。MAGMASOFT®自主设计的方式甚至在第一个铸件生产之前就提供了铸件设计、稳健的工艺参数和最佳的铸造工艺条件。通过利用虚拟实验设计和遗传优化的完全集成功能，MAGMASOFT®可以轻松可靠地找到最佳解决方案——从最初的铸件设计到改进正在运行的生产方案。

作为在全球首次展出，访问用户将在现场的全剧场式4D演示中体验自主设计。



“MAGMASOFT®软件——数字化铸造工艺”  
30多年来，MAGMA始终致力于为数字化铸造工艺开发强大的解决方案。凭借“虚拟射芯机”，MAGMA与领先的行业合作伙伴一起展示了创新的工业4.0应用程序。工艺模拟、芯盒设计、造型材料和射芯机之间的直接耦合使得完整射芯系统的实时优化得以首次实现。

MAGMA will present Autonomous Engineering live at its unique Holo-Theater, in a performance entitled “MAGMASOFT® - The Digital Foundry Process”.

MAGMA将通过现场的全剧场式4D场景演示“MAGMASOFT®-数字化铸造工艺”。

With the “Virtual Die Casting Die”, MAGMA demonstrates how to simultaneously realize and reliably evaluate a robust tooling design and an optimized production window simultaneously within the shortest possible time for high pressure die casting processes.

Moreover, MAGMA introduces numerous new capabilities for virtual optimization of all casting processes and alloys, heat treatment and the complete core production process. In cooperation with leading partners from the supplying industry, new developments for digitizing molding materials and for quantitative prediction of core distortion, degradation behavior of binder systems and core gas related defects during the casting process will be presented. Through new solutions, accessing databases for feeding system components in MAGMASOFT® has become even easier.

**Ease of Communication Internally and with Customers**

MAGMAinteract, the new and innovative visualization program for MAGMASOFT® results, supports communication internally within a company as well as a fast exchange of information with both customers and suppliers. Using real castings as examples, MAGMA will interactively show how easy it is to use information from MAGMASOFT® with MAGMAinteract.

借助“虚拟压铸模具”，MAGMA将展示在高压压铸中，如何在最短的时间内同时实现并可可靠地评估稳健的模具设计和优化的工艺窗口。

此外，MAGMA展示所有铸造工艺和合金、热处理及整个制芯工艺提供虚拟优化的解决方案的新的功能。MAGMA与行业的主要合作伙伴合作，将展示数字化造型材料的新发展、砂芯变形的定量预测、粘接剂的降解以及铸造过程中的砂芯发气相关的缺陷。通过采用新的解决方案，在MAGMASOFT®中使用冒口补缩系统组件的数据库变得更加容易。

**让内部沟通及客户沟通更加便利**

MAGMAinteract是MAGMASOFT®软件为铸造模拟结果开发的全新的创新型可视化程序，支持公司的内部沟通以及与客户和供应商的快速信息交换。以真实铸件为例，MAGMA以交互方式显示使用MAGMASOFT®与MAGMAinteract的信息是非常容易的。

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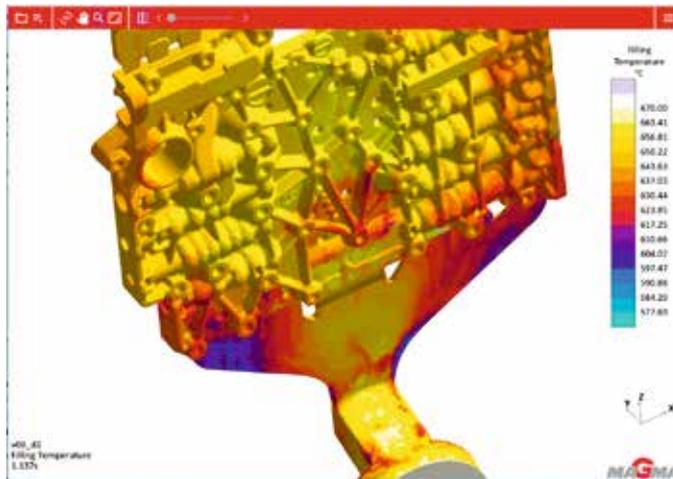
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**MAGMAacademy Understand – Implement – Benefit**

The MAGMAacademy will present its offering of comprehensive opportunities for further education for foundrymen, casting designers and casting consumers. The “Foundrymen’s Playground 2.0” will playfully show how easy it is to virtually optimize casting designs today. Here, visitors can interactively run their own simulations in a virtual test field, while simultaneously pursuing different quality and cost-related objectives. As part of a competition against MAGMASOFT® autonomous engineering, visitors will lay out their own casting on an electronic drawing board in just a few minutes.



MAGMAinteract – easy communication of results – internally within the company and with customers

MAGMAinteract -在公司内部和客户之间轻松沟通结果

**MAGMA培训学院——理解-实施-效益**

MAGMA培训学院将为铸造厂、铸造设计师和用户提供在职教育的广泛的机会。“Foundrymen’s Playground 2.0”以一种游戏的方式展示了今天我们对铸造设计进行虚拟优化是很容易实现的事情。在这里，用户将可以在虚拟测试中交互式地运行他们自己的模拟试验，同时实现不同的质量和成本目标。作为与MAGMASOFT®自主设计比赛的组成部分，用户将在几分钟内在电子屏上设计自己的铸造工艺，你设计的铸造工艺将直接与MAGMASOFT®自主设计的方案来对比排名。

**MAGMA – First-Time Exhibitor at the METEC Trade Fair**

MAGMA will also be presenting its innovative solutions for process optimization in continuous and ingot casting at its own booth at METEC (Hall 4, Booth E 29). Here, too, the company will showcase state-of-the-art solutions for the virtual optimization of conflicting objectives regarding productivity and quality, as well as for establishing robust process windows.

With its Student Camp, MAGMA once more shows its commitment to recruiting young professionals for the foundry industry. The young visitors will be shown in a fun and playful manner how interesting and innovative the foundry world is.

Be inspired by the fascinating world of “MAGMASOFT®-The Digital Foundry Process”! ■

**MAMGA——首次参加METEC冶金展览会**

MAGMA还将在METEC (4号馆E29展位) 展示其连续铸造和铸锭铸造工艺优化的创新解决方案。此外，公司还将展示平衡的艺术--生产效率和铸件质量这两个互相矛盾的优化目标，以及建立稳健的铸造工艺窗口的最先进的解决方案。

MAGMA的学生培训营，再次展示了其为铸造行业吸引更多年轻人才的承诺。公司将以轻松愉快的方式为年轻观众展示铸造世界的乐趣和创新。

从迷人的“MAGMASOFT®-数字铸造工艺”世界中获取灵感! ■



Foundrymen’s Playground 2.0 – playfully learn how to optimize casting designs with the MAGMAacademy

铸造人的Playground 2.0- 在MAGMA培训学院游戏式的学习如何优化铸造工艺设计

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## **GEMINY**

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## Capturing the Casting

Using modern prototyping and its own versatility, Aristo-Cast teamed with Librestream to produce an industrial camera with exacting specifications. BRIAN SANDALOW, ASSOCIATE EDITOR

### 锁定铸件

凭借现代原型制造和自身的灵活性，Aristo-Cast公司与Librestream公司合作生产具有严格规格的工业相机。  
副主编 Brian Sandalow

The OnSight Cube camera by Librestream (Winnipeg, Alberta, Canada) has to be tough. This isn't a camera designed for selfies at Disneyland or pictures at family reunions, but is instead a hand-held device with a built-in thermal camera intended for rugged industrial environments where durability, weight savings, and heat resistance are primary concerns.

Needing to convert the frame from a machined component, Librestream went hunting for a facility that could provide what they wanted. They found AFS Corporate Member Aristo-Cast (Almont, Michigan), an investment caster with the capability to produce products in aluminum and magnesium.

For both sides, the project was unique and a learning experience. Librestream was dealing with a casting company for the first time for the camera that can be handheld, placed on a hardhat or a monopod.

Aristo-Cast answered all the questions Librestream had about the casting process. Aristo-Cast vice president Paul Leonard said he described his company's processes, invited them for a tour and made sure all reservations they had were accounted for.

"There's a lot of things that we can do with a casting that people don't know is even possible," Leonard said. "That's why we like to get them in for a tour to open their eyes to the world they live in."

It's a world that was right for this product.

"They've all been plastics for camera cases, but this camera is special," Leonard said. "It needed to be more rigid and be more durable so they could put it into the field. They had to go to a casting."

Investment casting was the answer.

"A lot of people design the part in subtractive manufacturing, it might be machined from a solid," Leonard said. "With investment casting we can make it look much more aerodynamic and ergonomic for them using radiuses. That was a learning curve with them. They had some thin walls with some deep pockets and radiuses, so we had to help them create a better casting out of their design."

As for Aristo-Cast, it received the designed model files and suggested a few minor changes to make it a better

由Librestream公司(加拿大艾伯塔省温尼伯市)生产的OnSight Cube相机必须非常牢固。这款相机不是为在迪斯尼乐园自拍或家庭团聚时拍照设计的，它是一种手持设备，内置热摄像装置，用于严酷的工业环境，其耐用性、耐热性和减轻重量是首要考虑的问题。

因为要替换原来机加工制造的相机框架，Librestream公司需要找到一家可以提供其所需产品的供货商。他们找到了美国铸造协会会员Aristo-Cast公司(密歇根州阿尔蒙特市)，该公司是一家生产铝、镁合金铸件的熔模铸造企业。

对双方来说，这个项目都是独一无二的，也是一次学习的经历。Librestream公司是第一次与铸造企业打交道，生产这种可以手持、可以放安全帽上或单脚支架上的相机。

Aristo-Cast公司回了Librestream公司所有关于铸造工艺的问题。Aristo-Cast公司副总裁保罗·莱纳德介绍了公司的工艺并带领参观。

"很多产品都可以使用铸件，但大多数人并不知道这是可行的。" 莱纳德说，"因此，我们希望带领客户参观工厂并现场了解生产过程。"

我们的铸件适合这款产品。

"以前所有的相机外壳都是塑料的，但这款相机很特别。" 莱纳德说，"它需要更牢固、更耐用，这样才能适合所使用的环境。因此不得不选择铸件。"

熔模铸造是解决方案。

"许多人设计零件时依据的是减材制造，产品可能是用胚料加工出来的。" 莱纳德说，"有了熔模铸造，根据使用环境，我们可以使产品看起来更符合空气动力和人体工程学。客户也需要积累经验。原来产品有许多很深的凹槽和非常薄的壁，所以我们必须帮助客户设计更符合铸造工艺的方案。"

Aristo-Cast公司收到了设计的模型文件，并提出了小的修改，使方案更符合铸造



Librestream was dealing with a casting company for the first time for the camera that can be handheld, placed on a hardhat or a monopod.

Librestream公司第一次与铸造企业打交道，这款相机可以手持、可以放安全帽上或单脚支架上。

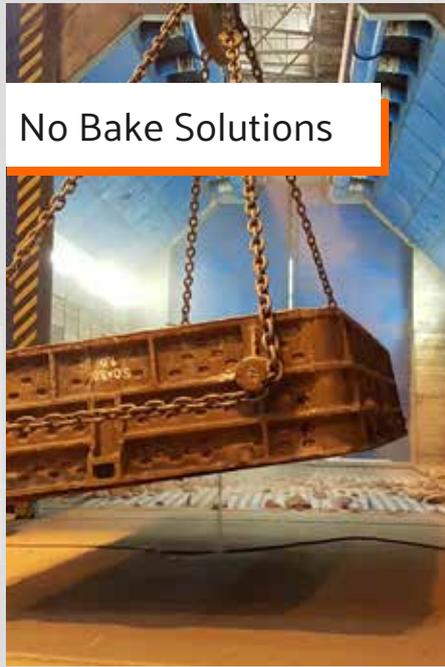
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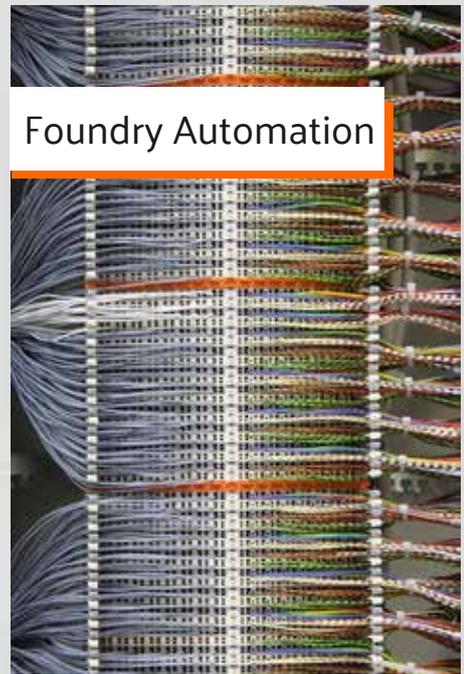
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casting application. Several castings were created for testing and design review, and after some iterations, Aristo-Cast better understood what the camera has to do. The camera itself has cooling fins around the whole exterior and the frame detail. That allows the electronics inside to stay cool when it's being in use.

"They needed the camera to be more rigid because of the environments it was going to be in, like hazardous sites,"

Leonard said. "If it's dropped it wouldn't leak any of the gas into or out of it, depending on where the cameras are being used. They need to be strong and air tight."

That led Aristo-Cast to suggest magnesium as an alternate material to aluminum, since it has superior thermal and damping properties. And since Aristo-Cast is a rare investment caster capable of doing magnesium, the company was able to pitch multiple versions.

*There were plenty of other benefits. For this project, the time from when Aristo-Cast received the solid model file to when Librestream had the first parts was under two weeks.*

"We were able to provide them prototypes that were both aluminum and magnesium," Leonard said. "They offer different lines. One that is offering the weight savings with the weight reduction due to using magnesium compared to the 357 aluminum that they're using."

Currently, only the A357 aluminum version is in production, even though the magnesium AZ91E was also prototyped. If Aristo-Cast needs to switch over to magnesium, it can.

"The shrink rate between aluminum and magnesium makes it so that we're able to use the same hard tooling to create castings in either material. All it would require is a change in the process to cast in magnesium instead of aluminum," Leonard said. "There are some special things that we do through our process to be able to eliminate the metal mold reaction between the magnesium and the shell that we use. That's proprietary information, but other than that there's not really a whole lot of difference."



Aristo-Cast is a rare investment caster capable of doing magnesium and aluminum, which allowed the company to pitch multiple versions.

Aristo-Cast公司是非常罕见的用熔模铸造工艺生产镁合金铸件的企业，该公司能够生产多种材质的铸件。

工艺。最初为了测试和评估设计方案生产了几批铸件，经过几次循环验证，Aristo-Cast公司更好地理解必须如何改进才能满足相机框架的要求。相机框架外壳环绕分布有散热片和细部框架。这样可以使内部的电子元器件在工作时保持冷却。

"因为相机将用于严酷的环境，所以需要更牢固。" 莱纳德说，"在相机使用过程中，如果它掉下来，既不能泄漏任何气体，也不能让气体进入，因此要牢固和非常好的气密性。"

由于镁合金具有优越的热性能和阻尼性能，Aristo-Cast公司建议用镁合金替代铝合金。Aristo-Cast公司是非常罕见的能够用熔模铸造工艺生产镁合金铸件的企业，该公司能够生产多种材质的铸件。

增材制造技术还有很多其他方面的优势。对于这个项目来说，从Aristo-Cast公司收到实体模型文件到Librestream公司得到首批样件用了不到两周的时间。

"我们能够生产铝、镁合金的原型件。" 莱纳德说，"根据客户提出的不同方案，其一是从减轻重量考虑，与现在使用的A357铝合金相比，镁合金可以减轻重量。"

目前，只有A357铝合金产品在生产，而AZ91E镁合金也完成了原型制造。如果Aristo-Cast需要把材料改为镁合金，也是可以做到的。

"铝、镁合金具有相似的收缩率，因此能够使用相同的硬质型壳生产这两种材质的铸件。所有需要改变的只是把浇注的材料换成镁合金，而不是铝合金。" 莱纳德说，"通过工艺设计我们做了一些特殊的处理，能够消除金属型中镁合金与型壳之间的反应。这是专利信息，但除此之外并没有太大的差别。"

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The prototyping was performed via additive manufacturing. Aristo-Cast has several 3D printers on site. Librestream was looking for a good surface quality, which is why the patterns were printed.

“Additive kicked it off right away,” Leonard said. “We were able to provide prototypes in no time at all, so they could review those before they went into hard tooling. It helped with the different iterations we were able to prototype so they could finalize the design for all of their castings.”

There were plenty of other benefits. For this project, the time from when Aristo-Cast received the solid model file to when Librestream had the first parts was under two weeks.

“Now with these prototype printers where we print from a solid model file, you don’t need a hard tool to get started,” Leonard said. “You can prove out your process and prove out your concept before you invest a ton of money into hard tooling. The way printers are going, it’s a great vehicle for the pattern. If it’s small enough and the quantities aren’t tens of thousands, you can set the whole production in one build-box.”

“It helps with the timing because it eliminates the 6-10 weeks or longer that you need to cut the hard tooling. You can have patterns in two days.”

According to Librestream, the camera can survive a 6 ft. drop. It can operate at -4F (-20C) and a maximum of 131F (55C) and survive storage at -22F (-30C) and a maximum of 140F (60C). In short, the camera is as tough as it needed to be.

“In discussions with our industrial customers and partners, we identified a large market opportunity for a multi-purpose wearable that enables remote assistance of complex assets in the field,” Kerry Thacher, CEO, Librestream said when the product was unveiled.

“The Cube is a significant leap forward in hazardous-location collaboration. This new capability now enables use of cases that were previously impossible to implement.” ■



Currently, only the A357 aluminum version is in production, even though the magnesium AZ91E was also prototyped.

目前，只有A357铝合金产品用于生产，而AZ91E镁合金也完成原型制造。

原型样件通过增材制造完成。Aristo-Cast公司有几台3D打印设备。Librestream公司正在寻求好的表面质量，这就是模样需要打印的原因。

“增材制造响应速度快。”莱纳德说，“我们能够在很短的时间提供原型，这样就可以在制造模具之前检查这些原型。原型帮助我们完成了不同产品的验证，最终完善所有铸件的设计。”

增材制造技术还有很多其他方面的优势。对于这个项目来说，从Aristo-Cast公司

收到实体模型文件到Librestream公司得到首批样件用了不到两周的时间。

“现在使用这些原型打印机，可以根据实体模型文件开始打印，而不需要从模具制造开始，”伦纳德说。“在投入大量资金制作模具以前，就可以验证工艺和设计的可行性。打印是很好的生产工具。如果产品尺寸不大，而且数量不是很多，可以用打印设备生产所有产品。”

“它有助于节省时间，因为不必为了加工模具而等待6-10周或更长的时间。可以在两天内得到样件。”

根据Librestream公司的实验，这款相机能够承受从6英尺的高度掉落而继续使用。工作温度在零下20°C-55°C，极限温度可达零下22°C-60°C。总之，这款相机非常耐用。

“在与工业客户和合作伙伴的讨论中，我们发现了巨大的市场机会，这是一种多用途的可穿戴设备，可以对复杂环境提供远程帮助。” Librestream公司CEO克里·塔赫在产品发布时表示。

“这款Cube相机的研发成功是为危险工作场所提供支持服务的重大飞跃，使之前不可能完成的项目获得成功。” ■



Librestream needed the product to be durable so it can survive in harsh conditions.



Librestream公司要求产品坚固耐用，可以在恶劣的条件下使用。

**FOUNDRY –  
A PASSION FROM  
OUR HEART.**

**BENNY DANIELS, HEAD OF TECHNICAL SERVICE EUROPE**

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FOR CASTINGS”**

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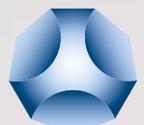
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## Imerys, Innovation & Customer Service

### Imerys: 创新与服务

Foundry industry: A strong sector of the global economy is changing over time, developing new technologies, trends and leading innovation.

Imerys supplies the foundry industry with high-performance minerals and innovative solutions for moulds and cores in sand and investment casting as well refractory solutions for both ferrous and non-ferrous foundries.

#### Minerals

A wide range of high performance minerals, from bentonite to various types of refractory sands and flours, are used in the foundry moulding process to improve casting accuracy and productivity. Imerys is a leading provider of green moulding sand additives for sand casting, as well as sintered and fused minerals for ceramic moulding. Imerys is also the world's leading producer of calcined products for the refractory industry.

#### The delicate balance of foundry technical requirements

In an industry focused on quality and productivity, finding the right technical solutions for every application is key. Imerys solution meet the requirements for mold stability, thermo-mechanical properties and flexibility to adapt to any type of process and casting. On the other hand, low emission additives and recycling solutions have been developed to address the sustainability issues while reducing the total cost of ownership for the foundries.

#### Innovative customized solutions

With an unique mine to market model, ensuring high reliability, quality and product development, Imerys supplies consistent high-quality solutions developed from effective resource management and customer development partnerships. This combination of innovative products, engineering know-how, effective project management, and installation services has made Imerys a flagship in the foundry industry.

#### Core and mould binders, sands and additives to improve casting surface

Due to their low thermal expansion and high refractoriness, Imerys molding binders, additives and special sands represent state of the art technology. They prevent the formation of cracks and veining in core sand and molds, ensuring defect-free core surfaces and the 'as-cast' condition of the final product.

#### Foundry coatings and Investment Casting

Imerys is also the world's leading supplier of fused aluminosilicates oxide, fused mullite and fused zirconia-mullite for foundry coatings and investment fused silica. Due to their high refractoriness and low thermal expansion, these minerals are ideal for preventing metal-mould reaction as well as thermal shock and cracking in foundry parts.



**IMERYS**  
Metalcasting Solutions

铸造行业：作为全球经济的重要领域，铸造行业正在发生变化，开发新技术、引领创新及发展趋势。

Imerys公司为铸造行业提供高性能矿物和创

新的砂型铸造型、芯的解决方案，以及为黑色和有色金属铸造企业提供耐火材料解决方案。

#### 矿物

在铸造成型工艺中使用各种高性能矿物，从膨润土到各类陶粒砂和耐火涂料原料和耐火砂，以提高铸件精度和生产率。Imerys公司是砂型铸造工艺的湿型砂添加剂以及用于陶粒砂的烧结和熔融矿物的领先供应商。Imerys也是世界领先的高岭土产品生产商。

#### 铸造技术要求的微妙平衡

在专注于质量和生产率的行业中，为每种应用找到合适的技术解决方案是关键。一方面，Imerys解决方案满足了铸型的稳定性、热态力学性能和灵活性的要求，以适应任何类型的工艺和铸件。另一方面，Imerys已开发出低排放添加剂和回收利用解决方案，以解决可持续发展问题，同时降低铸造厂的综合成本。

#### 客户定制的创新解决方案

凭借独特的市场模式、确保高可靠性、高质量和产品研发，Imerys通过有效的资源管理和客户合作伙伴关系中开发和提供一致的高效解决方案。这些创新产品、工程技术、有效的项目管理和安装服务相结合，使Imerys成为铸造行业的旗舰品牌。

#### 砂芯和造型粘结剂、砂及粘结剂，改善铸件表面质量

由于其低热膨胀和高耐火性，Imerys的造型粘合剂、添加剂和特殊砂代表了最先进的技术。它们可防止在砂芯中形成裂缝和脉纹，确保砂芯表面无缺陷和最终产品的“铸态”状态。

#### 铸造涂料和熔模铸件

Imerys还是世界领先的熔融氧化铝、熔融莫来石和熔融氧化锆-莫来石供应商，用于铸造涂料和熔模铸造。由于其高耐火性和低热膨胀性，这些矿物质是防止金属模具发生反应以及铸造部件产生热冲击和裂化反应的理想选择。

# Transparency is the prerequisite ...

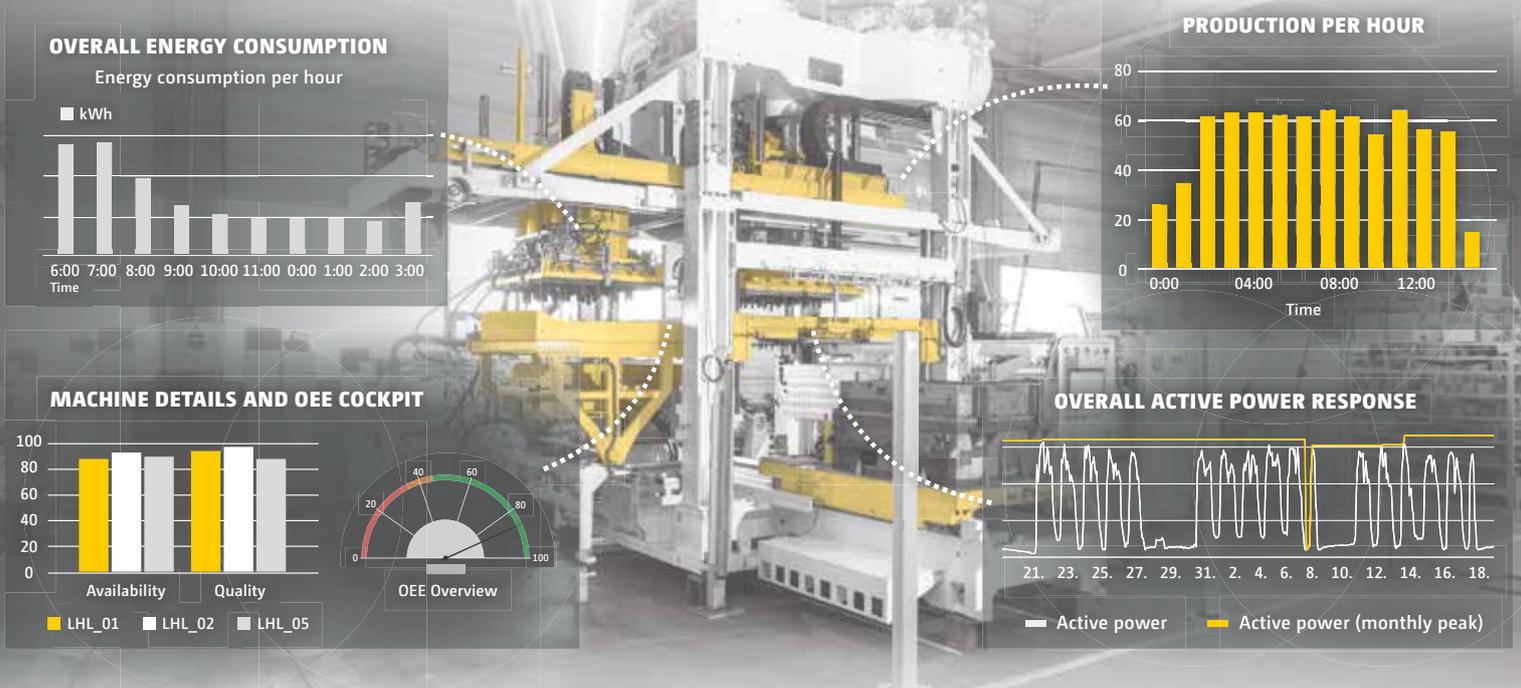
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### Refractory Solutions

Imerys, under the brand Calderys, is the world's leading provider of refractory solutions for both ferrous and non-ferrous foundries, combining innovative products, engineering know-how, project management, and installation services. With secure and consistent access to key raw materials vital for refractories, including an unique quartzite mine in Sweden, foundry owners can rely on quality, service and long term supply.

### Innovation & Customer Service

Imerys is constantly evolving, aiming to always be one step ahead of the technological developments, initiating innovative research, and leading to state-of-the art products launches. This way, it manages to cover the market demands for high quality castings, higher production efficiency, and meeting the increasing authorities requirements for a cleaner workplace inside the foundries and a cleaner environment.

Based on the statement above, lightweight casting- and emission reducing technologies are two of the latest examples of innovation in foundry, and Imerys with its expertise, long experience and know-how is managing relevant key projects that can offer custom made solutions, responding that way rapidly to the new market challenges.

The goal and vision of the Group is supported by the Imerys Foundry Laboratories, whose main functions include Customer Service, Quality Control & New Product Development. The labs are fully equipped with all the standard molding sand testing equipments, as well as with devices specialized in a range of more sophisticated applications, like emissions measurement of molding sands and raw materials.

Samples from all over the world arrive on a daily basis in Imerys Foundry labs, supporting that way not only customers, but also the Imerys Technical Support Departments in different geographical areas, such as the US, China and Europe, specifically Germany, France, Turkey & Italy, assisting Imerys activities on a global level.

Another area of customer support beside the daily business includes knowledge exchange, problem solving and customer training. The training can be onsite in the foundries or in our service laboratories. It will include nearly all moulding sand related analysis and physical moulding sand properties e.g. determination of active clay, loss of ignition, and determination of fines' content in the moulding sand as well as the important strength tests.

Imerys Metalcasting Innovation has worldwide co-operations and partnership contracts with various Universities and Foundry Institutes in N. America, Europe and Asia. Through those collaborations Imerys manages to continually increase the technical knowledge and keep the finger on the pulse of the industry, the latest breakthrough developments and newest methods.

### Envibond® reduces emissions

Foundries are constantly seeking new ways to produce high quality castings whilst complying with increasingly stringent emissions regulations. Marketed under the brand name Envibond®, one of the latest product innovations, can reduce casting emissions and odors by up to 95%, improving both workplace conditions and employee health.

### 耐火材料

Imerys旗下的Calderys品牌是世界领先的黑色和有色金属铸造行业的耐火材料供应商，综合了创新产品、工程技术、项目管理和安装服务。对耐火材料至关重要的关键原材料拥有安全和可靠的供应渠道，包括瑞典独有的石英岩矿，铸造企业享有质量、服务和长期供应的保障。

### 创新和客户服务

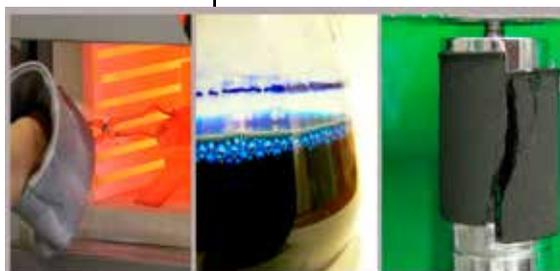
Imerys公司在不断发展，其发展宗旨是始终处于技术领先、开展创新研究，并开发出最先进的产品。通过这种方式，它可以满足市场对高质量铸件的需求、提高生产效率，满足当地政府对铸造企业清洁生产和环境整治日益增长的要求。

综上所述，铸件轻量化和减排技术是铸造行业最新的创新成果，拥有专业知识、丰富经验的Imerys公司正在通过相关关键项目、为客户提供定制解决方案，以迅速应对新市场的挑战。

公司的目标和愿景得到了Imerys铸造实验室的支持，其主要工作范围包括客户服务、质量控制和新产品开发。实验室配备了所有标准型砂测试设备，以及专门用于一系列更复杂应用的设备，如型砂和原材料的排放测量设备。

Imerys铸造实验室每天都会接收到来自世界各地的样品，实验室不仅为客户提供服务、还为不同地区的Imerys技术部门提供支持，例如美国、中国和欧洲，尤其是德国、法国、土耳其和意大利，在全球范围内为Imerys公司提供支持。

除日常业务外，客户支持的另一个领域包括知识交流、问题解决和客户培训。培训可以在铸造厂内部或实验室进行。它将包括几乎所有与型砂相关的分析和型砂物理性能分析，例如 确定活性粘土含量、灼烧减量、确定型砂中的细粒含量以及重要的强度试验。



Imerys铸造创新中心与北美、欧洲和亚洲的很多大学和铸造研究所签订了全球合作协议。通过这些合作，Imerys将不断提高技术水平、掌握行业发展脉搏、掌握最新的突破性发展和新工艺。

### Envibond®减少排放

铸造厂不断寻求生产高质量铸件的新方法，同时遵守日益严格的排放法规。目前推出的最新创新产品之一Envibond®，可将铸造污染物和废气排放减少高达95%，从而改善工作环境和员工健康。

**RIKO® utilizes waste streams**

Waste green sand extraction systems frequently contain large quantities of bentonite and coal dust. The RIKO® process utilizes this waste stream as a source of material for green sand molding operations creating a high value and sustainable product. Using RIKO® in the green sand process enhances molding sand properties, improves mold stability, reduces casting defects and mitigates waste disposal costs.

**Imerys' Kersand™ and Durandal™ - the right alternative to chromite sands**

Two Imerys' sands, Kersand™ (AFS 60) & Durandal™ 60 (AFS 50) now used by sand casting foundries, appear to fulfill requirements in terms of refractoriness and thermal expansion, as well as in terms of supplying, and price condition stability. Those two products are similar, made with natural minerals with intrinsic high refractoriness and low thermal expansion. In addition, they are respirable crystalline silica free, and this over the several sand loops. The two sands are performing in all steel alloys, cast iron & copper alloy foundries and are compatible with all type of binding systems (organic & Inorganic), and furthermore, generate no low melting temperature point when mixed with silica sand.

Finally, all Imerys processes are conducted under the highest safety standards; safe working conditions are the basis for all activities in Imerys and Foundry Labs are no exception to that. The daily business is guided by strict health- and safety regulations and protocols that ensure the safety and well-being of anybody present on the Imerys premises at all time. Moreover, regular safety trainings and in-house seminars by EHS specialists are offered not only to the staff members of the labs but also to all employees from all the different functions.

Continuing the Company's long tradition that established Imerys as leading supplier of the Foundry industry, Imerys commitment to the market is to continue developing innovative solutions, always having in focus the customer needs and the newest market trends.

Please visit us at the 2019 GIFA-METEC fair, June 25th – 29th, in Düsseldorf, Germany, to discover our wide range of innovative mineral solutions, consulting services, and turnkey concepts. ■

**IMERYS**

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www.imerys-metalcasting.com

**RIKO®旧砂循环利用**

湿型砂旧砂提取系统通常含有大量膨润土和煤粉。RIKO®通过循环利用系统，将旧砂作为湿型砂造型的材料来源，创造出高价值和可持续的产品。在湿型砂工艺中使用RIKO®可提高型砂性能、改善铸型稳定性、减少铸件缺陷并降低废料处理成本。

**Imerys的Kersand™和Durandal™-铬铁矿砂的替代品**

现在，铸造厂使用Imerys的两种砂Kersand™ (AFS 60) 和Durandal™60 (AFS 50)，似乎满足了耐火性和热膨胀以及供应和价格稳定性等方面的要求。这两种产品相似，都是采用天然矿物质制成，具有固有的高耐火性和低热膨胀性。此外，它们可以与硅砂混合使用，而且可以

经过几次砂再生。这两种砂可应用于所有钢合金、铸铁和铜合金铸造厂，并且与各种类型的粘结剂系统（有机和无机）兼容，而且当与硅砂混合时不会降低熔点温度。

最后，所有Imerys工艺都是在最高安全标准下进行的；安全的工作条件是Imerys所有作业的基础，铸造实验室也不例外。日常业务以严格的健康和法规和安全法规为指导，确保Imerys公司内部所有员工的安全和健康。此外，环境、健康和法规部门的专家定期对公司员工进行安全培训并举办研讨会，不仅面向实验室的工作人员、还对不同部门的所有员工提供培训。

传承Imerys公司作为铸造行业领先供应商的优良传统，Imerys公司对市场的承诺是继续开发创新解决方案并始终关注客户需求和市场趋势。

欢迎您6月25日-29日来到在德国杜塞尔多夫举办的2019年GIFA-METEC展会并参观我司展位，了解我们在矿物质方面的创新解决方案、咨询服务和交钥匙服务理念。■



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## Fusion-Diamond Ultrahard Grinding Tools & Equipment —Specialized In Cast Iron Create A New Grinding World For Foundry Industry

### 铸铁件磨削专用 金刚石熔合超硬磨具及磨削设备 开创铸造行业磨削新天地

Nanjing Guhua Electromechanical Technology Co., Ltd. is founded in 2017 and located in Nanjing, China. It is a one-stop service-oriented international high & new technology company specializing in research & development, manufacture and sales of ultrahard grinding tools & equipment for foundry industry. Meanwhile, it adheres to 16 years' advanced international management model and experience of the main company (Nanjing Guhua Metalwork Co., Ltd. - established in 2003).

Guhua brand fusion-diamond ultrahard grinding tools & equipment which can be widely used in manual and automatic grinding are specially researched & developed for the characteristics of foundry industry and problems of traditional grinding tools. It is the latest invention in the field of international ultrahard abrasives and upgrade & update of traditional diamond ultrahard grinding tools, resin silicon carbide and corundum grinding tools. Moreover, all products are internationally certified. The product quality management system has passed ISO9001:2015 standard certification. For safety standard, they have MPA and CE certification certificates. The characteristics are as follows:

1. High-efficient Durable & Economical—Advanced international fusion-diamond technology ensures high diamonds exposure and high-strength bonding between diamonds and steel substrate. Compared with traditional grinding tools, the grinding efficiency of cast iron will increase over 1 time and the life span will be over 60 times.

2. Safe & Environmental-Friendly—The product consists of premium steel and diamonds has thoroughly eliminated many problems of traditional grinding tools, such as poor water & alkali resistance, short storage time, easily broken, large sparks and serious dust pollution.

3. Perfect Choice For Automatic Grinding Equipment—Compared with traditional diamond ultrahard grinding tools, higher efficiency and longer life span of our products ensure more continuous operation of the automatic equipment, plus better economy thus being the perfect choice for automatic grinding equipment. ■

Our company will participate in GIFA 2019, welcome to visit and guide. Booth number: Hall12-D12-03.

For more information, please visit:  
<http://en.njguhua-et.com/>

南京固华机电科技有限公司成立于2017年，地处南京市六合区，是一家秉承主公司（南京固华金属制品有限公司-建于2003年）逾16年国际化经营管理模式及经验、面向国际市场、专业从事铸造行业专用超硬磨具及磨削设备的研发、生产与销售的一站式服务型国际化高新技术企业。

“固华牌”金刚石熔合超硬磨具及磨削设备，是针对铸造行业特点及传统磨削工具中存在的问题而研发及生产的，可广泛应用于手工与自动化磨削。它是国际超硬磨具领域的最新发明，是传统金刚石超硬磨具、树脂碳化硅及刚玉磨具的升级换代产品。产品质量管理体系通过ISO9001:2015标准认证，产品具备国际安全认证MPA、CE证书。产品优势如下：

1. 高效 耐用 经济——领先国际的金刚石熔合技术，确保金刚石出露高、金刚石与钢基体结合强度高。打磨铸铁件的效率较传统磨具可增加1倍以上，使用寿命可达传统磨具的60倍以上！

2. 安全 环保——磨具基体采用优质钢材、磨料采用金刚石，彻底消除了传统磨具的耐水性及耐碱性差、保存期短、易断裂、火花大、粉尘污染严重的问题！

3. 自动化磨削设备的最优选择——较传统金刚石超硬磨具，磨削效率更高、使用寿命更长，确保自动化设备更加连续地运转工作，配合良好的经济性，是自动化磨削设备的最优选择！ ■

我公司将参加2019年德国杜塞尔多夫冶金、铸造、热处理展览会，展位号：Hall12-D12-03。欢迎各位莅临参观指导。

更多信息，请登录网站了解：  
<http://www.njguhua-et.com/>



Fusion-Diamond Ultrahard Grinding Tools  
金刚石熔合超硬磨具



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高速砂轮机 (线速度≥80m/s)

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**NÜRNBERG MESSE**



## VDMA Metallurgy Foundry machinery – seizing opportunities and mastering risks

### 德国冶金设备协会 (VDMA Metallurgy) 铸造机械——抓住机遇，管控风险

Even before 'Big Data' foundry machine builders had to anticipate the future requirements of their customers to turn investments to profit. However, the complexity and dynamics of the challenges have increased enormously since the last GIFA. The range of technological options on the one hand and regulatory requirements on the other is now closely intertwined with shifting markets and changing value chains.

The current situation is marked by an equally high proportion of opportunities and risks for all market partners. The new value creation options in automobile production, for example, require comprehensive investigation and forecasting. Foundry systems have to be tailored to the expected subsequent phases of the engine mix - and adapted locally. For instance, quality specifications of an increasing number of lightweight structural components have to be met, or additive manufacturing technologies need to be integrated into core production. In addition, climate policy requirements are playing an increasingly important role. VDMA Metallurgy member companies help implement environmentally compatible solutions in an economically viable manner.

Foundry plant and equipment engineers already provide solutions based on data-driven innovations for all areas of production in order to improve productivity, regulatory compliance and flexibility in manufacturing processes and beyond – for upstream and downstream stages of value creation. This results in new services and business models that will enable machinery manufacturers as well as their foundry customers to extend their portfolio.

Together with our members at GIFA, we will therefore present outstanding examples of networked system concepts and digital services as well as energy- and resource-efficient solutions and thus foster the experience exchange with international market partners. We are looking forward to meeting you at our booth in hall 10 / B60. ■

早在“大数据”出现之前，铸造机械制造商就需要预测客户未来的需求，以便将投资转化为利润。但自上一届国际铸造展览会暨技术论坛 (GIFA) 以来，预测客户需求所面临的挑战愈加复杂多变。当前的技术选择范围和监管要求均与不断变化的市场及价值链密切相关。

就目前来看，市场所有合作伙伴都面临着同样巨大的机遇及挑战。例如，将新的价值创造技术投入汽车生产前需要进行全面的调查和预测。铸造系统必须根据发动机组合的预期后续阶段及当地情况进行调整。举例来说，轻质结构部件的数量不断增多，各部件的质量规格必须达到要求，或必须把增材制造技术集成到核心生产中去。此外，鉴于气候政策要求正在发挥越来越重要的作用，德国冶金设备协会 (VDMA Metallurgy) 中的成员公司会以经济可行的方式帮助实施环保解决方案。

铸造厂和设备工程师已为各生产领域提供了基于数据驱动的创新解决方案，以期提高生产过程中及上下游企业价值创造阶段中的生产率，法规遵从性和灵活性。这带来了新的服务和新的业务模式，使机械制造商及其代工厂客户能够扩展其产品组合。

因此，我们将与国际铸造展览会暨技术论坛 (GIFA) 的成员一起向您展示网络化系统概念、数字服务以及能源和资源效率解决方案的优秀案例，促进与国际市场合作伙伴的经验交流。我们期待在 10 号展厅的 B60 展台与您相见。 ■



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## The Future Needs High-Tech Know How

### 未来需要高科技专门知识

The European foundry equipment suppliers have realized for decades many different applications around the world. This leading knowledge is a benefit for future challenges. The know how through all technology levels and increasingly from the high-tech field is the key to high quality requirements, production efficiency and resource optimization in the coming years. The reduction from big data to smart data and the following analyzing and optimizing process is not possible without long experience in the foundry business.

The adaption of the new “language” OPC UA needs the full expertise of the foundry process and is the precondition for an intelligent IoT.

In the next years we will see, that long term experience in high-tech applications will be the leading requirement for profitable foundry business. Therefore the European foundry equipment suppliers have the best chances to keep their leading position also in the future. I believe that we will see a lot of important innovations at the world leading fair GIFA in June in Düsseldorf. ■

几十年来，欧洲铸造设备供应商已经把许多不同类型的高科技应用技术带到了世界各地。这种领先的知识有利于迎接未来的挑战。各个技术层次中以及来自于高科技日益提高的专门知识是满足未来几年质量改进、生产效率提高和资源优化需要的关键。如果没有铸造行业高科技应用的长期工作经验，从大数据到智能数据的成本降低和后续分析与优化工艺是不可能完成的。

OPC UA新“语言”的改编需要充分利用高科技铸造工艺知识，并且也是智能物联网的前提条件。

在接下来的几年里，我们将看到，在高科技应用方面的长期经验将成为盈利铸造业务的首要要求。

因此，在未来，欧洲铸造设备供应商也最有机会在全球保持其领先地位。我相信，在今年6月于德国杜塞尔多夫举办的世界领先的国际铸造博览会上，我们将能够看到许多重要的创新。 ■



Contact:

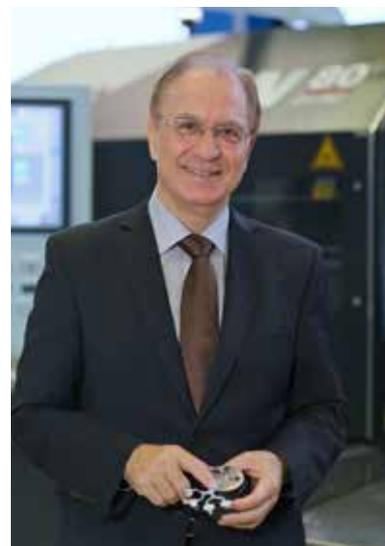
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# 中国铸造协会

## CHINA FOUNDRY ASSOCIATION

### World Foundry Family to Paint a Beautiful New Future

Mr. Zhang Libo, President, China Foundry Association

### 世界铸造是一家，共绘美好新未来

中国铸造协会会长 张立波

Foundry is an important guarantee for the innovation and development of many machine products and high-end technical equipment. It is an indispensable and important foundation for the world economy, and is even known as the “mother of the machinery industry”. In 2018, the total output of Chinese castings reached 49.35 million tons, accounting for about 45% of the world’s total. Since 2000, China has ranked first in the world for 19 consecutive years and is the largest casting production country with the most comprehensive kinds of products and a full system. At the same time, China is also the main market for high-end foundry equipment, raw and auxiliary materials, as well as foundry technology. We work together with the world foundrymen to establish a global green casting supply chain system.

This year, I will once again lead a delegation with record-setting numbers to Germany to participate in GIFA, to learn about new products, exchange views on new developments of foundry technology, and discover new trends in industry transformation and new developments in the upstream and downstream supply chain.

Not long ago, China Foundry Association has joined WFO as a supporting organization, allowing us to have one more platform to integrate into the world foundry family along with the BRICS Foundry Association, Asia Foundry Association and the “Belt and Road” Foundry Working Committee. Chinese foundry industry is willing to join hands with friends to work together for the sustainable development of the world foundry industry!

I wish friends from every part of the world foundry industry a pleasant journey in Düsseldorf. Looking forward to meeting you at the intersection of “Belt and Road”-Shanghai, China, May 13-16, 2020!

Thank you! ■



铸造是众多主机产品和高端技术装备创新发展的重要保障，在世界经济发展中处于不可或缺的重要基础地位，甚至被誉为机械工业之母。2018年中国铸件总产量达到4935万吨，占全球铸件总产量的45%左右，自2000年起，已连续19年稳居世界首位，是规模最大、品种最全、体系最完整的铸造

大国。同时，中国也是全球高端铸造装备、铸造原辅材料、铸造技术的主要市场，我们与全球铸造朋友一起，共同努力建立全球化的绿色铸造供应链体系。

今年，我再次率领刷新纪录的中国铸造业访问团来到德国，参加GIFA展会，与全球的铸造同仁共同了解铸造领域的新产品、研讨铸造技术的新发展，发现行业转变的新趋势以及上、下游供应链的新动态。

不久前，中国铸造协会以支持组织（supporting organization）的身份加入了WFO，让我们在金砖国家铸造业联合会、亚洲铸造业联合会、“一带一路”铸造业工作委员会以外，又多了一个融入世界铸造大家庭的渠道。中国铸造愿与全球铸造业的朋友们携手，共同为世界铸造业的绿色可持续发展而努力！

祝全球铸造业的朋友们在杜塞尔多夫的旅程愉快，期待2020年5月13-16日与朋友们相聚在一带一路的交汇点——中国上海！

谢谢! ■



**FOUNDRY  
INSIDE  
GIFA 2019**

**25 - 29 June  
Hall 12 Stand C50**

## Technology Inside

To be at the forefront of technology. That's the ambition that drives our **HA Group** every single day. So that we can help our customers to solve problems and improve processes.

Our international team is at your service.  
At the GIFA 2019 in hall 12, stand C50.

[huettenes-albertus.com](http://huettenes-albertus.com)

## China's Casting Production Kept Steady in 2018

### 2018年中国铸件产量保持稳定

In March 2019, Mr. Zhang Zhiyong, Executive Vice President and Secretary General of China Foundry Association, released data on China's casting production in 2018 to nearly 1,000 representatives at the 15th China Foundry Association Annual Congress.

He said: "In 2018, the total output of all kinds of castings in China reached 49.35 million tons, which was almost the same with that in 2017; but the demand structure of castings in the downstream industries changed significantly."

Since 2000, China's casting production has shown a positive growth; it has been transformed from "high-speed growth" to "medium-low-speed growth" since 2011. During this period, there was a 1.3% decline in 2015 and a slight decrease in total production in 2018 compared to 2017 (Figure 1).

From the perspective of demand structure of castings in downstream industries, casting demands in cast pipes and fittings, construction machinery and rail transit had a high growth in 2018, with 7.2%, 11.9% and 9% respectively; hydraulic parts and pump and valves in general machinery industry also maintained a positive growth; the castings demand in automobile industry declined for the first time over years, and demands declined significantly in industries including agricultural machinery, power generation equipment and electricity. Thanks to the increasing export of centrifugal casting pipes and castings for construction machinery, rail transit, pumps and valves, the casting output of China in 2018 kept the same level with the previous year.

According to the market demand analysis, it can be understood that the proportion in construction machinery, cast pipe and fittings, and rail transit industry has increased; the automobile industry is the largest customer of castings, and the proportion of automobile castings in 2018 has dropped to 30.0% (30.6% in 2017); the market share of agricultural machinery, machine tools and other industries have declined.

From the production of castings in different materials, the output of gray cast iron in 2018 was 20.65 million tons, which was a 2.4% decrease from 2017 of 21.15 million tons. Due to the influence of centrifugal cast iron pipes, the ductile iron (including compacted graphite iron) increased from 13.75 million tons to 14.15 million tons, an increase of 2.9%. Driven by rail transit, mining and metallurgy, construction machinery and other industries, the output of steel castings continued to grow, with a growth rate of 3.6%; with the decline in production of automobiles and motorcycles, the aluminum and magnesium castings showed a negative growth for the first time, with a decrease of 2.1%; the malleable cast iron, copper alloy and other castings kept stable.

From the proportion of castings of various materials in 2018: the output of steel castings kept growing, accounting for 11.7% (11.3% in 2017 and 10.8% in 2016); the production of aluminum/magnesium alloy castings dropped to 14.5% (14.8% in 2017 and 14.6% in 2016); the ductile iron increased to 28.7% (27.8% in 2017 and 28.0% in 2016). ■

2019年3月,在第十五届中国铸造协会年会上,中国铸造协会执行副会长兼秘书长张志勇向近千名年会代表发布了2018年中国铸件产量数据。

他说:“2018年中国各类铸件总产量4935万吨,与2017年基本持平;下游行业铸件需求结构变化明显。”

自2000年,中国铸件产量整体呈正增长态势;自2011年由“高速增长”转化为“中低速增长”。在此期间,2015年出现1.3%的下降,2018年总产量较上一年略有下降(见图1)。

从下游行业铸件需求结构变化来看,2018年铸管及管件、工程机械和轨道交通都有较高幅度的正增长,分别达到7.2%、11.9%和9%;通用机械中液压件、泵阀类产品也保持了较高的正增长;汽车工业对铸件的需求多年来出现首次下降,农机、发电设备及电力等多数行业对铸件的需求都有较大幅度的下滑。得益于离心铸管、工程机械、轨道交通、泵阀等通用机械及铸件出口的带动,2018年中国铸件产量方能保持与上一年基本持平。

工程机械、铸管及管件、轨道交通行业铸件市场占比上升;汽车工业是铸件最大需求用户,2018年汽车铸件占比下降至30.0%(2017年占比达30.6%);农机、机床工具等行业市场占比都有下滑。

从不同材质铸件产量来看,灰铸铁2017年产量2115万吨,2018年2065万吨,下降2.4%;受离心铸铁管的拉动,球墨铸铁(包括蠕墨铸铁)从1375万吨增长到1415万吨,增幅2.9%;受轨道交通、矿冶重机、工程机械等行业的带动,铸钢件产量继续保持增长,增速为3.6%;受汽车以及摩托车产量下降的影响,铝(镁)合金铸件首次出现负增长,降幅为2.1%;可锻铸铁、铜合金及其他类铸件变化不大。

从各类材质铸件占比来看,2018年:铸钢件产量保持增长,占比上升至11.7%(2017年11.3%,2016年10.8%);铝(镁)合金铸件产量占比下调至14.5%(2017年14.8%,2016年14.6%);球墨铸铁件产量有所提高,占比为28.7%(2017年27.8%,2016年28.0%)。■

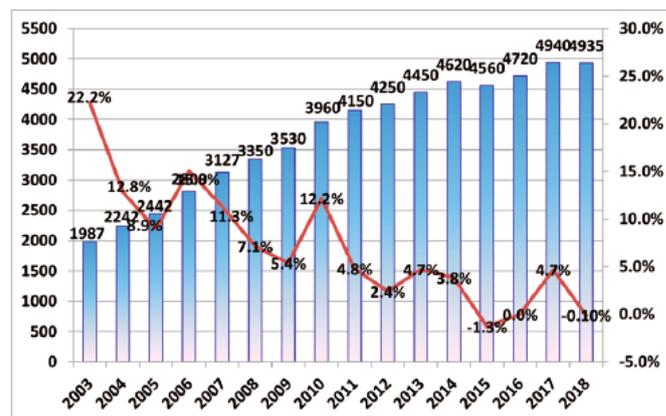


Figure 1: China's casting production (10,000t) and growth rate from 2003-2018

图1 2003~2018年中国铸件产量(万t)和增长率(%)

## The GIFA, METEC, Thermprozess and Newcast in June 2019 are just right!

### 2019德国国际铸造、冶金、热处理及铸件展6月再次闪亮登场!

Foundry-Planet interview with GIFA and NEWCAST trade fair president Dipl.-Ing. Heinz Nelissen, Managing Director Vesuvius GmbH, Fosco Foundry Division, Borken.

**FP: Worldwide forecasts for the foundry industry until 2025 are moderate but positive, yet the industry faces interesting challenges.**

Especially in Western Europe and Germany, we had two good years of growth in the iron and steel foundries in 2017 and 2018, and the aluminum foundries are growing rather continuously. The challenges for the foundries are manifold. If we think only of the economic performance of the companies, the competition by other foundries or by the competitors in low-wage countries, but also blacksmiths and editors are classic, well-placed competitors. As far as materials are concerned, iron and aluminum foundries are fighting for the best solutions, and the plastics industry has also defined the global automotive market as the target market. Here we casters must propagate even more our recycling solutions. The increasing lightweight construction, regardless of the material, challenges foundries and suppliers. Environmental regulations must be met and ideally require closed recycling cycles. The next generation of founders needs to be interested and trained to ensure the sustainability of the industry. I am convinced that the foundrymen will accept and master these challenges.

**FP: The unclear future of automotive powertrains, the Internet of Things (IoT) and additive manufacturing - these are three key words. What is the world of foundry currently doing most and in which order?**

Dividing the automotive industry into passenger cars and commercial vehicles gives a picture. Commercial vehicles, especially for overland traffic, will continue to be equipped with internal combustion engines. Especially here in Europe there are some investments in the production capacity for trucks. In cities, buses, postal and parcel services and cars in city traffic are more likely to drive electrically in order to reduce emissions in the centers. No matter which type of drive, casting products are needed. The foundry must define and find its segment and specialize there.

One megatrend is additive manufacturing. The generative processes represent one of the largest fields of research and investment in global industry. In large-scale production, casting processes have so far remained much more cost-effective. Therefore, 3D printers are used in addition for cores, tool inserts, prototypes and spare parts, but also for special aviation parts.

The Internet of Things and digitization enable digital transformation. As a result, significantly more process parameters can be recorded, evaluated and transferred to digital control loops. With automation, much more is possible. At the GIFA you will surely find interesting solutions from the big machine suppliers.

铸造星球网站对GIFA、NEWCAST展会主席，德国维斯威集团旗下福士科铸造董事总经理Heinz Nelissen的采访。

**FP: 到2025年,对于世界铸造行业的发展预测是温和且积极的,但是也面临着需引起关注的诸多挑战。**

特别是在西欧和德国,铸铁和铸钢件产量在2017年和2018年连续两年增长,并且铝合金铸件也在持续增长。铸造厂面临的挑战是多方面的。如果我们只考虑这些公司的经济表现,那么其他的铸造厂或低工资国家的竞争对手,都是处于有利地位的竞争对手。在材料方面,铸铁和铝合金铸造厂争相寻求最佳解决方案,塑料行业也将全球汽车市场作为目标市场。因此,我们铸造人必须更多地宣传我们的回收解决方案。越来越多的轻量化结构件要求,不仅对材料、也对铸造企业和供应商提出了挑战。必须遵守环保条例,最好是要求封闭循环系统。要培养下一代铸造业接班人,对行业的兴趣并开展培训,确保行业的可持续性发展。我相信铸造人将接受并成功应对这些挑战。

**FP: 尚不明朗的汽车动力系统市场、物联网(IoT)和增材制造-这是未来发展的3个关键词。铸造行业目前正在朝着什么方向发展,是按什么顺序呢?**

将汽车工业划分为乘用车和商用车市场,可以有清晰的认识。商用车特别是陆路交通车辆,将继续采用内燃机。特别是在欧洲,对卡车的产能进行了投资。城市里的公共汽车、邮政和包裹服务以及城市交通中的汽车更有可能采用电力驱动,以减少排放。无论采用哪种动力系统,都需要铸件产品。铸造企业必须确定这些零部件,配套生产。

另一大趋势是增材制造。它的出现是全球工业研究和投资的最大领域之一。在大规模生产中,铸造工艺到目前为止仍然具有更高的成本效益。因此,3D打印除了用于芯子、模具、原型和备件外,还应用于特殊的航空部件。

物联网和数字化使数字化转型成为可能。因为更多的工艺参数可以记录、判断和传输到数字控制回路。有了自动化,就有了更多的可能性。在GIFA展会上,你肯定会从大型装备供应商那里找到很好的解决方案。

**FP: How do you assess the future of iron, steel and non-ferrous cast iron by 2025 and do you see different developments in the big markets like China, India, Europe and North and South America?**

Unfortunately, global trade relations are not as stable and resilient as they have been in recent years. In general, different developments in the aluminum foundries and the iron, steel and malleable foundries can be assumed. The aluminum foundries show tonnage growth worldwide, while the iron and steel foundries are growing strongly, mainly in China and India, and otherwise tend to stagnate or shrink slightly. Due to the supply situation for the American automotive market, special growth can only be expected in Mexico.

**FP: How do innovative foundries have to set up to meet the challenges?**

The foundry industry is generally considered a fairly conservative industry. Nevertheless, some foundries, especially in Germany and Central Europe, succeed again and again in establishing innovative and commercially successful solutions in their foundries.

**FP: How do these businesses do that? How do they differ from their competitors?**

The innovative caster will work closely with his client to be involved in the client's work right from the development stage. Here he may be able to integrate solutions into the cast construction, which can later only be manufactured by him or at least have advantages for him. In material developments, he tests at an early stage, he proactively adopts process optimization, and brings his own ideas to light construction. Many new castings are being developed as system integration takes place and more attachments are integrated into the casting solution. The innovative caster will be exhibiting at NEWCAST to showcase his innovative solutions to customers, and he will visit the GIFA and presentations at the GIFA Forum in order to keep up to date and to network.

In addition, he will work closely with his supplier and involve him at an early stage in order to work in partnership on an innovative solution.

**FP: The valuation of castings is still largely reflected in tonnage volume. How can a change towards the reward of real value creation be achieved? Will foundries soon only offer complete Solutions?**

In fact, a foundry is valued essentially according to the sold pouring tonnage. Likewise, the big buyers of castings, the OEMs, are very focused on the price per kg of cast. As a result, the selling prices of foundries in global competition are made comparable and are under constant downward pressure. This is a dangerous trend, particularly in periods of economic downturn, as underutilized companies bring in additional quantities at prices that are sometimes ruinous. It is the task of the foundry to show the value-added advantages and unique selling points, which one might have against the competition, and translate it into a better selling price. For this, the foundry must know its own process and at least the most important competitors well. Fortunately, there are now more and more companies that are starting to convert the income statement to contribution margin per molding box, in order to optimize this parameter.

**FP: 到2025年, 您如何看待铸铁、铸钢和有色铸件的发展趋势? 您认为中国、印度、欧洲、北美和南美等市场会有一样的发展趋势吗?**

遗憾的是, 全球贸易关系并不像近年来那样稳定和快速恢复。一般来说, 铝合金铸造与铸铁、铸钢以及可锻铸铁的不同发展是可以认定的。铝合金铸造在世界范围内呈现强劲增长, 而铸铁和铸钢铸件的强劲增长主要集中在中国和印度, 其他地区往往会略有停滞或萎缩。由于美国汽车铸件市场的供应状况, 可以预测, 墨西哥汽车铸件市场将有较大增长。

**FP: 有创新意识的铸造厂如何才能迎接挑战?**

铸造行业通常被认为是相当保守的行业。然而, 一些铸造厂, 特别是在德国和中欧, 铸造企业着力创新并取得一次又一次的成功。

**FP: 这些企业是如何做到这一点的? 他们与其竞争对手有什么不同?**

创新的铸造企业总是与客户紧密合作, 从开发阶段起就参与客户的工作。这样, 他们能够将解决方案集成到铸件结构设计中, 至少对后续由他们独立完成的铸件生产过程是有利的。在材料开发方面, 可以在初期进行试验, 采用工艺优化, 并提出自己的轻量化见解。随着系统集成和更多附件集成到铸造的解决方案中, 许多新铸件正在开发。创新型的铸造企业将在NEWCAST上展示他们的创新解决方案, 他们也将参观GIFA展并参加在展会期间举办的论坛, 以了解最新信息和建立联系。

此外, 创新的铸造企业将与供应商密切合作, 并让供应商在初期阶段参与, 以便合作制定创新的解决方案。

**FP: 铸件的价格经常是按每吨来报价, 如何实现实际价值创造的回报? 铸造厂能够很快提供完整的解决方案吗?**

事实上, 铸造厂的销售额实质上取决于销售的铸件吨位。当然, 铸件的大买家OEM制造商也非常关注每公斤铸件的价格。因此, 在全球竞争中, 铸件的销售价格充分比较, 并承受不断下降的压力。这是危险的趋势, 特别是在经济低迷时期, 因为产能未充分利用的公司有时会追求产量而给出具有破坏性的价格。铸造企业的任务是展示其在竞争中可能具有的增值优势和独特的卖点, 并将其转化为更好的销售价格。为此, 铸造企业必须了解自身的工艺, 至少要了解最重要的竞争对手。幸运的是, 现在有越来越多的公司开始将损益表转换为每铸型的贡献率, 以优化这一参数。

The OEMs want to incorporate more components and complete solutions and reduce the number of suppliers. This can give foundries the opportunity to invest in machining or pre-assembly and deliver prefabricated components. As a result, additional contribution margin is generated, but high investment costs are necessary.

**FP: What contribution to support do global suppliers such as FOSECO make in the material mix or in the area of light metal casting for e-mobility?**

Some of the major global suppliers have invested in research and development capacity in recent years. FOSECO has set up the global R & D center for foundry in Enschede in the Netherlands. There, we carry out all development projects with a global reach, local projects are processed in the location-based laboratories.

The current trend towards e-mobility promotes a mix of materials in Aluminum and high-strength, thin-walled steels, for which new applications are possible. In general, lightweight construction continues in the automotive industry and presents the foundry with ever new challenges.

Incidentally, in the area of light metal casting, FOSECO has its own business unit for non-ferrous foundries, our focus is on the melt treatment of cast aluminum and refractory linings for dosing furnaces. Both technologies are in great demand for die casting and e-mobility and are already standard applications for structural components.

Thin-wall casting, also in iron and steel castings, is supported by FOSECO through filtration projects and optimized finishing applications. In the field of cylinder head for trucks, we have developed a coating with a leading European truck manufacturer, which leads to significantly better cleanliness of the oil and coolant channels. This technology will also be presented at the NEWCAST Forum.

In the field of medium-weight steel castings we will introduce Hollotex Shroud, a technology for hitherto impossible turbulence-free casting.

**FP: What about the junior engineers for the foundries? Who will have the say in the future: the metallurgist, IT or the executive?**

In general, one can say that we are increasingly looking for the next generation of foundrymen in Germany and Europe. BDG and VDG as well as universities and companies have made some efforts to improve the image of the industry and to interest

OEM希望将更多的零部件集成为单一铸件和完整的解决方案,以减少供应商数量。这可以为铸造企业提供投资于机加工或预装配和交付预制部件的机会,并因此产生附加的利润点,但这需要高的投资成本。

**FP: 如福士科公司等全球供应商,在材料组合或轻金属铸件领域为电动汽车提供了哪些支持?**

近年来,一些主要的全球供应商对研发能力进行了投资。福士科在荷兰的恩斯赫德设立了铸造业务的全球研发中心。在那里,我们开展了所有具有全球影响力的开发项目,但是本地化的项目都是在当地的实验室中开展的。

目前,电动汽车的发展趋势促进了铝合金和高强度薄壁钢材混合材料的应用,这为新的应用提供了可能。总的来说,结构轻量化在汽车工业中仍在继续,给铸造厂带来了前所未有的新挑战。

此外,在轻金属铸造领域,福士科公司有自己的有色金属铸造业务部门,我们的重点是铸造铝合金的熔体处理和用于配料炉的耐火材料炉衬。这两种技术在压铸和电动汽车方面有很大的需求,并且已经成为结构部件的标准应用。

福士科公司通过过滤系统和优化后处理方面对铸铁和铸钢薄壁铸件提供了支持。在卡车气缸盖领域,我们为一家领先的欧洲卡车制造商开发了涂料,极大地提高了油路和冷却剂通道的光洁度。这项技术也将在NEWCAST展会论坛上发布。

在中型铸钢件领域,我们将推出新产品Hollotex过滤系统,此技术开创了无紊流浇注系统的先河。

**FP: 铸造企业的青年工程师呢?未来谁会有发言权:冶金专家、IT工程师还是行政人员?**

总的来说,在德国和欧洲对招聘和培养年轻一代铸造人的投入

越来越多。德国铸造协会和工程师协会以及各大学和公司都做出了努力,以改善该行业的形象,并吸引更多的年轻人对铸造行业感兴趣。在GMTN展会上,也将有针对年轻人的项目Metals4You,在选择专业之前,应该首先让年轻人对技术产生兴趣。



more young people in the foundry industry. At the GMTN again there will be the youth program Metals4you, where young people should be interested in technical professions before choosing a subject to study.

An IT expert will certainly not run a foundry. However, the young engineer of today will increasingly find it easier to deal with the digital tools at his disposal and to master the extensive foundry process. He has a very good metallurgical background and basic commercial skills to successfully complete his demanding job.

**FP: How important is a leading international trade fair like the GIFA in Düsseldorf in the digital age?**

I would like to argue against it: ESPECIALLY in the digital age, face-to-face communication is invaluable. Of course you can get the most out of the digital channels and get an overview - but the personal impression and the personal conversation with business partners and customers cannot be surpassed and are the alpha and omega in the business world.

**FP: What impulses and highlights await you in June and what distinguishes GIFA from regional events all over the world and makes them so attractive?**

GIFA is undoubtedly the world's most important trade fair for foundry technology - and has been for 63 years. Together with its sister fair, the NEWCAST, it covers the entire spectrum of foundry technology and cast products in a unique depth and width. Global players and market leaders are represented as well as small, innovative companies. Current megatrends, state-of-the-art technology and the innovations of tomorrow will be presented on an international scale. Trade visitors from business, research, development and teaching cannot obtain such a complete overview of the industry at any other trade fair worldwide. Not to forget: METEC and THERMPROCESS - the leading international trade fairs for metallurgy and thermal process technology - offer real added value.

**FP: Please give us three reasons why the GIFA visit in June 2019 is a must for every foundryperson.**

1. GIFA, NEWCAST as well as METEC and THERMPROCESS offer a veritable fireworks display at congresses, seminars, specialist events and special shows - for the expected approximately 78,000 visitors from all over the world this is a unique opportunity to enrich the know-how. From this wealth of events, I would particularly like to highlight the special show Additive Manufacturing in Hall 13 and the congress on the same topic.

2. With around 900 exhibitors from all over the world - and that alone at the GIFA - the who's who of the international foundry industry awaits you. Take this opportunity to learn first-hand about the technology of today and tomorrow.

3. The GIFA is the international summit of the foundry industry. Do not miss it!

I strongly encourage you to visit GIFA, METEC, THERMPROCESS and NEWCAST from June 25, 2019 to June 29, 2019 in Dusseldorf. We look forward to seeing you! ■

IT专家肯定不会经营铸造厂。然而，今天的年轻工程师将发现，利用数字工具处理业务越来越容易，并且可以掌握广泛的铸造工艺。如果有良好的冶金背景和基本的商业技能，他们将能够成功完成有挑战性的工作。

**FP: 在数字时代，在杜塞尔多夫举办GIFA这样的领先国际贸易博览会是否依然重要？**

我反驳这一观点：特别是在数字时代，面对面的交流更是无价的。当然，你可以从数字化渠道中得到最大的好处，并从中得到综合信息。但个人印象以及与商业伙伴和客户的对话交流是无法被超越的，并且将贯穿在整个商业活动中。

**FP: 6月GIFA展会上有什么值得期待的活动或亮点呢，是什么使GIFA独树一帜，使它得到全球铸造人的广泛关注呢？**

GIFA无疑是世界上最重要的铸造技术展览会，已经走过了63个年头。与其姐妹展览会NEWCAST，GIFA在广度和深度上涵盖了整个铸造技术和铸造产品产业链，包含全球参与者和市场领导者以及小型创新公司，展示了目前的发展趋势、最先进的技术和未来的创新技术。来自铸造行业、研发和高校的专业观众无法在世界各地的任何其他贸易展览会上获得对该行业的全面了解。不要忘记：METEC和THERMPROCESS展是冶金和热处理技术方面的领先国际贸易博览会，提供了真正的附加值。

**FP: 请您给出铸造人必须参加2019年6月GIFA展的3个理由。**

1. GIFA、NEWCAST以及METEC和THERMPROCESS展会包括大型会议、研讨会、专业活动和特别展示，预计将有来自世界各地的大约7.8万名专业观众利用这个特别的机会丰富专业知识。在这些丰富的活动中，我特别想强调的是，在13号馆将举办关于增材制造的大会和特别展示。

2. 仅仅GIFA就有来自世界各地的约900家参展商，因此，来自国际铸造行业的精英正在等待与您会面。利用这个机会，您将可以了解当前和未来的技术。

3. GIFA是铸造行业的国际峰会。请别错过！

**诚挚邀请您参加即将于2019年6月25-29日在杜塞尔多夫举办的GIFA、METEC、THERMPROCESS以及NEWCAST展会。期待与您见面! ■**

## Eye contact Foundry on Wheels – Bringing Automotive and Foundry together in Portugal

In 2017 CITNM in Portugal presented the first edition of Foundry on Wheels, Foundry Planet likes to ask Vitor Anjos, CITNM General Manager about the upcoming edition this year.

### 车轮上的铸造大会——将汽车及铸造行业汇集在葡萄牙 2017年，CITNM在葡萄牙推出了第一届车轮上的铸造大会， Foundry Planet对CITNM总经理Vitor Anjos进行了采访。

Foundry-Planet Interview with Vitor Anjos, CITNM General Manager

**FP:** Vitor please just explain who is CITNM, the organizer of this excellent event?

**Vitor Anjos:** The Centre for Innovation and Technology N.Mahalingam (CITNM) is a non-profit association created in 2015 by Sakthi Portugal with the mission to enhance knowledge and innovation in the metallurgy field, encourage cooperation between institutions in order to strengthen R&D&I and perpetuate knowledge for future generations. In order to accomplish its mission CITNM's strategy is based on the development of partnership for R&D projects, implementation of educational programmes and metallurgical consultancy to help companies evolve towards facing future challenges and lead in innovation.

**FP:** Regarding the 1st edition of Foundry on Wheels in 2017, we heard about many satisfied comments, how was your impression?

**Vitor Anjos:** The congress's 1st edition in October 2017 was really successful and we explored three important axes for the future of both sectors: I) Strategy alignment for the automobile and foundry sectors in order to anticipate R&D solutions; II) Leverage R&D initiatives in foundries; III) Reposition the foundry industry in the automotive value chain as a response to market needs and trends.

We have dedicated two days to sharing ideas, knowledge and to debate innovation, which allowed an enlightening view on the future of these two industries, emphasizing the actual discussion about the dichotomy between the electric and internal combustion engine and the evolution in the application of castings to the production of components.

#### 关于CITNM

N.Mahalingam创新与技术中心 (CITNM) 是由Sakthi Portugal公司于2015年创立的非营利组织，其使命是加强冶金领域的知识积累和创新，鼓励各机构之间的合作，以加强研发与创新，并使知识永久化、为年轻一代学习使用。为了完成这一使命，CITNM的发展战略关注研发项目合作伙伴关系的建立，培训项目的实施和咨询，以帮助企业面对未来的挑战并引领行业创新。

#### 车轮上的铸造大会的举办背景

汽车工业是铸造行业的主要客户，我们注意到缺乏专门的会议将这两个利益相关的行业联合起来，尤其是对铸造企业本身产生巨大影响的重大变化可能产生的情况下。2017年，CITNM举办了第一届国际性大会，以协调铸造和汽车行业的研发战略。主要目标是将OEM和铸造行业相关供应商联系起来，讨论这两个领域的创新，并探讨进一步的发展战略。大会每两年在CITNM的葡萄牙总部举行。

Vitor Anjos  
General Manager CITNM  
COO – Sakthi Portugal SP21

Vitor Anjos  
CITNM总经理  
葡萄牙萨克蒂SP21铸造厂首席  
运营官



We were pleased to have the special participation of Robert Dover (former CEO Austin Martin and former Director of Manufacturing for JLR) and Götz Mehner (Head of the Product Development Department at Continental Automotive), among so many others influent decision makers in the industry.

#### FP: What will we expect in 2019?

**Vitor Anjos:** 2019 Foundry On Wheels the second edition will take place on the 17th and 18th of October 2019. The topics for this year's event are dedicated to: I) Advanced Materials and Technology, II) Product Development and III) Body in White. This year we will have the special participation of representatives from Opel/PSA Groupe, BMW, Rolls Royce, Renault, Kirchhoff, SinterCast, Sakthi Portugal, IK4-Azterlan, among others.

#### “Reason to be” of Foundry on Wheels

The Automotive industry is the main customer of foundry castings. Based on our experience we noticed the lack of a dedicated debate that could join the specific interests of the two industries, especially in a moment where there are important changes going on that will have a huge impact on foundry itself. In 2017, CITNM launched the 1st edition of an international congress to align the R&D strategies of the foundry and automotive industries. The main goal is to join OEMs and foundry related suppliers to debate innovation in both sectors and align strategies for further developments. The congress takes place every two years, in CITNM's headquarters in Portugal.

CITNM also pays special attention on showing the best work being done by Start-Ups, Universities and Research Centres by giving them the time and space to announce their latest findings of interest for the automotive industry.

I am pleased to invite you to learn the programme we are preparing for you and register at [www.citnm.pt](http://www.citnm.pt). ■

Vitor Anjos has been actively involved in foundry technology and material development for automotive components since 2007, year of conclusion for his MSc. in Metallurgy and Material Engineering from the Engineering Faculty of the Porto University (Portugal) and started to work with OCC GmbH for some of the main German foundries. He has specialized in the development of material components and process for Grey Cast Iron, Nodular Cast Iron and Compacted Graphite Cast Iron production and thermal analysis-based process control. Over the years he accumulated experience working also at foundries in China, Brasil, Turkey and Sweden, contributing for his wider perspective on the foundry's current development status and future possibilities. Upon graduating with his Doctorate at the University of Duisburg-Essen in 2015, he moved back to Portugal to start the Centre for Innovation and Technology N.Mahalingam, a research centre dedicated to the innovation in the development of new materials and processes to produce automotive castings. Since January 2019, he is also de Chief Operating Officer at Sakthi Portugal SP21 foundry in Portugal. ■

#### 第一届大会成功举办

第一届大会于2017年10月成功举办，会议探讨了汽车及铸造领域未来的三个重要发展方向：（1）汽车和铸造行业的战略调整，以预测研发方向；（2）发挥铸造企业的研发积极性；（3）将铸造行业重新定位于汽车产业价值链，以响应市场需求和发展趋势。

大会用两天的时间来分享观点、知识和讨论创新，这使得对这两个行业的未来有了启发性的观点，强调了关于电动和内燃机及其铸件应用到组件的生产的演变等的实际讨论。

我们很高兴有Robert Dover（前首席执行官Austin Martin、前JLR生产总监）和Götz Mehner（大陆汽车公司产品开发部主管）的特别参与，以及行业众多其他有影响力的决策者的参与。

#### 2019车轮上的铸造大会

第二届大会将于2019年10月17-18日举办。今年活动的主题是：（1）先进材料与技术；（2）产品开发；（3）轻合金车身。今年，将有来自欧宝/PSA集团、宝马、劳斯莱斯、雷诺、基尔霍夫、欣特卡斯特、葡萄牙萨克蒂、IK4-Azterlan等企业的特别参与。

CITNM还特别关注初创公司、大学和研究中心所做的工作，给予他们时间和场合来宣布他们在汽车行业最新的有价值发现。

诚挚邀请您来学习我们为您准备的课程，请通过[www.citnm.pt](http://www.citnm.pt)网站注册。 ■

自2007年以来，Vitor Anjos一直积极参与汽车零部件的铸造技术和材料开发工作。他于2007年获得了葡萄牙波尔图大学工程学院的冶金与材料工程硕士学位，并开始与OCC公司合作，为一些主要的德国铸造厂提供技术服务。他专门从事灰铸铁、球墨铸铁和蠕墨铸铁的材料组件和工艺的开发以及基于热分析的过程控制研究。多年来，他曾在中国、巴西、土耳其和瑞典铸造厂工作并积累了大量工作经验，从而使他具备了对铸造业发展现状和未来发展趋势的更全面的认识。2015年，在获得了杜伊斯堡-埃森大学的博士学位后，他回到葡萄牙，成立了N.Mahalingam创新与技术中心。该中心致力于新材料和工艺的研发。自2019年1月起，他担任了葡萄牙萨克蒂SP21铸造厂的首席运营官。 ■

## Creating value for our customers – with innovative solutions

Dr. Jens Müller, Global Head of Innovation at ASK Chemicals gives a brief outlook on GIFA – in conversation with GCM – and describes the importance of innovation for ASK Chemicals and the role of customers in the company's innovation process.

### 以创新性解决方案为客户创造价值

ASK Chemicals全球创新主管彦斯·穆勒 (Jens Müller) 博士在与GCM的对话中简要介绍了GIFA, 并描述了创新对于ASK Chemicals的重要性以及客户在企业创新过程中所扮演的角色。

Dr. Müller: GIFA 2019 is just around the corner and we are all eager to see what the foundry industry will be presenting at the industry's most important exhibition. What new solutions can we look forward to at ASK Chemicals?

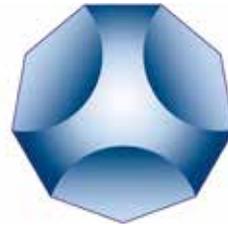
A highlight at GIFA 2019 will certainly be our latest solutions for 3D sand printing. Here we will present some exciting developments both in the field of organic binders as well as inorganic binders. We will also present our new EXACTPORE 3D filter technology.

穆勒博士, GIFA 2019即将来临, 我们都等不及想了解铸造行业将在这个业内最重要的展览会上会展示什么。ASK Chemicals会有哪些新的技术方案?

GIFA 2019的一大亮点一定会是我们最新的3D打印方案。我们将展示有机粘合剂和无机粘合剂领域中振奋人心的新成果。我们还将推出我们新的EXACTPORE 3D过滤技术。



**ASKCHEMICALS**  
We advance your casting



As a leading supplier of environmentally friendly and employee-friendly solutions, we will present new products for this area, such as our latest innovation - the low-formaldehyde system - a package solution consisting of binder, additive and coating that complies with the stricter formaldehyde limits in exhaust gas flow that will come into force in Germany at the beginning of 2020. Of course, that's not all. Visitors to our stand can look forward to further innovative products that improve technical and economic performance.

#### Dr. Müller, what is innovative for you?

New offers that create high value and are sustainable are innovative. Knowledge is translated into values such as performance, environmental compatibility or cost savings. Ultimately, customers and suppliers benefit from this together. The value for the customer is that he becomes more competitive, while the provider of innovative solutions invests part of the value created in generating knowledge and developing further innovation. Innovations are therefore crucial for success and growth on both the customer and supplier sides. An innovative product or business model does not have to be perfect from the very first minute, but it has to generate enthusiasm with customers, surprise them and, at least in some aspects, offer more than they expected.

As you say, innovation transforms knowledge into benefit and ultimately into value. Can you put this into concrete terms?

The easiest way to illustrate this is probably to use examples - such as cold box binders, which are now standard in the industry. When Ashland (then the parent company of ASK Chemicals) invented this technology, its knowledge of polyurethane chemistry converged with the automotive foundries' need for fast and reproducible processes to produce sand cores. Then, technology push and market pull forces came together, and our customers and we at ASK Chemicals benefit from this innovation until this day. Another example is the INOTEC inorganic binder system invented by ASK. The anticipation of stricter environmental guidelines resulted in a market pull that our researchers combined with the possibilities of silicate chemistry. Without a close cooperation with our customers' innovative thinking and acting, this development would not have been possible. Today, both our customers' employees and the environment benefit from this innovation.

#### What is the innovation process at ASK Chemicals like?

Our innovation process consists of three phases: In the first step, the creative phase, we develop new approaches. This is

作为环保和员工友好型技术领域中的领先供应商，我们将推出该领域的新产品，例如我们最新的创新成果：低甲醛系统，这是一套由粘合剂、添加剂和涂料组成的打包方案，它符合将于2020年初生效的对废气中甲醛更为严格的限制。当然，这并非全部的新成果。在我们展台，参观者还可以了解到更多用于提高技术和经济性能的创新产品。

#### 穆勒博士，您认为什么是创新？

创新是创造高价值和可持续发展的新产品，让知识转化为诸如绩效、环境兼容性或成本节约等价值，最终，让客户和供应商共同受益。客户的价值在于能让自己变得更具竞争力，而创新解决方案的提供者则将部分价值放在创造知识和一步开发创新方面。因此，创新对于客户和供应商双方的成功和成长都至关重要。创新产品或商业模式并非要从一开始就完美无缺，但它必须能激发客户的热情，给他们带来惊喜，至少要能在某些方面为客户提供超出预期的产品。

如您所说，创新将知识转化为利益并最终成为价值。您能否就此具体地谈一谈呢？

要说明这一点，最简单的方式应该是举个例子。以冷芯盒粘结剂为例，它如今已成为业界的标准配置。当亚什兰（Ashland，当时还是ASK Chemicals的母公司）发明这项技术时，企业对聚氨酯化学的知识融合了汽车铸造厂对砂芯的快速、可重复生产的工艺需求。

就这样，技术的推动和市场的拉动两相结合，使得我们的客户和我们ASK Chemicals直到今天仍能从这项创新中受益。另一个例子是ASK发明的INOTEC无机粘合剂系统。对更严格的环境指导方针的预期产生了市场的拉动，而我们的研究人员将之结合在硅酸盐化学的诸多可能性中。

如果没有紧密配合客户的创新性思维与行动，这种发展就不可能实现。今天，我们的客户以及环境都得益于这一创新。

#### ASK Chemicals的创新流程是怎样的？

我们的创新过程包括三个阶段：第一步是创造阶段，在这个阶段，我们开发新的方法。例如，与客户、销售、

done, for example, through trend analyses and evaluation of new topics in discussions with customers, sales, technical service, R&D, suppliers and other internal and external partners. This is primarily about effectiveness, or „doing the right thing“. This is a very important step, because it is basically about „discovering problems that need to be solved“. In the second step, idea and project management, the core assumptions of the innovation approach, i.e. the technology and the business model, are tested. This is then about efficiency, or „doing it the right way“. The projects that also survive this selection process - and these are usually only a few - then enter the 3rd phase, the market launch. At the same time, we aim to have sufficiently clarified all uncertainties critical to success at this point in time in order to be able to convince our customers of the intrinsic value of the innovation.

#### What role does the customer play in the process described?

ASK Chemicals puts the customer at the centre. As already mentioned above, it is about solving a customer's problem or arousing enthusiasm. We often use the so-called lead-user method. This means that we try to involve particularly innovative customers, with whom we usually have a very good relationship of trust, in the innovation process. Our customers not only contribute to the honing our ideas and projects, but are also the essential litmus test for the value we want to generate with innovation. In concrete terms, this can also be seen in the example of the development of our low-formaldehyde (LFS) technology. The customer is confronted with a problem, namely a tightening of limit values for formaldehyde in the exhaust gas flow from 2020 (deadline applies to old plants), which triggers a process as described above. Ideas for solving the problem are generated, initial preliminary tests carried out and optimised in an iterative process between laboratory, test foundry and customer to such an extent that at the end a product package was put together which demonstrably reduces formaldehyde emissions in the drying oven by more than 70%. And this is exactly what I see as an essential task of innovation, namely the solution of a customer problem.

#### What are the value drivers that ASK Chemicals has identified for its innovation activities?

We focus on three core areas that are particularly important for our customers: In the „Performance“ area, we develop products that simplify, improve or accelerate foundry processes and thus offer our customers cost and competitive advantages. In the „Environment“ area, on the other hand, we have a clear focus on products that comply with the environmental regulations and rules to be expected in the future today without compromising performance. In this way, our customers can already now make their processes and investments fit for the future. It has always been part of our philosophy to work closely with our customers so that foundries can achieve optimum results with our products. This would not be possible without service as a core element of our business model. This is why we are also placing a very clear focus on innovation in the third area, „Services“. In doing so, we are now increasingly relying on digital possibilities that enable us to support our customers even faster and more competently. ■

技术服务、研发、供应商以及其他内部和外部合作伙伴进行讨论，得出新主题的趋势分析和评估，从而完成这一步骤。其主要着眼点是效用，或说是“做正确的事”。这是非常重要的一步，因为它基本上就是“发现需要解决的问题”。在第二步的创意和项目管理中，对创新方法的核心设想——既技术和商业模式——进行测试。这里着眼于效率，或是“用正确的方式做事”。

通过了这个筛选过程的项目——通常只剩下少数几个——随即进入第三阶段，即市场推出。与此同时，我们旨在充分地阐明当前影响成功的所有不确定因素，以便能够使客户相信创新的内在价值。

#### 客户在这一流程中扮演着什么样的角色？

ASK Chemicals以客户为中心。如上所述，关键在于解决客户的问题或激发他们的热情。我们经常使用所谓的“引导用户法”。这就是说，我们在创新过程中尝试让特别具有创新精神的、通常与我们建立了良好信任关系的客户参与进来。我们的客户不仅为我们的创意以及项目的打磨做出了贡献，同时也是我们想要通过创新来创造的价值的重要试金石。对此，我们的低甲醛（LFS）技术开发就是一个实例。客户面临的问题是：从2020年开始收紧废气中甲醛的极限值（截止日期适用于旧工厂）。这就触发了上面描述的流程。各种解决问题的思路被提出，在实验室、测试铸造厂和客户之间的迭代过程中进行初始初步测试并加以优化，直到最终组合出一套明显将烘干线中甲醛排放减少70%以上的组合产品。在我看来，这正是创新的中心任务，即解决客户的问题。

#### ASK Chemicals为其创新行动定出了哪些价值驱动因素？

我们把重心放在对客户特别重要的三个核心领域：在“绩效”领域，我们开发产品来简化、改进或加速铸造流程，从而为客户提供成本上的和竞争方面的优势。另一方面，在“环境”领域，我们明确着眼于符合未来环境法规和规则、同时又不影响绩效的产品。通过这种方式，我们的客户如今就能够使他们的流程以及投资很好地适应未来。

与客户密切合作始终是我们理念的一部分，这样铸造厂就可以借助我们的产品实现最佳效果。这就离不开作为我们业务模式核心要素的客户服务。这也解释了为什么我们也极为重视第三个领域的创新，即“服务”领域。在这一过程中，我们越来越多地采用数字化手段，以便更快、更有力地为客户提供支持。 ■

## Current research topics on the hot chamber die casting machine DAM500F

### 关于DAM500F型热室压铸机的研究



Zentrum für Gussleichtbau und Konstruktion

Logo of the Department of Foundry Technology - GTK

铸造技术研究所的标志-GTK



Logo of the University of Kassel

卡塞尔大学的标志

The Institute of Foundry Technology (GTK) of the University of Kassel is working on fundamental as well as industry-related research topics in the field of magnesium die casting. Thereby the scientists of the GTK are exploring the advantages of the hot chamber technology regarding to the product development process with the result of completely new production concepts.

#### AiF-Project „InProGas“

Relating modern magnesium melting technology the GTK is working recently on a cooperative industrial research AiF project (IGF-Project 19713) „Nachhaltige, qualitative Schutzgasregelung für Magnesiumschmelzen“. The main objective of the project „InProGas - Intelligent Protective Gas Control“ is the continuous analysis of the gas composition in furnace chamber above the melt surface. Currently only rudimental information existing about the exact gas composition inside the melting furnace. The lack of knowledge according to the gaseous decomposition products, that are occur out of a chemical reaction between protective gas, ambient air and the magnesium, leads to an incorrect dosing of the protection gas, such as R134a. For a realistic investigation the process is analyzed on a MB500 Meltec Magnesium furnace, that is implemented in a Frech hot chamber die casting cell – DAM500F. The gas composition inside the magnesium furnace is investing relating a reference variable that indicates an imperfect protective layer. That information is the baseline for a demand controlled safety system. A primary target in this context is the increase of the occupational safety of the foundrymen as well as an improvement of the effectiveness of resources. Additional information about the fundamental processes and reactions of the gas phase inside the magnesium furnace, e.g. the impact of hydrofluoric acid according the lifetime of crucible and furnace cover, are examined in the project. The pre-competitive research complies to currently discussions of environment protection, that are named “phase down” for a reduction of F-gases. Thereby the amount of circulation of partly fluorinated hydrocarbons (HFC), e.g. common used protective gas R134a, shall be reduced of 79% by 2030. Furthermore, the project affects the challenges of the digitization of the production. Herein analog processes are substituted by sensors and actuator that are enable the industry for a global interconnection. Due to the remote maintenance and control, the demand control of the protection gas regulation is a huge benefit for the development of the Industry 4.0 in the foundry environment, picture 1.

卡塞尔大学铸造技术研究所正在进行镁合金压铸领域的基础以及与工业有关的课题研究。因此，研究所的科学家们正在探索热室技术在产品开发过程中的优势，产生了全新的生产概念。

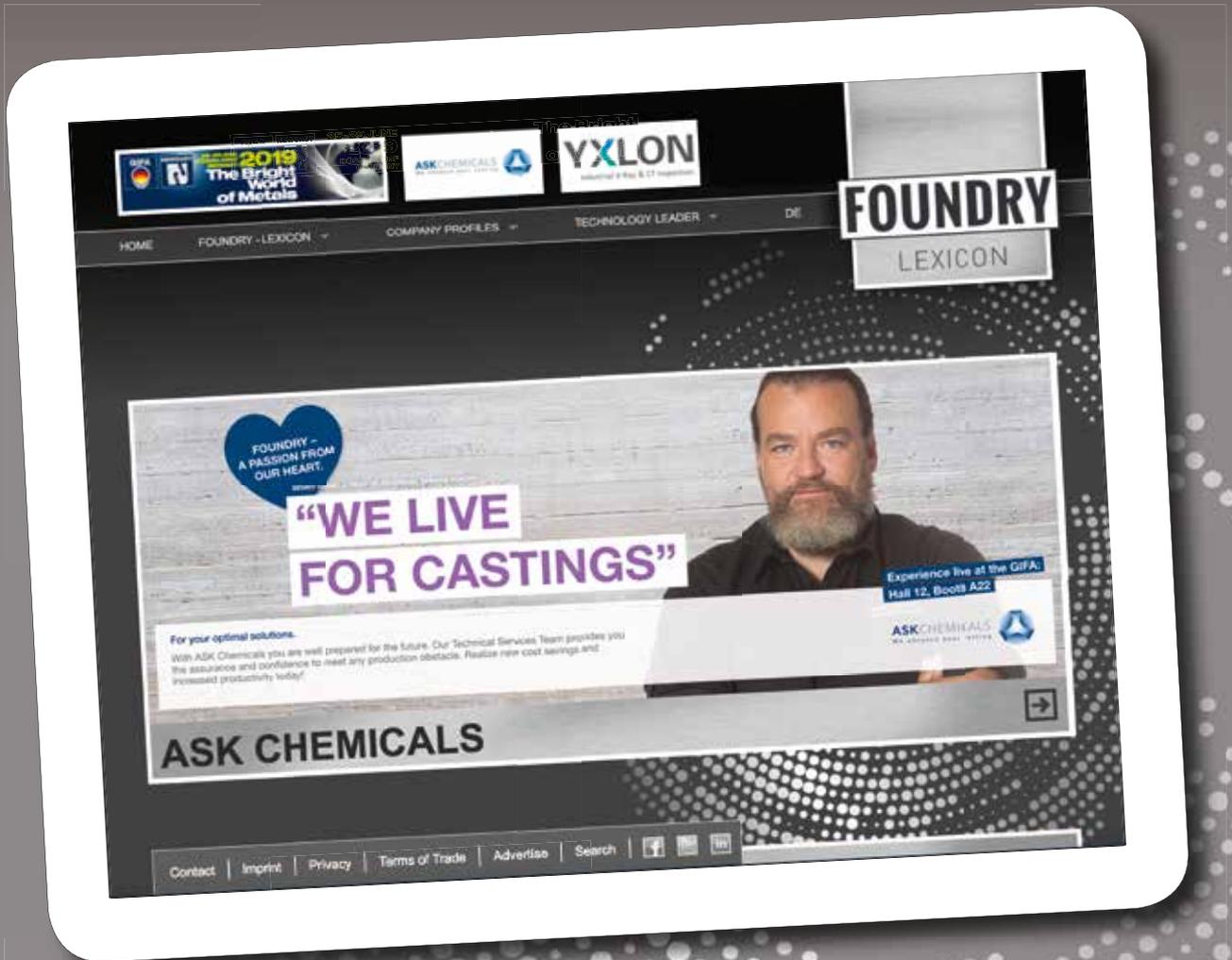
#### AiF项目 “InProGas”

结合目前的镁合金熔炼技术，研究所最近正在进行AiF工业合作研究项目(IGF项目19713)“对镁合金熔体的可持续性研究、质量保障”。项目的主要目的是“智能保护气体控制”，对熔池上方炉膛内的气体成分进行连续分析。目前仅有关于熔炼炉内气体组成的初步信息。对于保护气体、环境空气和镁合金之间的化学反应所产生的气体分解产物缺乏了解，导致了保护气体R134a等不正确的投入量。

为了开展实际研究，本文分析了采用德国富来公司DAM500F热室压铸机对MB500 Meltec镁合金熔化炉的工艺过程分析。镁合金熔化炉内的气体成分与指示保护层不完善的参考变量有关。这些信息是需求控制安全系统的基准。在这方面的一个主要目标是提高铸造工人的职业安全以及提高资源利用率。该项目还审查了有关镁合金熔化炉内气相基本过程和反应的其他信息，如氢氟酸对坩埚和炉盖寿命的影响。竞争前研究符合目前关于环境保护的讨论，这种讨论被称为“逐步减少”以减少氟的排放。因此，部分氟化烃(HFC)的循环量，例如常用的保护气体R134a，到2030年应减少79%。

此外，该项目还响应数字化生产的挑战。在此，模拟过程被传感器和执行器所取代，这些传感器和执行器能够实现全球互连，用于远距离的维护和控制保护气体调节，对铸造行业4.0的发展有着巨大的益处。

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**Publisher:**

Foundry Technologies & Engineering GmbH (FT&E) – Phone: +41 52 620 10 56

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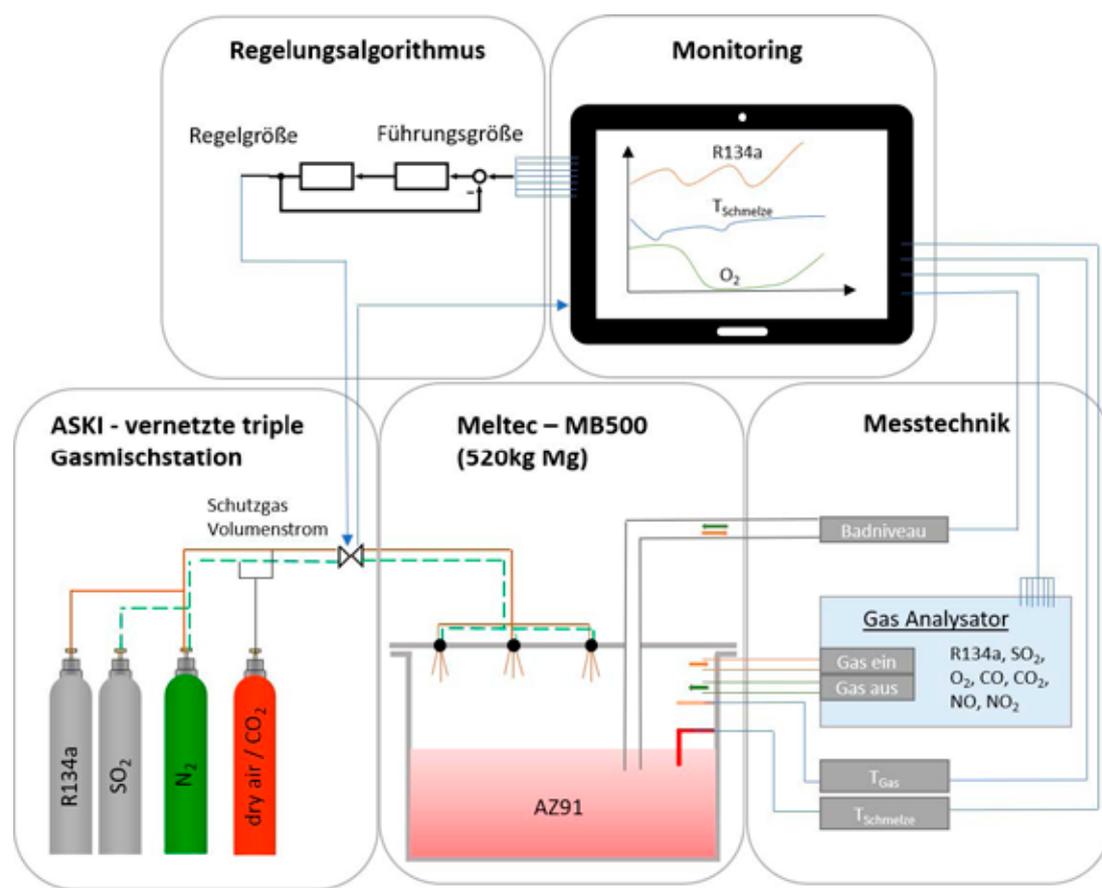
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Project AIF-IGF project, 'Intelligent Protective Gas Control', -InProGas-  
AIF-IGF项目“智能保护气体控制”-InProGas-

### AiF-Project „Mg-Bond“

The lightweight construction trend, which has been emphasized for years by political guidelines, is intended especially for the automotive industry. This leads to a develop of modern joining technology solutions, e.g. thin-walled, weight-optimized structural components also in multi-material mix. In the AiF / IGF project „Mg-Bond - Bonding of structural components made of thin-walled magnesium die casting“ is carry out in cooperation of the GTK and the department of joining and separating production processes of University of Kassel, Prof. Dr.-Ing. Böhm. Different pretreatment methods for process-reliable, aging-stable and crash-optimized bonding of magnesium structural components are being investigated. In particular, the interdisciplinary project should also consider the relationships between casting-technical parameters and joining-technical aspects. In addition, the effects of the component surfaces and release agents on the subsequent pretreatment of the components for a stable and durable bonding are analyzed.

### Salt cores in die casting

Further projects related to the hot chamber die casting cell at GTK are concerned with the development and validation of simulation data for salt core production and processing. For this purpose, the free simulation software OpenFoam is used to construct corresponding models and algorithms for solidification and strength calculation as well as analysis methods for the validation simulation test. ■

### AiF项目“Mg-Bond”

结构件轻量化的趋势，是多年来一直被强调的发展方针，特别是针对汽车行业。这导致了现代连接技术解决方案的发展，例如，在使用多种材料的薄壁、减重的结构件也是如此。在AIF/IGF项目中，“镁合金薄壁压铸结构件”是由研究所与卡塞尔大学生产工艺系Böhm博士合作进行的。该项目研究了镁合金结构件在工艺可靠、时效稳定、断裂优化连接等方面的不同预处理方法。特别是，跨学科研究项目还应考虑铸造技术参数与连接技术方面之间的关系。此外，还就为获得稳定和持久的粘结性、对组件表面和脱模剂对组件后续预处理的影响进行了分析。

### 压铸用盐芯

与研究所的热室压铸机有关的其他项目涉及盐芯生产和工艺的模拟数据的开发和验证。为此，利用免费的模拟软件OpenFoam建立了相应的凝固和强度计算模型和算法，并给出了验证模拟试验的分析方法。 ■



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## Department of Foundry Technology - GTK at the University of Kassel

### 卡塞尔大学铸造技术研究所-GTK

Since the founding of the Department of Foundry Technology - GTK at the University of Kassel in October 2012, the chairholder Univ.-Prof. Dr.-Ing. Martin Fehlbier combines university research and academic education with the requirements and needs of the industry. By this means, research results are transferred into industrial applications quickly and efficiently. The aim of currently 15 employees is the education of theoretical and practical basics to young students as well as research on recent challenges of the foundry industry. Especially in practice there is a close cooperation with the most common commercial partners from the foundry industry. This includes not only large car manufacturers, light metal and Fe foundries but also other partners from the supplier industry, plant and binder manufacturers, toolmakers as well as aluminum and tool steel producers. To bundle the interests and the know-how at the GTK, the „Industrial Cooperation of Foundry Technology“ was founded in 2013. The intention of the “Industrial Cooperation of Foundry Technology” is the support of the institute, the education of young scientists and the realization of common research projects.

#### Research Focus: „Innovative lightweight construction“

In addition to classical foundry technology, a focus is placed on the design and simulation of the whole casting process as well as the resource efficiency.

#### • Tool and Component Development:

Design and Simulation/ Material and Tool Development/ Simulation Casting Process / Crash and Lifetime Simulation / Hybrid and Multifunctional Components/ Ultra-Thin-Wall Casting

#### • Process Development:

Cold and Hot Chamber HPDC/ New Spray Technology and Mold Concepts/ Innovative Thermal Management Concepts/ Mg Joining Technologies/ Rheo- and Thixomolding/ Salt Core Technologies and Simulation/ Innovative Removal Technology/ Industry 4.0 and Sensor Technologies/ Recording of Energy and Material Flows/ Energy Management

#### • Material Development:

Naturally Hard Al alloys/ Optimization of Heat Treatment/ Mg Alloys/ Hybrid Materials/ New Tooling Materials/ Thin-film Technologies/ Testing Equipment/ Recycling Concepts.



The chairholder Univ.-Prof. Dr.-Ing. Martin Fehlbier combines university research and academic education with the requirements and needs of the industry since the founding of the Department in October 2012

自2012年10月卡塞尔大学铸造技术研究所-GTK成立以来，学校主席Martin Fehlbier博士将学术研究、教育与行业的需求相结合。

自2012年10月卡塞尔大学铸造技术研究所-GTK成立以来，学校主席Martin Fehlbier博士将学术研究、教育与行业的需求相结合。通过这种方式，研究结果可以快速有效地转移到工业应用中。目前学院15名员工的目标是对年轻学生进行理论和实践的基础教育，以及研究铸造行业面临的最新挑战。特别是在实践中，学校与铸造行业典型的商业合作伙伴密切合作。合作伙伴不仅包括大型汽车制造商、轻金属和铸铁厂，还包括供应商、工厂和粘合剂制造商、模具制造商以及铝和工具钢生产商等其他合作伙伴。

为了将GTK的利益和专业技术捆绑在一起，“铸造技术产业合作”大会成立于2013年，其目的是为研究所、青年科学家的教育提供支持，以及促进共同研究项目取得成功。

#### 研究重点：“创新轻量化结构”

除了传统的铸造技术，重点还放在整个铸造工艺的设计和模拟以及资源效率上。

#### •模具和组件开发:

设计和模拟/材料和模具开发/模拟铸造工艺/碰撞和使用寿命模拟/混合和多功能组件/超薄壁铸件

#### •工艺开发:

冷、热室压铸机/新型喷涂技术和模具概念/创新热管理概念/镁加入技术/流变和触变成型/盐芯技术和模拟/创新清除技术/工业4.0和传感器技术/能量和物料流记录/能源管理

#### •材料开发:

天然硬质铝合金/热处理优化/镁合金/混合材料/新模具材料/薄膜技术/测试设备/回收概念

铸造技术研究所GTK具备现代化的研究和测试环境，其



The „Industrial Cooperation of Foundry Technology“ combines know how of many different areas of the foundry industry in one network. In alignment to each other, research projects are sponsored together to create benefits to all participants.

“铸造技术产业合作”结合了铸造行业的许多不同领域的知识。相互协调，共同发起研究项目，为所有参与者创造利益。

The Institute of Foundry Technology – GTK is equipped with a modern research and testing environment, which contains a fully atomized 1.400t Al-Mg-Cold-Chamber HPDC Cell Bühler Carat 140 Compact with a wide range of different periphery (extractor and filter unit (KMA), spray and removal robot (Kuka/ Böhmer), three oil and three water temperature control units (Robamat), Aluminum crucible furnace including vacuum dosing up to 800kg Al (Meltec), Magnesium crucible furnace including vacuum dosing up to 500kg (Meltec), SSR-Rheocasting-equipment (Idra)). Additionally, a highly modern 580t Mg hot chamber HPDC cell from Oskar Frech - DAM500F including protective gas mixing stations (Meltec) is set up at the GTK laboratory. ■

中包含一个完全雾化的1400吨Al-Mg冷室高压压铸单元 Bühler Carat140Compact，具有各种不同的周边设备：取件和过滤器单元 (KMA)、喷涂和清除机器人 (Kuka/ Böhmer)、三个油和三个水温控制单元 (Robamat)、包括真空计量高达800kg铝 (Meltec) 的坩埚炉，包括真空计量高达500kg镁的坩埚炉 (Meltec)、SSR流变铸造设备 (Idra)。

此外，还在GTK实验室建立了一个高度现代化的580吨镁合金热室高压压铸单元Oskar Frech-DAM500F，该单元包括Meltec公司的保护气体混合站。 ■



The fully atomized 1.400t Al-Mg-Cold-Chamber HPDC Cell (Bühler Carat 140 Compact) and different periphery devices are the baseline for academic education and university research close to the needs of the industry.

完全雾化的1400吨铝镁冷室高压压铸单元Bühler Carat140 Compact和不同的周边设备是贴近行业需求的学术教育和科研的基础。



The ambitious targets of the Department of Foundry Technology - GTK are the education of students for the needs and requirement of the foundry environment. Therefore several Bachelor and Master courses are available that are combining theoretical content with practical training.

铸造技术研究所的雄心勃勃的目标——对学生进行满足铸造行业需求的教育。因此，已经有几门本科和硕士研究生课程将理论与实践相结合了。

## Personalized Rapid Customization Integration Solution Provider for Equipment Complex Parts

### 装备复杂零部件个性化快速定制一体化解决方案提供商

China Academy of Machinery Science & Technology Group (CAM) was founded in 1956, the goal of CAM is improve the equipment manufacturing level of China. CAM has 16 subsidiaries including the holding companies with the operation system of the group management of parent-subsidiary type. CAM has built 39 key laboratories and engineering research center, and all these have been certified by government as national, provincial and industrial level innovation platform. CAM is engaged in the basic common technology research for manufacturing industry. With the development in these 60 years, CAM has gained more than 7,000 achievements which have been applied in the main domestic economical industries such as machinery manufacturing, automobile, aeronautic and aerospace, environmental protection, energy, transportation, information, metallurgical chemical engineering, construction and etc.

Complicated casting patternless composite manufacturing technology and equipment which is developed by CAM won the second prize of National Technological Invention. The key patternless casting technology of high-efficiency, high-performance, and high-precision has been break through and Great achievements have been made in technology, composite casting and Seria equipments. Complex curved sand/core flexible extrusion near forming technology, cutting net forming technology and composite forming process developed by CAM make the patternless, high-precision, high-efficiency manufacturing of complicate castings realized, shortening more than 50% of the manufacturing cycle and reducing more than 30% of the cost. Invented a multi-material composite casting mold matching with the casting and its assembly method, realized the active regulation of the casting performance, solved the problem of shape and performance precisely control, casting scrap rate reduced from 5%-10% to 2%-4%, weight reduced about 10%-20%; Developed the digitally controlled flexible array contacts and high wear-resistant large aspect ratio cutting tools, proposed an integrated tool cooling and cutting sand removal method, developed a sand/core flexible extrusion molding

机械科学研究总院集团始建于1956年，提升中国装备制造水平是机械总院的神圣使命。拥有16家全资及控股子公司（公司），实行母子公司式集团管理体制。

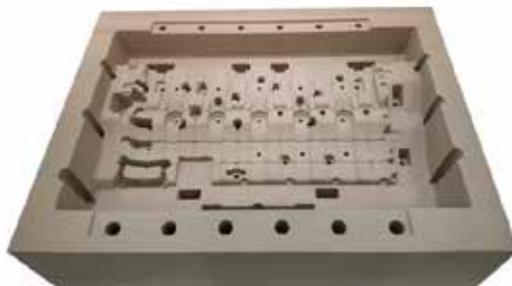
建有39个国家级及省市级重点实验室和工程（技术）研究中心。

主要从事装备制造业制造技术（基础共性技术）研究开发的研究院和现代制造服务业企业，自成立五十余年来，累计取得科研成果及专利7000多项，广泛应用于机械制造、汽车、航空航天、环保、能源、交通运输、信息产业、冶金、化工、建筑等重要产业领域。

由机械科学研究总院集团自主研发的“复杂铸件无模复合成形制造方法与装备”荣获国家技术发明二等奖。该成果突破了复杂铸件高效率、高性能、高精度无模成形关键技术，在工艺方法、复合铸型、系统装备等方面取得重大成果。

开发出复杂砂型/芯曲面柔性挤压近成形技术、切削净成形技术及其复合成形工艺，实现了复杂铸件无模化、高精度、高效率制造，制造周期缩短50%以上，成本降低30%以上；发明了一种与铸件相匹配的多材质复合铸型及其坎合组装方法，实现了铸件性能主动调控，解决了形性精确控制难题，铸件废品率从5%~10%降至2%~4%，减重10%~20%；开发出数字化控制的柔性阵列触头、高耐磨大长径比切削刀具，提出了刀具冷却与切削排砂一体化方法，研制出砂型/芯柔性挤压成形机、无模铸造精密成形机等7类15种装备，解决了复杂铸件高精度成形制造装备难题，铸件精度提高了2~3个等级，可达CT8。

无模铸造精密成形机可用于树脂砂、水玻璃砂、覆膜砂、陶瓷等多种铸型制造，最大成形尺寸为5000mm×3000mm×1000mm。



machines, patternless casting precision forming machines and other 15 kinds of equipment in 7 categories, solved the problems of complicate castings high-precision forming manufacturing equipment, casting accuracy has increased by 2 to 3 levels and can reach up to CT8. The patternless casting precision forming machine can be used to manufacture resin sand, water glass sand, coated sand, ceramics, etc. The maximum forming size is 5000mm×3000mm×1000mm.

The achievements were granted 47 invention patents (19 in the United States, Japan, and Europe) and 12 software copyrights. won the second prize of National Technological Invention in year 2017, the China Machinery Industry Science and Technology Award (technical invention) in year 2016, China Patent Gold Award in year 2016, Beijing Science and Technology Award (technical invention) in year 2012, First Prize of Beijing Invention Patent in year 2011 and 3 national key new products and so on. The technology has been promoted and applied in more than 100 companies including Shanghai Academy of Space Technology, AECC Harbin Dongan Engine, Guangxi Yuchai Machinery Group, FAW Foundry and Yto Group Corporation. The equipment has been exported to Spain. 14 application demonstration bases have been established in China, realized the manufacturing of steel/iron, aluminum/magnesium alloy castings. This technology is of great significance for promoting the innovation of high-end equipment technology, safeguarding of national defense security, and promoting of green development.

For more information, please visit: [www.cimpe.cn](http://www.cimpe.cn) ■



该成果获授权发明专利47件(美、日、欧等19件), 软件著作权12项。获2017年度国家技术发明二等奖、2016年中国机械工业科学技术特等奖(技术发明)、2016年中国专利金奖、2012年北京市科学技术一等奖(技术发明)、2011年北京市发明专利一等奖和3项国家重点新产品等。该技术已在航天八院、东安发动机、广西玉柴、一汽铸造、中国一拖等100多家企业推广应用, 设备出口西班牙, 并在国内建立14个应用示范基地, 实现了铸钢/铁、铝/镁合金等铸件制造。

该技术对促进高端装备技术创新, 维护国防安全, 推动绿色发展具有重大意义。

更多内容, 请访问[www.cimpe.cn](http://www.cimpe.cn) ■

PRODUCT NEWS/产品新闻

Powerful scaling with multi-needles  
多针束强力除垢气铲

Nitto Kohki's (Tokyo, Japan) original Jet Chisels, pneumatic needle scalars, quickly and efficiently removes scale, rust, weld slag or paint from most surfaces. They are ideal for cleaning castings and also useful for descaling steel, brick, stone and many other materials.

Proven superior design features with no internal spring components ensure trouble-free performance.

Self-adjusting needles  
The Jet Chisel needles automatically adjust to any surface contour. They get deep into corners, reach into uneven surfaces, and conform to all types of shapes, making it a tool no shop should be without.

Visit Nitto Kohki's eCatalog for more information including the full line-up of Power Tools and Machine Tools.

<http://nitto-kohki.meclib.jp/Tk126/book/index.html> ■

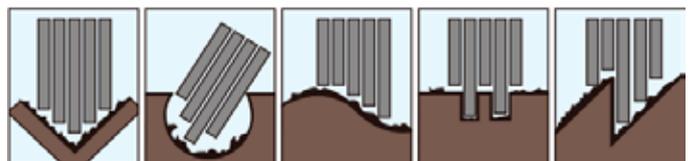


总部位于日本东京的日东工器公司生产的气动多针束气铲, 能快速有效地去除铸件表面污垢、锈蚀、焊接渣或油漆。它是理想的铸件清洁设备, 也适用于钢、砖、石头等其他材料。其设计经过优化并已获得验证, 不含内部弹簧组件, 确保可靠性。

自动调整针束  
气铲针束可根据任何表面轮廓自动调整, 可深入到角落、延伸到凹凸不平的表面, 并适用于所有形状, 使之成为任何工具店不可缺少的商品。

请访问日东工器公司的网站以获取更多信息, 包括电动工具和机床的全系列产品。

<http://nitto-kohki.meclib.jp/Tk126/book/index.html> ■



## THE NEED FOR TARGETED AND SPECIFIC THERMOREGULATION SYSTEMS FOR THE ALUMINUM DIE CASTING INDUSTRY.

### 铝合金压铸行业需要专业并有针对性的热调节系统

The demand for temperature control in castings production can no longer be exempt from being highly specialized and targeted, first and foremost towards the peculiarities of the sector and subsequently towards each component of the production cell.

This is the reflection which is leading IECI Thermoregulators, from Brescia, towards the development of the next future.

Currently, the thermoregulators for molds are designed, most of the times, to cover an average of the various needs of different sectors, sometimes not very compatible with each other, as is to be considered the processing of plastic in relation to aluminum. It is precisely in the sector of aluminum castings production that this type of equipment is often found in a situation of inadequacy, caused by difficult working environment and by production demands.

Inside the production cell there are also several elements that have different thermal requirements, in order to work at their best. Molds, mold holders, containers, pistons, fountains, trolleys, molding devices, direct cooling are all elements that cannot be managed with the same machine and the same technology. This is the reason that led IECI Thermoregulators to create over the years a range of specific TCUs for each element, reaching a very high level of specialization.

Hence today it is possible to choose a specific thermoregulator for the container, available in different configurations (water, oil, electric, gas, single or double zone, with one water and one oil zone) as is for a thermoregulator for molds. Even the piston has been considered of primary importance, in the concept of targeted thermoregulation.

The Plunger Pad system allows the user to choose pressures and flow rates and to keep the temperatures under complete control, so to understand and monitor the efficiency and effectiveness of the system.

At the IECI booth in GIFA, it will be possible to admire the latest generation of water thermoregulators 200°, alongside



铸件生产中对温度控制的要求已经越来越高度专业化和有针对性，首要的是针对各部位的特点，然后是针对生产单元的每个组成部分。

这就是意大利布雷西亚的IECI公司的调温器未来的发展方向。

目前，大多数情况下，模具的温度调节器的设计是为了满足不同部位的不同需要的平衡，有时它们之间并不十分兼容，这与铝压铸和注塑行业的工艺要求有关。在铝压铸件生产过程中，由于工作环境恶劣和生产要求的限制，设备往往会出现冷却不足的情况。

在生产单元内部，也有几个元素具有不同的热要求，以便在最佳状态下工作。模具、型板、压室、冲头、喷嘴、手推车、成型设备、直接冷却都是

无法用同样的机器和技术管理的元素。这就是导致IECI公司温度调节器多年来为每个元素创建一系列特定的TCUs（导热非绝缘散热片）的原因，并且达到了非常高的专业化水平。

因此，目前，公司可以为压室选择一种特殊的调温器，其配置不同（水、油、电、气、单区或双区、一个水和一个油区），就像用于模具的调温器一样。在有针对性的热调节概念中，活塞甚至也被认为是最重要的。

柱塞垫系统允许用户选择压力和流量，并可以完全控制温度，从而了解和监测系统的效率和有效性。

在GIFA展的IECI公司展位，您可以了解到最新一代的200°水热调节器以及气体模型和新的冷却系统，如模块



with the gas models and the new cooling systems such as the modular JET PAD Cooling, the Pioneer Multichannel System and the proportional Multi PAD for cooling management. A Controller system will also be exhibited, driven by an active thermal camera, a central and essential element for the future of thermoregulation in die-casting.

Mauro Inverardi ■

化喷射垫冷却、以及用于冷却管理的先锋多通道系统和多功能垫。还将展示由一个主动热感摄像机驱动的控制器系统，这是未来压铸热调节的核心和基本要素。 ■

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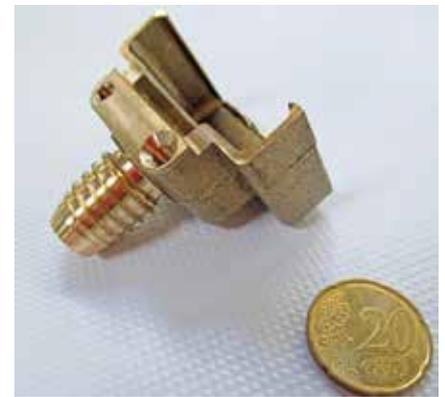
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## GIENANTH GROUP

## Gienanth集团-质量稳定与设计创新



The GIENANTH GROUP is a leading manufacturer of high-precision cast iron parts - we stand for sustainable quality and innovative design - perfectly coordinated and tailor-made with and for our customers.

From the initial technical idea to the finished component, GIENANTH's production is based on cutting-edge engineering expertise in every step of the process, as well as on technological leadership, craftsmanship and innovation.

GIENANTH covers three iron casting processes: hand-moulded castings and machine-moulded castings on vertical and horizontal moulding lines with a wide variety of materials ranging from vermicular graphite iron (GJV), spheroidal graphite iron (GJS), lamellar graphite iron (GJL) and thus allow us to offer an incomparably broad product portfolio.

The machine casting product family primarily consists of automated cast components for the automotive market and the commercial vehicle and agricultural machinery segments as well as parts for railway industry with components weighing between 0.5 kg and 40 kg in medium series and mass production; especially balance shafts, brake components, bracket components, threaded rings, clutch pressure plates, crankshaft bearing caps, flywheels, hubs and much more.

In addition to large cast parts for mechanical and systems engineering, the hand-moulded casting product family primarily focuses on crankcases and cylinder heads weighing from 0.5t up to 12t for the heavy-duty engine segment.

We stand for the highest quality and 100% reliability of our deliveries. We do not see ourselves as merely a producer, but as a partner with our customers - the Gienanth Group has been repeatedly honoured for its unique "zero-defect mentality". Our success is based on the time-honoured and long-standing expertise of our 1400 highly motivated employees, who always have one thing in their sights: The best products and custom-made solutions for our customers.

**GIENANTH IS METALLOVATION®. Meet us on the GIFA2019 in hall 14 on our outstanding stand D16. ■**

GIENANTH集团是领先的高精度铸铁件制造商，坚持稳定的质量和创新的设计理念，与客户进行完美的协调并为其量身定制产品。

从最初的技术理念到完成零部件，GIENANTH集团的生产是基于生产环节每一步的领先的工程专业知识，以及先进的技术、工艺和创新。

GIENANTH集团有3种铸造工艺：手工造型、垂直和水平分型的机械化造型线，产品材质种类繁多，包括蠕墨铸铁(GJV)、球墨铸铁(GJS)、灰铁(GJL)，从而可提供广泛的产品系列。

机械化造型线的系列产品主要是汽车、商用车零部件和农业机械以及轨道交通零部件，为中等和大批量生产，铸件重量在0.5Kg-40Kg之间。主要有平衡轴、制动部件、托架部件、螺纹环、离合器压板、曲轴轴承盖、飞轮、轮毂等。

除了用于机械和系统工程的大型铸件外，手工铸造产品系列主要集中于重负荷发动机的曲轴箱和缸盖，重量为0.5t到12t。

我们坚持交货产品拥有最高的质量和100%的可靠性。我们不认为自己仅仅是生产者，而是作为客户的合作伙伴。GIENANTH集团因其独特的“零缺陷意识”而一再受到表彰。公司的成功是建立在1400名积极且拥有长期工作经验的员工努力的基础上，他们始终坚持的目标是：为客户提供最好的产品和定制的解决方案。

**GIENANTH集团将参加GIFA2019，展位是：14号馆 D16。 ■**

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Industrial Autumn  
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Kielce - Poland

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**HEAT TREATMENT**



**ALUMINIUM  
& NONFERMET**



**RECYKLING**



## The Kimura Group 木村铸造所

The Kimura Group was founded in 1927 and has continuously operated since that time. In the intervening 90+ years, we have demonstrated tenacious efforts and flexibility in the face of upheaval and have sustained a business based on the production of castings.

Our “Full Mold Casting” process, which was introduced in 1964, brought a big revolution to us and we have grown to be recognized as “KIMURA of Full Mold Casting” by the industrial production world.

**I.T. + I.T. = ∞**

Infinite challenge to creation

By specializing in the Full Mold Castings Process for over 50 years, we have become capable as a supplier into a lot of new fields. Simultaneously, we also have developed manufacturing technologies based on Information Technology (IT), such as modeling by CAD/CAM, various measurement systems and casting simulation through production mainly of Full Mold Casting. As a result, we succeeded to establish a new casting technology integrating the Full Mold Casting and IT. We now continue strongly to step forward, applying our technologies to utilizations of 3D printers, reverse engineering and so on.



We have just opened a new foundry, Kimura Foundry America, in Shelbyville, IN, USA to contribute especially to its R&D market. It specializes in providing high quality Rapid Prototype (RP) castings and small lot production services. RP castings are produced with zero defects in just 5 days.

With proven expertise in precision design, highly advanced pouring, finishing, inspection, machining and rapid prototyping, Kimura has longstanding relationships with customers across industries, including automotive and Tier 1 suppliers, large and small engine manufacturing, machine tools, industrial pumps, oil, gas & renewable energy, construction and mining and agricultural equipment.

Focusing on a technology leads to a new technology, and new technology makes a new world. Our technologies have infinite potential, which would be developed and expanded to various fields. We do hope that, by being a world-leading foundry, our technological innovation will support our customers in a way that contributes to all the people in the world. ■

木村铸造所成立于1927年，在过去的90多年中，木村铸造所在变革面前表现出了顽强的斗志和灵活性，始终坚持以铸件生产为主营业务。1964年引进的“实型铸造”工艺给木村铸造所带来了一次巨大的变革，“木村实型铸造”已被业界公认。

经过50多年的实型铸造工艺的专业生产，公司已经具备成为许多新领域的合格供应商的能力。同时，公司还开发了基于信息技术(IT)的制造技术，如CAD/CAM建模、各种测量系统和以实型铸造为主要生产方式的铸件仿真技术。因此，我们成功地建立了将实型铸造与信息技术相结合的铸造新工艺。我们正在不断向前发展，将我们的技术应用于3D打印、逆向工程等。

我们刚刚在美国印第安纳州谢尔比维尔新建了木村美国铸造厂，主要提供研发服务。美国工厂将专业提供高品质铸件的快速原型及小批量订单的生产，只需5天就能生产出无缺陷的快速原型铸件。



在精密设计、先进的浇注、清理、检验、机械加工和快速原型制造方面，木村铸造所与汽车及其一级供应商、大型和小型发动机制造、机床、工业泵、油、气和可再生能源等行业的客户建立了长期的合作关系。

专注于一项技术并发展为一项新技术，而新技术创造了新世界。我们的技术具有无限的潜力，将开发并扩展到各个领域。我们希望成为世界领先的铸造厂，希望我们的创新技术能为客户提供支持并为全世界做出贡献。 ■



## In Poland, the world's largest swinging bell "Vox Patris" was cast for a special order of the Basilica of the Eternal Father in Trindade, Brazil. This year, it's unique voice will welcome not only pilgrims from South America, but also from around the world.

### 为巴西特林达德天父大教堂定制的世界最大的摆钟 "Vox Patris" 在波兰铸造成功。 今年，它独特的声音将不仅欢迎来自南美的朝圣者， 也欢迎来自世界各地的朝圣者。

"Vox Patris" was created by Jan Felczyński Church Bell Manufactory from Przemyśl, Rduch Bells & Clocks from Czernica and Metalodlew from Krakow. Over 100 people worked to make this incredible project come true. The journalists were the first to see the outcome in Krakow.

The bell made of bronze (78% copper and 22% tin) weighs 55-tones, is over 4 meters high and has a diameter of 4,5 meters. To make it swing, four linear motors are needed, also the largest ones in the world made so far.

„The weight of „Vox Patris” is equal to 10 African elephants and its height is as big as a giraffe itself. We used 9000 bricks to build its core. With the same amount of bricks we would be able to build at least three detached houses. The mould was made of clay mixed with horse dung. At the time of pouring, the metal floated to it at a speed of 150 kg per second. At the climax it reached 1070 °C,“ recalled Piotr Olszewski, owner of Jan Felczyński Church Bells Manufactory.

The moment of pouring the alloy into the mould was one of the most important stage in the whole process of creating the bell. „It lasted about 12 minutes and was emotionally intense for us. It was crucial that the mould withstands the pressure and weight of the liquid bronze. After a short while, it was clear that the metal did not escape from the mould and that fact was the crowning achievement of our hard work,“ said Waldemar Olszewski, the master of bell making.

In the 200-year history of Jan Felczyński Church Bells Manufactory in Przemyśl dozens of bells have been made, and among them very large ones, like "Blessed Wladyslaw" of 10 tones for a church in Ursynów district in Warsaw. However, the biggest challenge for the bell makers from Przemyśl, Silesian specialists and casters from Lesser Poland was creating the "Vox Patris". Initial talks on the project started in 2013 and were supported by scientific and technical consultations conducted by researchers of Silesian University of Technology in Gliwice and of Metalodlew from Krakow. The first attempt to cast the bell in November 2016 failed due to a mini-crack in the mould, during the second one in the summer of 2017 there were no more surprises. „The failure brought us many precious and useful information and after deep analysis we used different materials to seal and protect the mould,“ said a scientist from Gliwice, dr hab. inż. Dariusz Bartocha.

Never before had such a large bell been casted, therefore

"Vox Patris" 大钟是由普热梅希尔市的Jan Felczyński教堂钟制造厂、切尔尼察市的Rduch钟表厂和克拉科夫市的Metalodlew公司共同创作的。经过100多人的努力，这个令人难以置信的项目获得成功。记者们第一时间在克拉科夫见证了这件作品。

青铜大钟(78%铜, 22%锡)重55吨、高4米多、直径4.5米,也是迄今为止世界上最大的钟。要使它摆动,需要4台直流电机。

"Vox Patris大钟的重量相当于10头非洲象,它的高度和长颈鹿相当。我们用9000块砖建造大钟的铸芯。同样数量的砖块,我们至少可以建造3座独立的房子。大钟的铸型是用粘土和马粪混合而成。在浇注时,金属液以150Kg/秒的速度进入铸型。浇注温度达到了1070°C。" Jan Felczyński教堂钟制造厂的老板 Piotr Olszewski说。

将合金浇注到铸型中的时刻是整个大钟制作过程中最重要的阶段之一。"浇注过程持续了大约12分钟,对我们来说很紧张。铸型必须经受住液态青铜的压力和重量。片刻之后,确定金属液没有从铸型中渗漏,这是我们努力工作的最高成就,"制钟大师Waldemar Olszewski说。

在普热梅希尔市的Jan Felczyński教堂钟制造厂200年的历史中,共制造了几十座钟,其中包括非常大的钟,比如华沙乌尔西翁区一座教堂的10吨重的"祝福瓦莱德洛"钟。然而,对于来自普热梅希尔、西里西亚的专家和来自波兰雷瑟的铸造企业来说,最大的挑战是制造"Vox Patris"大钟。关于该项目的初步讨论始于2013年,并得到了格利维茨西里西亚技术大学和克拉科夫金属研究所技术人员在科研方面的支持。2016年11月的第一次试验因铸型上的小裂缝而失败,在2017年夏天的第二次试验中没有出现意外。"第一次的失败给我们带来了许多宝贵和有用的信息,经过深入的分析,我们使用了不同的材料来密封和保护铸型,"格利维茨大学的一位科学家Dariusz Bartocha说。

以前从未铸过如此大的钟,所以要执行非常严格的作业

very strict rules were introduced during the work.

„The metal could not have a temperature lower than 1000 °C and higher than 1200 °C. We melted four portions, which were then poured together into a 60-ton vat. We have done tests before, every 10 minutes checking how quickly it cools down. It turned out that we have 3 hours to melt the metal needed to fill the mould. Doing it in such a short time was a real challenge,“ said the project manager and president of the board of Art-Kolor in Metalodlew group, Jacek Winiarczyk.

The ornamentation of the bell illustrates the history and present day of the Sanctuary in Trindade and shows characteristic motifs of Brazilian flora and fauna. The adornments were made using the lost wax method. The amount of wax used equals an average amount of two years of normal production in the bell foundry in Przemysł. In order to cast the bell, a foundry pit reaching below the foundations of the factory hall was made.

„The 2-tone clapper for the bell was also designed. After being forged, with mounting, it will be 6 meters long. Its yoke will weigh 10 tons,“ Grzegorz Klyszcz - the owner of the Rduch Bells & Clocks talks about the unusual sound of „Vox Patris“. „It is already known that it is going to have a very low sound, heard within a few kilometers from the Sanctuary. The

assumed key note is Fis 00 with the frequency of 92 Hz. The lower octave exceeds 40 Hz. So before we hear the sound of the bell, we will feel it with our whole body. And the shivers passing on the back will be the first sensation of the sound.“

“Vox Patris” will be hung on the over 100-meter bell tower. The scientists have to calculate all the forces generated by the bell during its work to evaluate an impact on the construction.

It will sail to Brazil, and will be transported to the harbour on a special car platform. Polish bell makers together with Silesian specialists will create also 68 smaller bells for the Basilica of the Eternal Father in Trindade. The Sanctuary, located in central-western Brazil, is one of the largest centers of religious worship in this country.

So far the largest swinging bell in Europe, Saint Peter's bell (Dicker Pitter - 24 tones), hangs in the belfry in Cologne Cathedral. Polish Sigismund Bell weighs 9,6 tones. Until now, the largest swinging bell in the world, weighing over 36 tones and cast in the Netherlands, is located in the Japanese health resort of Gotenba, on the slope of Mount Fuji. ■

指导。

“金属的浇注温度不能低于1000°C，也不能高于1200°C。我们熔化了4炉，然后把金属液一起倒进一个60吨的浇包里。我们曾做过测试，每10分钟检查一次降温的速度。结果显示，我们有3个小时的时间来熔化并充满铸型。在如此短的时间内做到这一点是真正的挑战，” Metalodlew集团艺术委员会主席兼项目经理Jacek Winiarczyk说。

钟的外饰展示了特林达德的历史和现状，并包含了巴西动植物的特色图案。这些装饰品是用失蜡法制作的。蜡的用量相当于普热梅希尔市钟制造厂平均两年的正常用量。为了铸造大钟，在车间的地面开挖了铸造地坑。



“2吨重的大钟铃锤也设计完成，锻造后安装，长度有6米，重量10吨。” Rduch钟表厂的老闆Grzegorz klyszcz在谈及“Vox Patris”大钟的声音时说：“大家已经知道，它的声音非常低沉，在教堂几公里以外能听到。假设键音为Fis 00，频率为92Hz。低八音超过40 Hz。所以在我们听到钟声之前，我们会用整个身体来感

受它。后背的颤抖将是对声音的第一感觉。”

“Vox Patris”大钟将被悬挂在超过100米高的钟楼上。科学家们必须计算钟在鸣奏时产生的所有力，以评估对建筑物的影响。

大钟将通过特殊的汽车平台运输到港口，海运到巴西。波兰的大钟制造者和西里西亚专家还将为特林达德的天父大教堂制造68个较小的钟。该教堂位于巴西中西部，是巴西最大的宗教活动中心之一。

迄今为止，欧洲最大的摆钟是圣彼得钟(Dicker Pieter-24吨)，悬挂在科隆大教堂的钟楼上。世界上最大的摆钟重量超过36吨，在荷兰铸造，位于日本富士山山坡上的疗养胜地御殿场。 ■

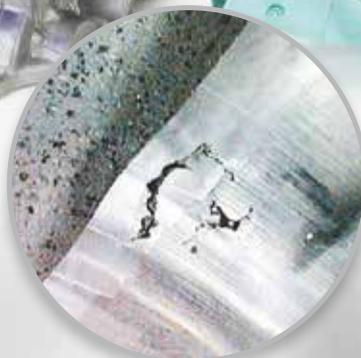
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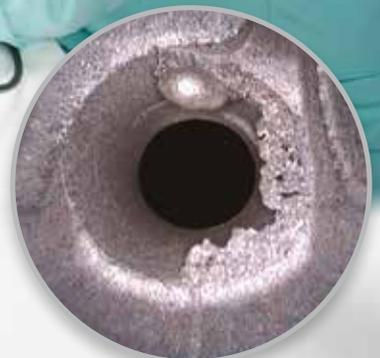
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# „Vox Patris bell” “Vox Patris” 大钟

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In 2017 in Cracow foundry Metalodlew SA the biggest in the world swinging bell was cast. The bell made of CuSn20 bronze, is over 4 meters high, has a diameter of 4,5 meters and weighs 55-tons. It was made on the commission of the builder of the Sanctuary of God the Eternal Father (Divino Pai Eterno) in Trindade, one of the largest centers of religious worship in Brazil. The main contractor was Jan Felczyński Church Bells Manufactory from Przemysł, who dealt with this undertaking in cooperation with Rduch Bells & Clocks from Czernica and mentioned above Metalodlew SA. Comprehensive scientific and technical support was provided by the Department of Foundry Engineering Silesian University of Technology.

The casting mold and the bell casting itself were made using traditional techniques and traditional mold materials. Therefore, almost every element that makes up the broadly understood technology of casting a bell of such size, both in terms of materials and technical solutions, required an individual and innovative approach based on scientific research and the experience of the bell-founders from Jan Felczyński Church Bells Manufactory.

Each one of the basic stages of making the mold and the bell casting was preceded by the development of a concept and design based on research, analysis, calculations and computer simulations. For the fundamental stages may be included the following:

1. Development of the designed bell geometry in the based on the scaling to the required dimensions (mass) of the profile/template. The own bell profile developed by bell-founders from Przemysł. During the scaling process the prediction of frequencies of the Vox Patris normal mode vibration was made with modal analysis.

2017年, 克拉科夫市Metalodlew SA铸造厂成功铸造了迄今为止世界上最大的摆钟。CuSn20的青铜大钟, 高4米多、直径4.5米、重55吨。它是由巴西最大的宗教礼拜中心之一, 特林达德天父大教堂(Divino Pai Eterno)的建造者委托建造的。大钟的主承包商是普热梅希尔市的Jan Felczyński教堂钟制造厂, 联合了切尔尼察市的Rduch钟表厂和Metalodlew SA铸造厂。综合的科技支持由西里西亚理工大学铸造工程系提供。

大钟的铸型和钟体铸件采用传统工艺和传统造型材料。因此, 在材料和技术方案方面, 人们广泛理解的铸造如此大尺寸的大钟的技术的几乎每一个要素, 都需要基于科学研究和Jan Felczyński教堂钟制造厂的经验进行独立的创新。

制作铸型和大钟铸件的每一个阶段都是在研究、分析、计算和计算机模拟的基础上发展出概念并设计。就基本阶段而言, 可包括以下几个阶段:

- 1.大钟几何形状设计的基础是缩放到符合轮廓/模板所需的尺寸(质量)。大钟的基本轮廓开发由钟厂创始人在普热梅希尔市完成。在缩放过程中, 利用模态分析方法对Vox Patris大钟的正常振动频率进行了预测。

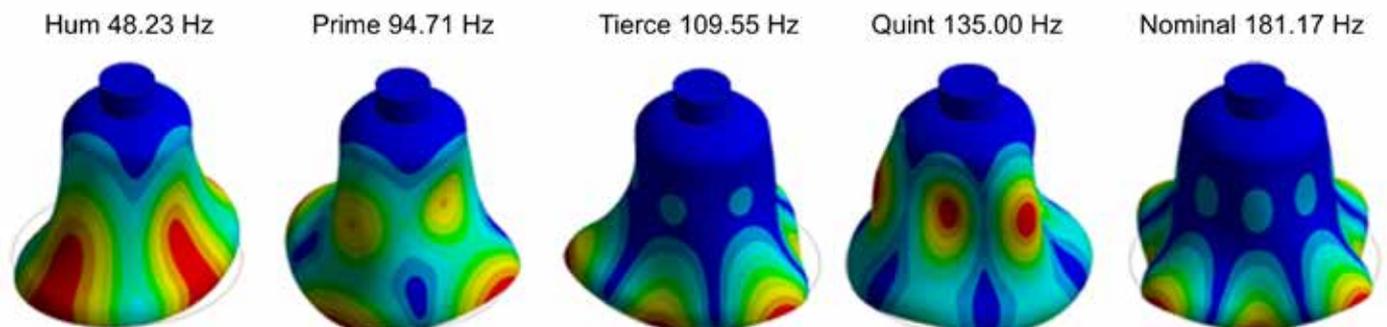


Fig. 1. Result of modal analysis, frequencies and shapes of the Vox Patris normal mode vibration

图1. Vox Patris大钟模态分析、正常震动的频率和形状结果

2. Design and execution of the strickle board construction with the mechanism of its fixing, positioning and movement (fig. 2). The geometry of the mechanism should ensure its proper stiffness, taking into account the own weight of the strickle board and the resistances resulting from the molding mass shaping process. It should also provide free approach to the mould for workers.

2. 施工框架结构的设计和制作及其固定、定位和移动如图2。该结构的几何形状应确保有适当的刚度，考虑到框架结构自身的重量、浇注成型时的阻力，还需要为作业人员留有靠近铸型的通道。

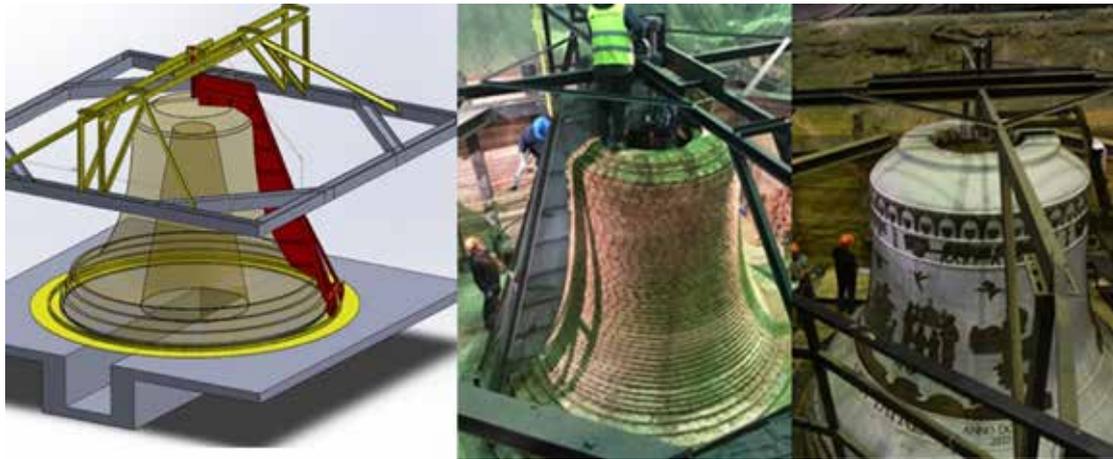


Fig. 2. Construction of strickle board mechanism; core and so-called false bell

图2. 施工的框架结构；芯子以及模拟的大钟

3. Design and execution of steel “reinforcement” of the upper part of the casting mold, so-called “coat”. The mould upper part “coat” of such large dimensions (diameter ~ 5m, height ~ 4m, thickness ~ 0.4m) made of clay molding mass, due to its low mechanical properties required a specially designed steel „reinforcement“ providing it with adequate strength and stiffness (Fig. 3).

3. 图3是为上部铸型，即所谓的“外罩”设计和制作的“钢筋”。铸型上部的“外罩”尺寸如此巨大(直径5m、高度4m、厚度0.4m)，所用材料为黏土造型材料。由于其机械性能低，需要设计一种特殊的“钢筋”，为其提供足够的强度和刚度。

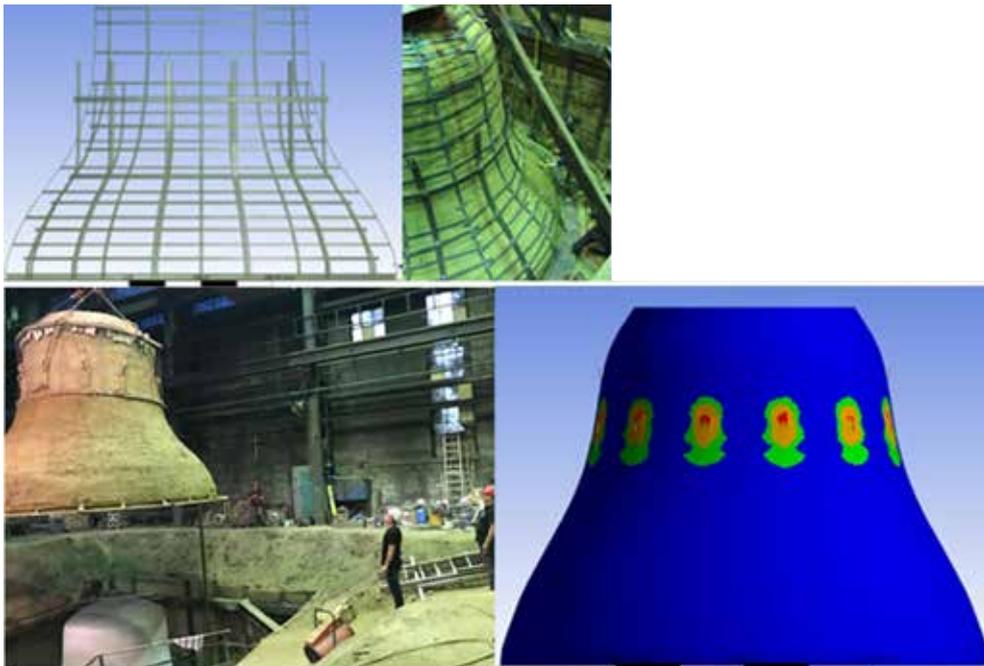


Fig. 3. The designed geometry of the coat „reinforcement“ and results of the computer simulations of stress during transfer and pouring

图3. 外罩“钢筋”的几何形状设计以及运输和浇注过程中应力的计算机模拟结果

4. Design and execution of the pouring system. Designed pouring system consisted of a reservoir (collector) placed under a double-stopper main bottom-tap ladle, an eleven-meter pouring spout, a pouring basin and a pouring-gate (Fig. 4). The main purpose of the pouring system is uniform and continuous supply of liquid metal to the mold until it is completely filled. In the case of so a non-standard both dimensionally and structurally pouring system, the basic parameters to be determined were: the diameters of the tapping holes in the main bottom-tap ladle, the slope angle of the pouring spout from the collector under the ladle to the pouring basin, the volume of the pouring basin itself and the diameter of the pouring-gate. Based on a series of computer simulations, various configurations of the pouring system parameters have been virtually tested, for the choose the optimal one.

4. 浇注系统的设计与实施。设计的浇注系统包括金属液储集器（收集器），下面有底部有双塞杆的底注式浇包，11米的浇道、浇口杯和浇口（图4）。浇注系统的主要目的是将液态金属均匀、持续地注入铸型，直至完全充满。对于这种非标准的立体且结构复杂的浇注系统，需要确定的基本参数是：底注式浇包浇口的直径、金属液储集器下浇包到浇口杯的浇道的倾斜角度，浇注盆的浇注口斜角、浇注杯的容积和浇口直径。在计算机一系列模拟的基础上，对浇注系统参数的各种配置进行虚拟测试，选出了最优的浇注系统参数。

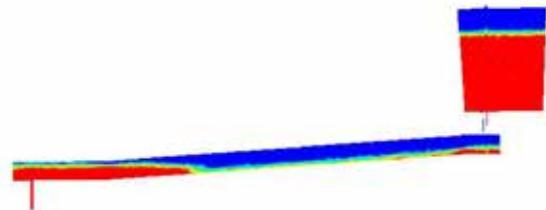
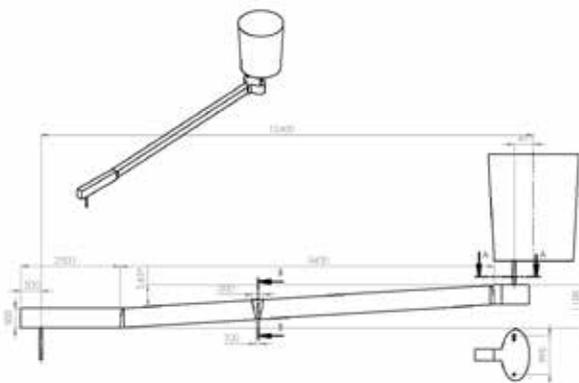


Fig. 4. The pouring system and the pouring process itself

图4. 浇注系统及浇注施工现场

5. After shaking out of the casting (excavating), cleaning and machining, the most time-consuming and artistically demanding stage was chiseling the inscriptions, ornamentations and the entire surface of the bell took place. The experience and talent of Jan Felczyński Church Bells Manufactory workers proved irreplaceable (Fig. 5). After completing the finishing work, the analysis of the frequency of the aliquots that make up the audible bell sound of Vox Patris was carried out. The results of the sound wave analysis by Fourier transformation are also presented in figure 5.

5. 铸件落砂（取出）、清理和机械加工后，最耗时和艺术性要求最高的阶段是对钟的所有表面凿刻铭文、装饰。Jan Felczyński教堂钟制造厂工人的经验和才华证明是不可替代的（图5）。在完成精整工作后，对Vox Patris大钟的钟声的频率进行了分析。图5也给出了用傅里叶变换得出的声波分析的结果。

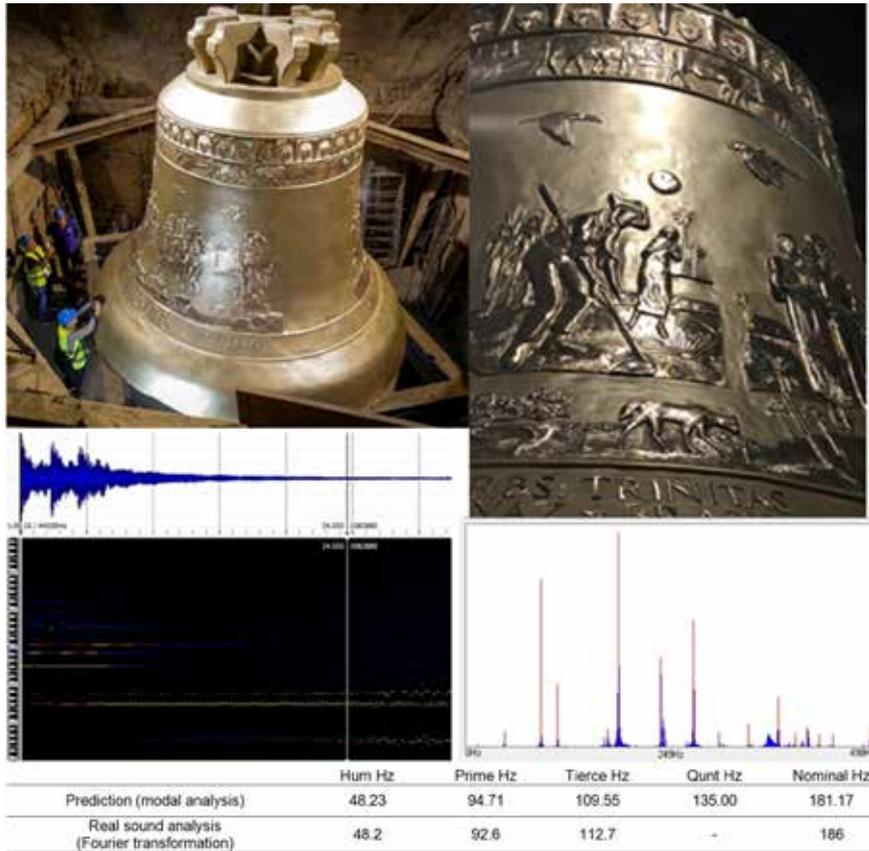


Fig. 5. The final appearance and results of Vox Patris bell sound analysis

图5. Vox Patris铃声分析的最终外观和结果

Achievement of Jan Felczyński Church Bells Manufactory from Przemysł, Department of Foundry Engineering of the Silesian University of Technology, Rduch Bells & Clocks from Czernica and Foundry Metalodlew SA from Krakow was presented inter alia at the plenary session opening the World Foundry Congress (Fig. 6). ■

大钟成功制成了，普热梅希尔市的Jan Felczyński教堂钟制造厂、西里西亚理工大学铸造工程系、切尔尼察市的Rduch钟表厂和克拉科夫市的Metalodlew SA铸造厂共同在世界铸造大会开幕式上做了技术报告。 ■



Fig. 6. Vox Patris on World Foundry Congress in Krakow

图6. 世界铸造大会上关于Vox Patris大钟的报告

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## Case study from a die- and tool-making shop High-pressure diecasting moulds: HSC milling better than EDM

### 来自模具生产车间的案例研究 压铸模具：HSC铣削比EDM更好



The HSC machining centre RXU 1001 DSH from Röders was specially designed for the efficient machining of hard steels in mould and tool making (Photo: Klaus Vollrath)

Röders的HSC加工中心RXU 1001 DSH专为高效加工模具和工具制造中使用的硬钢而设计。(图片来源: Klaus Vollrath)

Diecasting moulds are high-performance products made of hardened tool steel. Their shaping contours are produced either by sinking electrical discharge machining (EDM) or by milling. Due to the high hardness of the hot working steels they are made of, past milling technologies could only be utilized to a quite limited extent. Hence EDM erosion took up a considerable share of the total production process, especially when machining narrow and simultaneously deep contour details - such as e.g. ribs. This had considerable disadvantages in terms of productivity and surface finish, as well as in terms of extra finishing expenditures such as polishing. For such applications, modern high-speed cutting (HSC) machining centres offer clear economic advantages. A medium-sized mould maker reports on his experiences.

压铸模具是由硬质工具钢制成的高性能产品。它们的成型轮廓可以通过下沉式电火花加工 (EDM) 或铣削来实现。由于它们由热加工的钢而具有的高硬度，过去的铣削技术只能在非常有限的范围内使用。因此，EDM侵蚀占整个生产过程相当大的比例，特别是在加工狭窄且同时深轮廓细部时-例如铸筋部位。这在生产率和表面光洁度以及额外的精加工支出 (例如抛光) 方面存在很多缺点。对于此类应用，现代高速切削 (HSC) 加工中心具有明显的经济优势。一家中型模具制造商对此做了经验分享。

*“In recent years, we have changed our manufacturing processes from EDM to HSC milling wherever possible. This manufacturing technology is more accurate and speedier”*



*Jürgen Jung* (Picture: Foto Nieder)

**Jürgen Jung表示：**  
“近年来，我们尽可能地将制造工艺从EDM改为HSC铣削。这种制造技术更准确、更快捷。”

(图片来源: Foto Nieder)

“Our customers are mainly diecasting foundries that produce aluminium, magnesium or zinc die-cast parts for the automotive industry and their suppliers as well as other high-tech industries,” says Jürgen Jung, owner and managing director of the mould- and die-making shop Jürgen Jung GmbH in Gransdorf, Germany. The company also makes injection moulds. Having gained ample experience working in the mould shop of the foundry where he completed his vocational training, Mr. Jung started his own part-time business in 1991 and became fully self-employed from 1997 onwards. Notwithstanding this modest start, he now supplies diecasting foundries all over Germany as well as in Switzerland, where die-casters know and appreciate the quality “Made in Germany” he and his team produce. The customer base is about 80 % contract foundries and 20 % foundries with their own proprietary products. Collaboration with the latter yields clear advantages, as this offers the opportunity to influence the component design, often resulting in cost savings and fewer adjustments to the casting tool.

“我们的客户主要是压铸厂，为汽车行业及其供应商以及其他高科技行业生产铝、镁或锌压铸件，”德国格兰斯多夫（Gransdorf）模具公司所有人兼总经理Jürgen Jung说。该公司还生产注塑模具。Jung先生从铸造模具车间的职业培训中获得了丰富的工作经验，于1991年创办了自己的兼职业务，并从1997年起成为完全自营职业者。虽然起步普通，但他现在在德国和瑞士都设有压铸厂，在那里，压铸人员了解并欣赏他和他的团队的“德国制造”品质。客户群包括约占80%的合作工厂和20%拥有自主品牌的工厂。与后者的协作具有明显的优势，提供了参与组件设计的机会，通常可以节约成本、减少对铸造模具的调整。

Partially machined ejector-side component of a mould for diecasting aluminium, featuring a parting plane with steep offsets, shown here with the associated die-cast part. This mould insert is installed in a “three-plate tool” (Photo: Klaus Vollrath)



用于铝压铸件模具的部分机械加工喷射器侧部件，具有带有陡峭偏移的分型面，如图所示为关联的压铸件。该模具插件安装在“三板工具”中。  
(图片来源: Klaus Vollrath)

### In-depth experience benefits customers

“Since I gained my first experiences at a time when the casting tools were made based on drawings instead of 3D CAD data and the machine axes were moved manually, I have been able to follow the development of modern IT and CAM technologies very closely,” adds J. Jung. During his many years of experience in mould making, he has been able to gather a wealth of experience regarding the possibilities and limits of the diecasting process. This know-how base helps him to advise his customers with respect to the design of the casting and consequently of the casting tools. This feed-back loop has had a positive effect on the productivity of the process, the durability of the tool and the properties of the diecast part. His staff also know the special requirements diecasting tools have to meet and already pay attention to the vital details at the start of production. In his dealings with customers, J. Jung relies on the CAD software “VISI” in his own CAD/CAM department. This software offers him optimal continuity from the interfaces for entering various customer data formats right through to the postprocessors for the machine tools in his production. His workforce includes an engineer with extensive experience in foundry processes who helps customers to optimally design the infeed and evacuation gateways of diecasting tools. Casting-simulation calculation services are provided by an experienced external service provider. Further support comes from intensive cooperation with foundry research institutions such as the universities in Aalen and Aachen.

### 深入体验为客户创造利益

“自从我第一次了解到铸造模具是基于图纸设计而不是3D、CAD工具，而且机床轴是手动移动的时候，我已经开始密切关注现代IT和CAM技术的发展，”J. Jung补充说。在他多年的模具制造经验中，他能够在压铸工艺的可能性和局限性方面积累丰富的经验。这种专有技术有助于他就铸件设计和铸造模具的设计向客户提出建议。该反馈回路对工艺的生产率、工具的耐久性和压铸件的性能产生了积极影响。他的员工也知道压铸工具必须满足的特殊要求，并且在生产开始时已经注意到重要的细节。在与客户的合作中，J. Jung在他自己的CAD/CAM部门依赖CAD软件“VISI”。该软件为他提供了最佳的连续性，从用于输入各种客户数据格式的接口到生产中的机床后处理器。他的员工包括一位在铸造工艺方面具有丰富经验的工程师，帮助客户优化设计压铸工具的进料和排气通道。铸件模拟计算服务由经验丰富的外部服务商提供。进一步的支持来自与奥伦和亚琛的大学等铸造研究机构的密切合作。

**Precision and flexibility speed up emergency repairs**

“We attach great importance to high accuracy in our moulds, as this positively influences the performance properties of the casting tools and the quality of the castings,” adds Jan Petri, toolmaker and right-hand man of J. Jung. He emphasizes that the company mainly focuses on the hard, contour-forming components of the mould, while less critical operations,

*“The precision of the new Rödgers HSC milling machine is impressive and makes our task much easier”*

*Jan Petri (Photo: Julia Fritzen)*



**精确性和灵活性加速紧急维修**

“我们非常重视模具的高精度，因为这会对模具的性能和铸件的质量产生积极的影响，” J. Jung的模具制造商和得力助手Jan Petri补充到。他强调，公司主要专注于模具的坚硬轮廓成型部件，而不太关键的操作，如模架的生产，往往会转包给供应商。公司服务的另一个优势是，在客户的铸造模具发生故障或紧急维修时，灵活性高、反应

**Jan Petri说：  
“新的Rödgers HSC铣床的精度令人印象深刻，让我们的工作任务变得更加轻松。”**

(图片来源: Julia Fritzen)

such as the production of mould frames, is often passed on to suppliers. Another strong point of the company’s services are high flexibility and short reaction times in the event of breakdowns or urgent repairs of customer casting tools. This applies to tool breakage (partial breakouts of the contour surface) as well as e.g. when welding and reworking worn contour areas is required. Such jobs perfectly match the strong points of the small, owner-operated enterprise. The boss knows his resources and production planning like the back of his hand and can allocate or reorganize machine capacities and personnel on the spot. Such “hot assignments” are also accepted for foreign-made moulds whose original manufacturers might have problems reorganizing their capacities with equal flexibility. In addition, according to Mr. Petri, their plants are not interlinked, thus facilitating the breakup and rearrangement of process chains without major problems.

A good example of this flexibility was the recent commission of a follow-up order for a tool that had been built years ago, at a time when the jobs had been performed mainly by sinking EDM processing. Taking into account the capabilities of the modernized equipment, it was decided to switch the production of the new tool largely from EDM to HSC milling. Instead of using eight electrodes on the ejector side as before, only one was needed this time, and only one of the formerly two electrodes was retained on the nozzle side. “Although the cost of this in-depth overhaul of the manufacturing process was considerable, the total cost calculation yielded a positive result,” says Jürgen Jung.

时间短。这适用于模具破损（轮廓表面的局部破裂），以及当需要焊接和再加工磨损的轮廓区域时。这些工作完全符合小型经营企业的优势。企业老板非常了解公司资源和生产计划，可以在现场分配或重新安排设备产能和人员。这种“热门作业”也被外国制造的模具所接受，这些模具的原始制造商可能在以相同的灵活性重组生产能力方面存在问题。此外，据Petri先生介绍，他们的工厂没有相互关联，从而促进了生产链的分解和重组，而没有出现重大问题。

这种灵活性的一个很好的例子是，公司最近接到了多年前生产的一种模具的新订单，当时主要是通过下沉电火花加工EDM处理完成的。考虑到高科技的现代化设备，决定将新模具的生产主要从EDM切换到HSC铣削。不像以前那样在喷射器侧使用八个电极，这次只需要一个，并且在喷嘴侧仅保留了前两个电极中的一个。“虽然对生产工艺进行深入改革的成本相当可观，但总成本上产生了积极的结果，” Jürgen Jung说。



A look into the interior shows the sturdy Quadroguide Z-axis, which is equipped with four guide rails (Photo: Klaus Vollrath)

内部结构展示了配备有4个导轨的坚固的Quadroguide Z轴。  
(图片来源: Klaus Vollrath)

### HSC milling faster than EDM

“Over the last few years, we have thus gradually switched our preferences from sinking EDM to HSC milling,” explains J. Jung. Eroding is a process which results in harmful tensile stresses and a “white layer” on the contour surface, which can cause premature wear of the die if it is not removed to sufficient depth by polishing. This removal alone requires considerable time and expense. Also, the accuracy achievable in eroding does not always satisfy him. Therefore, four years ago, he invested in his first five-axis milling centre from Matek with a swivel head and rotary table. This was his entry ticket to the 5-sided milling of moulds. The cost advantages quickly showed up and also benefitted the customers. Consequently, the milling rate increased significantly, while EDM decreased. Meanwhile, HSC milling use has largely overtaken sinking EDM since it is faster and more accurate. Only three years after this first acquisition, Jung already had to consider investing in a second system, which, however, would have to meet higher standards of accuracy and driving dynamics than the first one.

### HSC铣削速度比EDM快

“在过去的几年里，我们逐渐将我们的偏好从下沉式的EDM转向HSC铣削，” J. Jung解释到。侵蚀是一种在轮廓表面上产生有害拉伸应力和“白色层”的过程，如果不通过抛光将其清除到足够的深度，则会导致模具过早磨损。仅这种清除就需要相当多的时间和费用。而且，在侵蚀中可实现的精度并不总能让Jung满意。因此，四年前，他从Matek公司购买了第一个五轴铣削中心，带有旋转头和旋转台。这是他进入五面铣削模具领域的“入场券”。其成本优势迅速显现，也使客户受益。因此，研磨速率显著提高，而使用EDM减少。同时，HSC铣削已经在很大程度上超过了EDM，因为它更快、更准确。在第一次购买后仅仅三年，Jung已经不得不考虑投资第二个系统，然而，第二个系统必须达到比第一个系统更高的准确性和驱动动力标准。



The job of machining these four graphite electrodes on the rotary tilting table equipped with zero-point clamping systems on a rotating revolver takes a total of 200 hours (Photo: Klaus Vollrath)

在旋转器上配备零点夹紧系统的旋转倾斜台上加工这4个石墨电极总共需要200个小时。(图片来源: Klaus Vollrath)

### Röders recommended by fellow businesses

“An important contribution to the decision for the new production system was the experience of industry colleagues,” says J. Petri. Of course, due diligence had been performed, involving a lot of research, studying leaflets and comparing data. In addition to the resulting findings, much trust was put into the long-term experience of fellow mould makers. It turned out that Röders machines excel with their long-term accuracy and outstanding reliability. Additionally, Röders received good marks for its fast and competent service. In view of the importance of the investment, a colleague who already had two Röders plants in operation was also visited. His recommendation in favour of Röders ultimately tilted the balance in favour of this manufacturer. Another important point was the possibility to use the system both for HSC machining of the hardened contour parts of the moulds and for milling graphite electrodes, since despite the declining use of the technology, it still remains indispensable in certain areas such as deep, narrow ribs. And before the acquisition of the new machining plant, around 90% of the electrodes had to be bought from outside. Since the introduction of the new Röders milling centre, almost all electrodes are manufactured in-house. Another factor for the acquisition was the expertise of the Röders sales representative, who proved very helpful in identifying the exact model and layout of the machine that would best fit the requirements of the company. In September / October 2016, the plant – a five-axis HSC milling machining centre RXU 1001 – went into operation.

### Röders受到同行推荐

J. Petri说：“对采用新生产系统的一个重要决定性因素是来自于同行的经验”。当然，对此已经进行了尽职调查，涉及大量研究、问卷调查和数据比较。除了最终的发现外，对模具制造商的长期经验给予了很多信任。事实证明，Röders机器具有出色的精度和可靠性。此外，Röders因其快速而有竞争力的服务而获得了好评。鉴于投资的重要性，公司还访问了一位已经有两台Röders设备的同行，同行对Röders设备的推荐最终使公司做出了决定。另一个重点是可以将该系统用于模具硬化轮廓部分的HSC加工和铣削石墨电极，因为尽管该技术的使用在减少，但在某些领域，例如深、窄的铸筋部位，它仍然是必不可少的。在购买新的设备之前，大约90%的电极必须从外部购买。自推出新的Röders铣削中心以来，几乎所有电极都是工厂内部制造的。此次采购的另一个因素是Röders销售代表的专业介绍，证明了Röders设备非常有助于确定最符合公司要求的型号和布局。2016年9月/10月，该设备-五轴HSC铣削加工中心RXU 1001-投入运营。



Essential peripheral units: The powerful dust extraction system for graphite dust (left) and the temperature control system for the thermal stabilization of the entire machine (Photo: Klaus Vollrath)

基本外围装置：用于石墨粉尘的强大除尘系统（左）和用于整机热稳定的温度控制系统。（图片来源：Klaus Vollrath）



Mould insert with roughed parting plane and contour as well as already smoothed sprue system and overflows. Due to the very good surface quality, these do not require further polishing (Photo: Klaus Vollrath)

模具嵌件具有粗糙的分型面和轮廓以及平滑的浇道和溢流系统。由于表面质量非常好，它们不需要进一步抛光。（图片来源：Klaus Vollrath）

### Learning by doing

“We were able to put this system to use from the very first day of commissioning on,” recalls J. Jung. Practically from the beginning of the training, real-use milled parts could be produced. A big advantage was that the CAM system J. Jung relies on is also used by Röders. Thus, staff on both sides share a common knowledge level and both know where buttons and screen icons are located. This greatly facilitates the exchange of information on a one-to-one basis using communication software such as Teamviewer when discussing optimal milling strategies. The Windows-based Röders control was easy to use, e.g. by sorting feedback from the process by relevance. The very clearly organized manual, which can be accessed directly on the operating panel, as well as the clear-text documentation of commands, proved to be very helpful. For example, one may simply key in “oil on” instead of having to memorize M-command reference numbers. CNC programs could easily be altered by the operator, for example to insert an additional bore or to repeat operations at different coordinates. With respect to the quality of the Röders service, the staff at J. Jung can only say that its reputation is good, because they have not had the opportunity to really challenge it in the year and a half since the plant was commissioned.

### Convincing precision

“The precision of the new HSC milling machine is impressive and makes our task much easier,” reveals J. Petri. Both hot-work tool steels with hardness levels of 44-47 HRC and graphite electrodes are processed. Efficient removal of the graphite dust is ensured by a powerful vacuum cleaning system. A positive experience with the new machine was the superior service lifetime of the machining tools, probably attributable to its low vibration level. Parts machined on the Röders machine also exhibit an excellent surface quality. Cutters with very small diameters

### 在实践中学习

J. Jung回忆说：“我们能够在调试的第一天就开始使用这个系统。”实际上，从培训开始，就可以生产出实际使用的铣削零件。一个很大的优势是Röders也使用了J. Jung信赖的CAM系统。因此，双方的工作人员拥有一致的认知，并且都了解设备的操作。在讨论最佳铣削策略时，这极大地促进了使用Teamviewer等通信软件进行一对一的信息交换。基于Windows的Röders控件易于使用，例如通过相关性对工艺的反馈进行分类排序。非常清晰的组织手册可直接在操作面板上访问，以及操作命令的文件记录，这些证明都是非常有用的。例如，工人可以简单地输入“oil on”而不必记住M-command等命令符号。操作员可以轻松更改CNC程序，例如插入额外的孔或不同坐标处重复操作。关于Röders服务的质量，J. Jung的工作人员只能说它的声誉很好，因为在设备投入使用后的一年半内，他们还没有机会去真正挑战它。

### 令人信服精确度

“新HSC铣床的精度令人印象深刻，使我们的工作变得更加容易，”J. Petri透露。可以加工硬度为44-47 HRC的热工具钢和石墨电极。强大的真空清洁系统确保了高效去除石墨粉尘。对新机器体验的积极方面是加工工具的卓越使用寿命，可能归因于其低振动水平。在Röders机器上加工的零件也表现出优异的表面质量。其直径非常小，仅0.3 mm的刀具可用于加工仅0.2 mm的角半径。加工零件的高精度也使简化作业策略成为可能。过去，滑块必须加工为超大尺寸，然后必须逐渐清除材料直到适合的

down to just 0.3 mm can be used to machine very small corner radii of only 0.2 mm. The high precision of machined parts also made it possible to simplify job strategies. In the past, slides had to be machined with a certain oversize and then material had to be gradually removed until they fitted. Today, most of the time they can be taken off the machine and just pushed into place.

Likewise, the time required for spotting the moulds could be significantly reduced in most cases. Since the introduction of the new Rödgers plant, the quality of the moulds has become so good that they are accepted with just one spotting run on average. Furthermore, post-processing is mostly centred on amending the runner and gating system rather than on the contours shaping the casting. Such results make the job easier and more rewarding.

The machine table is fitted with a zero-point clamping system that interfaces with matching counterparts installed directly on the underside of the workpieces. This brings about decisive advantages in terms of set-up time. In combination with the equally equipped coordinate measuring machine, workpieces and clamping devices can be precisely aligned even before they are fitted onto the machining centre, so that the time required for set-up can be reduced to a minimum.

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尺寸。现在，大多数情况下，它们都可以从机器上取下并就位。

同样，在大多数情况下，可以显著减少定位模具所需的时间。自从引进新的Rödgers设备以来，模具的质量已经变得非常好，平均只需一次定位。此外，后处理主要集中在修改流道和浇注系统中，而不是塑造铸件的轮廓。这样的结果使工作更容易，更有价值。

机床工作台配有零点夹紧系统，可与直接安装在工件底部的匹配对应装置连接。这在安装时间方面带来了决定性的优势。与配备齐全的坐标测量机相结合，工件和夹紧装置即使在安装到加工中心之前也可以精确对准，从而可以将安装所需的时间最大限度的减少。

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## The Rödgers RXU 1001 DSH Rödgers RXU 1001 DSH

The Rödgers RXU 1001 DSH machining centre was specially developed to meet the high demands of mould making. An important feature is the quad-guideway design of the Z-axis with four instead of the usual two guide rails at the four corners of the particularly stiff Z-axis. This enables high roughing rates coupled with high dynamics and precision, and the machines can be equipped with spindles with a maximum of 100 Nm. All axes feature high-performance and frictionless linear direct drives or torque drives. The C-axis is supported on both sides to ensure high stability and machining accuracy, with a counter bearing that can support loads of up to 7 t. All axes have high-resolution optical encoders. The pivoting direction of the C-axis, which is arranged transversely to the X-axis, ensures a dynamic decoupling of the directions of movement. The special 5-axis geometry compensation of the Rödgers control guarantees the highest accuracy for any job as well as for simultaneous machining. The 32 kHz control circuit of the axes allows the Rödgers Racecut to achieve a particularly high level of dynamics with very good surface qualities during machining. All major machine components feature internal flow channels for a tempering medium with a temperature stabilized within  $\pm 0.1$  K. The dimensions of the working space are 800 mm x 855 mm x 500 mm, and the maximum workpiece weight is 800 kg. The swivel range of the table with a diameter of 600 mm is  $\pm 115^\circ$ . Interfaces for different pallet systems can be integrated in the table. The system can be equipped with different spindles and table geometries. ■

Rödgers RXU 1001 DSH加工中心专为满足模具制造的高要求而开发。一个重要的特征是Z轴的四导轨设计，在特别坚硬的Z轴的四个角上有四个而不是通常的两个导轨。这样可以实现高粗加工率、高动态性和高精度，并且机床可以配备最大100Nm的主轴。所有轴均采用高性能无摩擦线性直接驱动或扭矩驱动。

两侧均支持C轴，以确保高稳定性和加工精度，配有可承受高达7吨负载的支座。所有轴都配有高分辨率光学编码器。

横向于X轴布置的C轴的旋转方向确保了运动方向的动态分离。Rödgers控制器的特殊5轴几何补偿保证了任何作业和同步加工的最高精度。轴的32 kHz控制电路使Rödgers Racecut在加工过程中具有非常好的表面质量，可实现特别高的动态水平。

所有主要机器部件均配有内部流动通道，用于温度稳定在 $\pm 0.1$  K范围内的回火介质。工作空间尺寸为800 mm x 855 mm x 500 mm，最大工件重量为800 kg。桌子的旋转范围直径为600 mm，为 $\pm 115^\circ$ 。不同托盘系统的接口可以集成在表中。

该系统可配备不同的主轴和几何形状的工作台。 ■

## An innovative partner with comprehensive know-how

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FAVI is a French company that designs and manufactures industrial solutions revolving around die-casting.

The company, which employs more than 300 people today, develops and manufactures technical parts and complete sub-sets for many different sectors such as the automobile industry, aeronautics, industry, health, agriculture, electricity...

FAVI offers its customers high productivity brought by the pressure die casting process itself but also by fully automated machining and assembly operations.

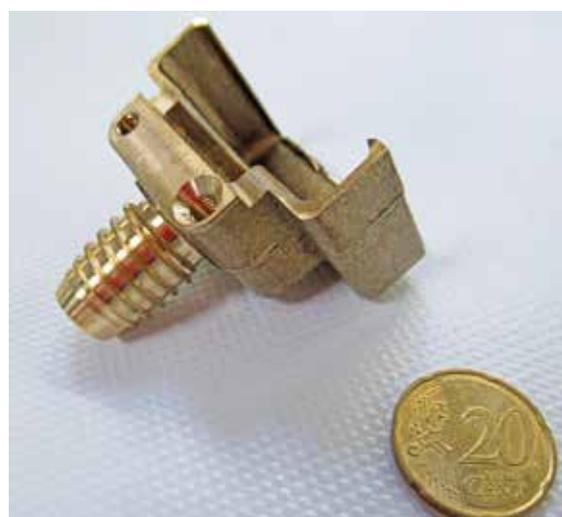
In the automotive area, FAVI is a Tier 1 equipment supplier, recognized at a European level by manufacturers such as PSA, Renault-Nissan, Volkswagen, Audi and Fiat.

FAVI是一家法国公司，提供压铸领域相关的工业解决方案。

该公司目前拥有300多名员工，为汽车、航空航天、工业、医疗、农业、电力等很多行业研发和制造零部件和全系列产品.....

FAVI为客户提供压铸工艺本身以及全自动加工和装配操作带来的高生产率。

FAVI是汽车行业的一级设备供应商，被PSA、雷诺-日产、大众、奥迪和菲亚特等制造商认定为已达到欧洲水平。





In collaboration with AFICA, a leading company in the refining industry, FAVI relies on more than 60 years of expertise in the development, use and industrialization of a wide range of copper and aluminum alloys, meeting most of the industrial requirements: alloys with high mechanical or corrosion resistance, UBA compliant brass, hard wearing aluminum alloy, etc...

The company has already developed custom-made alloys for specific requirements. For instance, FAVI proposes an antimicrobial brass that kills bacteria on the contact areas for the health sector.

Granting high priority to quality, FAVI is naturally certified ISO 9001 and IATF 16 949.

With key values such as innovation, agility and responsiveness, FAVI invests every year in Research & Development, in the industrial tool and in its collaborators to ensure that its customers receive the best quality products in response to their needs.

FAVI's objective? To offer its customers tailored and innovative solutions, particularly in terms of process, aiming for operational excellence and performance. ■

FAVI公司与AFICA（炼油行业的领先公司）合作，依靠60多年的研发经验和专业知识，使用各种铜和铝合金并使其产业化，满足大多数的工业要求：高机械性能或耐腐蚀合金、符合UBA标准的黄铜、耐磨铝合金等.....

该公司已经开发出满足特定要求的定制合金。例如，FAVI研发了一种抗菌黄铜，可以杀死接触区域的细菌。

FAVI高度重视质量，已通过了ISO 9001和IATF 16 949认证。

凭借创新、灵活性和响应能力等关键价值，FAVI公司每年都在研发、工业设备和合作伙伴等方面进行投资，以确保其客户能够获得满足需求的最优质的产品。

FAVI公司的目标是什么？即为客户提供量身定制的创新解决方案，尤其是在工艺方面，目标是实现卓越的运营和绩效。 ■



## CSIC-Jari Intelligent Casting Automation Production Line Shows on GIFA

### 中船重工-杰瑞智能浇铸自动化生产线出征德国杜塞尔多夫国际冶金铸造展

On June 25, 2019, CSIC-Jari Automation Co., Ltd. will participate in the five-day 2019 Düsseldorf International Metallurgical Foundry Exhibition in Düsseldorf (Jari Booth No.: 17A60-05). At the exhibition, the company will show the world's foundry users the latest piston full-process intelligent casting products.

Jari intelligent casting products include full-process automated production lines for casting and die-casting and intelligent casting production control platforms, which are widely used in the manufacture of automotive parts such as piston and wheels, and other metal forming processes. Among them, the latest piston full-process intelligent casting product features the capability of integrated solution. Jari intelligent casting products have been successfully applied to Dongfeng Motor, Bohai Piston and Dongfeng Honda, and have won wide approval from customers.

Jari Automation Co., Ltd. was established by the industrial robot intelligent equipment, energy equipment and other major military-civilian integration industries of the CSIC 716

Research Institute (Jiangsu Automation Research Institute). It is a national high-tech enterprise, AAA-level credit enterprise, and is selected as one of the Jiangsu provincial key enterprise R&D institutions. The company has passed ISO9001 quality management system certification, GB/T24001-GB/T28001 environmental and occupational health and safety management system certification, and has built automation production and assembly test lines and precision machining workshop with imported machining centers as its main equipment. The company has tackled down a series of key core industry leading technologies and obtained more than 70 independent intellectual property rights such as invention patents and software copyrights.

By adhering to the CSIC business philosophy of "striving for perfect, strengthening the core", and upholding the customer philosophy of "enhancing customer satisfaction and exceeding customer expectations", Jari continuously improves product design and manufacturing level and is dedicated to provide customers with the highest quality products and service. ■

2019年6月25日，中船重工-连云港杰瑞自动化有限公司将参加在杜塞尔多夫举办的为期五天的2019年德国杜塞尔多夫国际冶金铸造展（杰瑞自动化展位号：17A60-05）。展会上，公司将向世界铸造用户展示最近推出的活塞全流程智能浇铸产品。

杰瑞自动化智能铸造产品包括浇铸和压铸的全流程自动化生产线及智能铸造生产管控平台，广泛应用于活塞、轮毂等汽车部件制造和其他金属成形加工领域，其中最新推出的活塞全流程智能浇铸产品，具备一体化的解决能力。杰瑞自动化智能铸造产品已成功应用于东风汽车、渤海活塞、东风本田，得到客户的广泛好评。



连云港杰瑞自动化有限公司由中船重工第七一六研究所（江苏自动化研究所）工业机器人智能装备、能源装备等主要军民融合产业组建成立，是国家高新技术企业、AAA级资信企

业，入选江苏省重点企业研发机构。公司通过ISO9001质量管理体系认证、GB/T24001-GB/T28001环境与职业健康安全管理体系认证，建有自动化产品生产与总装测试线和以进口加工中心、慢走丝等为主要设备的精密机加车间。公司突破一系列具有行业领先水平的关键核心技术，取得发明专利、软件著作权等众多自主知识产权70余项。

公司秉承中船重工“打造精品、做强主业”的经营理念，以“增强顾客满意、超越顾客期望”的客户理念，不断提高产品设计、制造水平、竭诚为广大用户提供最优质的产品和服务。 ■

## Modern sand preparation plant for Friedrich Lohmann

### 现代的砂处理装置，用户弗里德里希·洛曼

# KÜTTNER

Use of the industrial Information Management System „iIM“ in sand processing. -

Implementation of Life Cycle App during commissioning.

The stainless steel foundry Lohmann in Witten ordered a new sand preparation plant from Küttner for the energy-efficient and resource-saving production of steel castings. In addition to two automatic molding machines, this central sand preparation plant also serves a single molding machine as well as a hand molding area. The molding material is produced for each consumer according to a separate and automatically selectable recipe which is optimally adapted to the quality requirements of each individual consumer.

Küttner used a Savelli SGMT 1500 mixer as the core component of the sand preparation plant with the AQUATEST moisture measurement system and the SANDCONTROL automatic compactability and compression strength tester.

The concept of the greensand control represents a combination of online control with the plausibility tests and predictive control.

The aim of mixer and molding material control is to achieve as constant as possible molding composition and quality. To achieve a stable compactability, the water is added in two steps: primary water, calculated from the difference between the nominal water requirement and used sand, and correction water, calculated from the difference between the target and actual compactability based on an online test. At the end of the mixing cycle, a second molding material test is carried out as a proof of quality and optimization of the correction factors. The bentonite is added intelligently based on the previous batches. By evaluating the online compressive strength measurement with the aid of a moisture-compactability-active-tone control chart, an online correction of the molding compound takes place with respect to a predefined desired compressive strength.

In addition to the results of the online material testing, a



在砂处理工艺中采用工业信息管理系统“iIM”。在调试期间实施了生命周期App的应用程序。

位于威顿 (Witten) 的不锈钢铸造厂洛曼 (Lohmann) 从科特纳公司 (Küttner) 订购了一套新的砂处理装置，用于高效节能和资源节约的钢铸件生产。除了供应两台自动造型机外，这套中央砂处理装置还为一台单独造型机和一个手工造型区供砂。造型材料是根据每个用户的特定质量要求，自动选择最优化的配方生产的。

科特纳采用了萨维利SAVELLI SGMT 1500型混砂机作为砂处理装置的核心设备，配备了AQUATEST水分测量系统和SANDCONTROL砂控自动压实和抗压强度测试仪。

潮模砂控制的概念代表了在线控制与似真性测试和预测控制的结合。

对混砂机和造型材料控制的目的是尽可能实现稳定的造型成分和质量。为了达到稳定的压实度，分两步加水：一次加水（根据标称需水量与旧砂的差值计算得出），和二次校正加水（根据目标值与在线试验得出的实际压实度的差值计算得出）。在混砂循环结束时，进行第二次造型材料试验，以验证质量和优化校正系数。膨润土是根据以前的批次智能添加的。通过对在线抗压强度测量结果的评价，结合湿度-压实性-主动状态控制图的目标，按照预定的期望抗压强度，对造型化合物实施在线校正。



molding material balance from the production, consumption and used sand data is created and evaluated for quality control. As part of the Industry 4.0 approach, complex data base models are used:

- All consumption and production data and machine parameters recorded and maintained by a special Industrial Information Management Systems „iIM“. The iIM is used by Küttner for the first time in a sand processing;
- All results of the online material test, to maintain and update the Humidity Compensability Active Tone Control Char moisture-compactability-active-tone control chart
- landfill quantities - excess sand, oversize / lump discharge, filter dust;
- Model-related production data, such as liquid iron per flask, core sand content, casting-sand ratio, etc.

As a result of this balancing, the specific consumptions of additives are determined.

The iIM generates trend analyzes from the recorded molding material data and also enables comparison and manual intervention.

The application of the Industry 4.0 methods by the iIM shows very good results. Thus, mold material balancing is increasingly being taken over by data-driven models. These models capture all relevant data and independently optimize the corresponding correction factors, such as the online control of the quality parameters compactability and compressive strength, thereby achieving a very stable trend.

The Küttner Life Cycle App was also used for the first time in the foundry industry for this project. The app supported commissioning by having already stored all necessary function and signal tests in advance, as well as the complete machine documentation. By checking the respective tests, the project manager was always informed about the current status. In addition, this app is mainly to support the maintenance. ■



除了在线材料测试的结果外，还建立了造型材料平衡表，对生产、消耗和旧砂等数据进行评估，方便质量控制。作为工业4.0方案的一部分，使用了复杂的数据库模型：

- 所有的消耗和生产数据以及设备参数都由特殊的工业信息管理系统“iIM”记录和维护。在砂处理工艺中，首次由科特纳公司使用iIM。
- 在线材料测试的所有结果，以维护和更新湿度补偿主动状态控制图，湿度-压实性-主动状态控制图。
- 填埋量 - 多余的砂子、超大/块状排出物、除尘灰；
- 与造型相关的生产数据，如每箱用铁液、芯砂量、铁砂比，等等。

通过这样的平衡，确定了添加剂的具体消耗量。iIM根据记录的造型材料数据生成趋势分析，还可以进行比较和人工干预。

以iIM为代表的工业4.0方法在应用中取得了很好的效果。由此，造型材料平衡越来越多地被数据驱动模型所取代。这些模型收集了所有相关数据，并独立优化了相应的校正因子，如质量参数的在线控制、压实度和抗压强度，从而实现了一个非常稳定的生产趋势。

这个项目是科特纳生命周期App应用程序首次在铸造行业使用。该App应用程序预先存储了所有必要的功能和信号测试以及完整的设备资料来支持调试。通过检查相应的测试，项目经理总能得到当前的设备状态。此外，该App应用程序还主要支持设备维护。 ■

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## THERMOREGULATORS DIATHERMIC OIL

- Diathermic oil up to 350 °C working temperature;
- Optimal management of the pumps through the adaptive system with INVERTER (patent);
- Heating system also available by METHANE GAS or LPG.



## THERMOREGULATORS PRESSURIZED WATER

- Pressurized water up to 200 °C working temperature by pneumatic system;
- Heating system patent IHCS with external electrical resistors, not in contact with the fluid;
- Heating system also available by METHANE GAS or LPG.



## THERMOREGULATORS FOR PLUNGER AND SLEEVE

- **PLUNGER PAD:** Control and selection of delivery pressure and temperature monitoring;
- **SLEEVE VERSION:** adjust sleeve temperature through diathermic oil or pressurized water.



## JET-PAD CORE COOLING SYSTEM

- Modular cooling system for core pins by pressurized water of circuit.
- Ideal for few cooling points;
- Inexpensive.



## QUENCHING TANK

- Stainless steel tank;
- Self-cleaning filter;
- No maintenance required
- Pneumatic lift for molded parts;
- Openable bottom of basket for easy emptying



## PIONEER SYSTEM

- Pioneer is an innovative system to control different channels independently.
- Combined with a pressurized water TCU, it allows to differentiate the thermoregulation on each channel.



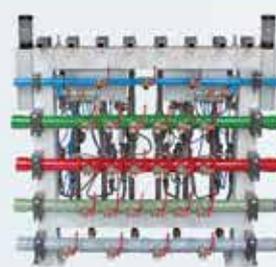
## CONNECTION PLANTS

- Customized or modular system;
- Fixed plants;
- Flexible plants;
- Multi-way distribution manifolds;
- Several types of insulation.



## DOCKING STATION

- Quick disconnection for die change;
- Mold replacement in full safety;
- Controlled temperature;
- Completely automatic without any human intervention.



## Foundation Laying Ceremony for the New Factory of Mingzhi Technology Leipzig

### 明志科技德国莱比锡公司新工厂奠基仪式

On April 29th, 2019, the foundation laying ceremony for the new factory of Mingzhi Technology Leipzig GmbH (MTL), was held at Grosslehna Industry Park. More than 30 people attended the ceremony including the General Manager of the head company, Suzhou Mingzhi Technology, the District Administrator of Leipzig, the Mayor of Markranstädt and local administrators.

During the ceremony, the District Administrator of Leipzig along with the Mayor of Markranstädt held speeches in which they emphasized the special significance and importance of this investment for the Markranstadt community. They further expressed being devoted to a long-term collaboration between the local government and MTL.

In a subsequent speech, the General Manager of Mingzhi Technology, Mr. He Qiu, announced that the new factory will be used not only to improve and expand the production capability of MTL, but also to build the latest model of core shop equipment developed by Mingzhi Technology, known as MiCC (Mingzhi integrated Core Center). This brand new and intelligent foundry equipment will be launched in June at the upcoming GIFA exhibition in Duesseldorf. As a fully integrated and all-electric core machine, MiCC will offer significant value to the customer through energy savings. In addition, a unique and intelligent control system was developed, named Mingzhi Intelligent Core Control system (MiCL), which offers the user operating convenience and increases the production data available. Due to these energy and time saving attributes, Mingzhi symbolically represents MiCC with a green apple, the "Mingzhi Apple".

Beyond being used to develop MiCC, the newly built MTL factory will, also serve as an "Experience and Service center for our customers worldwide. In line with Mingzhi Technology's pursuit to develop green products, the same concept is being applied in the construction of this new facility: photovoltaic solar energy for electricity, geo-thermal heat pump technology for the hot water and air conditioner, recycling the heat from the compressed air station, and adding an electrical car charging station.

With twenty years of steady development, Mingzhi Technology has never lost sight of its mission from the beginning. Hold fast to the dreams! Endeavour to reach the top! ■



2019年4月29日，明志科技德国莱比锡公司（MTL）新工厂的奠基仪式在Grosslehna工业园区隆重举行。明志科技总经理、莱比锡区域区长、Markranstädt市长及议员等共计30多人参加了奠基仪式。

奠基仪式上，莱比锡区域区长和Markranstädt市长分别致辞，阐明了MTL在Markranstädt投资对整个地区的重要性和特殊性，并表示将致力于市政府与MTL公司之间的长期合作。

明志科技总经理邱壑在随后的致辞中表示，明志科技投资建设这个新工厂不但为了改善目前的生产环境扩大产能，更是为了在国际市场推广明志科技即将在今年6月GIFA展览会上投放上市的全新智能铸造设备MiCC-集成式制芯单元。

这套设备不但以全新的结构和全电驱动方式改变了传统的液压机械模式，充分体现绿色环保的节能理念，而且还配套了明志科技首创的MiCL人工智能控制系统来为客户提供更为便捷的生产体验。

新建设的工厂不仅是明志继续深入研发和组装调试的中心，也是客户深入体验MiCC——明志科技的“Apple”及为客户提供生产服务的基地。

明志科技不仅在产品技术上追求绿色智能，对于新工厂的建设也秉承这个原则，公司将采用多项节能技术：如采用太阳能、地源热泵、空压站热能回收技术为工厂供电供热，停车场设置充电站为未来的汽车电动化做好充分的准备。

20载砥砺前行，不忘初心，明志科技坚持自己的梦想为做世界一流的企业而努力！ ■



## FCRI Group Will Attend GIFA 2019 Again 金刚集团将携新品再次亮相GIFA 2019

The international foundry exhibition GIFA 2019 will be held at Düsseldorf Exhibition Centre in Dusseldorf, Germany on June 25-29, 2019. FCRI warmly welcome you to visit us at booth 12C44 in Hall 12. In this exhibition, FCRI will mainly promote ceramic foam filters on site.

FCRI Group is originated from Foshan Ceramics Research Institute which was established in 1958 with the head-quarter in Foshan, Guangdong. With the production and sales experiences of ceramic foam filters for more than ten years, FCRI has built a number of high levels and advanced ceramic foam filter production lines. The annual output of FCRI ceramic foam filter is 5,000 cubic meters.

FCRI ceramic Foam Filter has high refractoriness, good filtration effect and high filtration efficiency with unique three dimensional structures and 80-90 % open cell rate. Besides for melting metal filtration at high temperature, it can also be applied in gas treatment at high temperature, carrier of catalyzer, solid thermal exchange and special filling for chemical industry. ■

四年一届的国际铸造展览会GIFA 2019 将于2019年6月25-29日在德国杜塞尔多夫会展中心举行，届时金刚集团将在12号馆12C44号展位恭候您的光临。金刚集团营销团队精英及专业技术人员将携主打产品——泡沫陶瓷过滤器亮相展览，迎接来自各地的新老客户。金刚团队将以专业的技术、专注的态度接待每一位客户。

佛山金刚企业集团源自一九五八年成立的佛山市陶瓷研究所，在六十年的发展历程中，以科技创新为发展之本，一直致力于新材料的研究、开发与应用。公司具备十余年生产销售泡沫陶瓷过滤器的经验，组建多条泡沫陶瓷过滤器生产线，设备水平高，工艺技术先进，具备年产泡沫陶瓷过滤器5000立方米的产能。

金刚牌泡沫陶瓷过滤器耐火度高、过滤效果好、过滤效率高，具有独特的三维连通孔网状骨架结构和80-90%开口通孔率。该产品除了用于高温熔融金属过滤外，还适用于高温烟气处理、催化剂载体、固体热交换器和特种填料等领域。 ■

# FCRI Ceramic Filter



**2019  
GIFA**



June 25-29, 2019  
FCRI booth 12C44

Warmly welcome to visit us.

## Designing Cores With Virtual Design of Experiments

Virtual design of experiments and coremaking simulation can help establish cost-effective production parameters that can be applied to other casting jobs within a foundry. MAURICIO VELAZQUEZ BLANDINO, MAGMA FOUNDRY TECHNOLOGIES, INC. (SCHAUMBURG ILLINOIS), INGO WAGNER AND JOERG STURM, MAGMA GIESSEREITECHNOLOGIE GMBH (AACHEN, GERMANY)

### 制芯虚拟实验设计

虚拟实验设计和模拟制芯可以帮助企业确定符合成本效益的生产参数，也可以应用于铸造工厂的其他工艺。

迈格码铸造技术公司(美国伊利诺伊州绍姆堡), Mauricio Velazquez Blandino, 迈格码铸造技术公司(德国亚琛) Ingo Wagner和Joerg Sturm

In metalcasting, using software to simulate core production is one of the most efficient ways to design core boxes and solve production problems. The application of innovative methods for virtual experimentation and computer-based design of experiments (DoE) offers new potential for the largely automated and first principle-based core production process design.

Today, simulation of core shooting and curing for different binder systems, including the thermal control of core boxes, comprehensively represents the core making process. The appropriate representation of the process-relevant physics, which often take place simultaneously, is a basic requirement for the realistic prediction of the processes. For core shooting, the coupled flow of sand and air needs to be calculated, with both materials able to move independently. For the gassing of PUCB cold box binder systems or the dry hardening of inorganic binders in thermally controlled core boxes, the transport as well as the vaporization and condensation of amine or binder water in the porous core are calculated based on the process-specific physical conditions.

Virtual experimentation through individual simulations is replacing real-world experimenting. One or multiple parameters are modified, the resulting effects are observed and analyzed, and subsequent changes are then derived and tested by the expert (Fig. 1). This procedure is repeated until the core box reaches the series production stage. In the real world of complex processes like core production, it is easy to lose track of the quantitative assessment of decisions. Due to the numerous interactions, the relationships between the applied changes and the resulting effects are not always clear. In many cases, only the final core density result indicates whether the result improves or worsens from one change to the next. Multiple core box changes, however, also result in an increasing number of possible combinations. This can result in losing track of whether a different combination than the one selected may have led to the desired result faster or yielded a better result.

In most cases, it is not possible to retrace the history of core box changes. This limits the assessment of root causes

铸造生产中，利用软件模拟制芯过程是设计芯盒和解决生产问题最有效的方法之一。虚拟实验和基于计算机的实验设计(DoE)等创新方法的应用，为大批量自动化生产和基于基础原理的制芯工艺设计提供了新的潜力。

目前，射芯过程和不同粘结剂系统的固化过程，包括芯盒温度控制，模拟已全面覆盖了整个制芯工艺流程。同时适当的表示工艺过程中的各个物理参数是工艺过程模拟的基本要求。对于射芯，需要计算砂子和空气的耦合流动，这两种材料都可以独立运动。针对PUCB冷芯粘结剂系统的通气或热芯盒中无机粘结剂的烘干硬化，根据工艺具体的物理条件，计算了胺类或水基粘结剂在多孔芯中的输送、蒸发和冷凝过程。

通过独立的模拟，虚拟实验正在取代现场的实际实验。修改一个或多个参数，观察和分析结果的影响，然后导出并由专家测试随后的变化(图1)。这个过程需要重复进行，直到芯盒达到批量生产的要求。

在实际生产中，像制芯这样的复杂的过程，很容易对决策的定量评估失去跟踪。由于众多变量的相互作用，实验参数变化与结果之间的影响关系并不总是清晰。

在许多情况下，一个变量的变化是改善还是恶化只能靠最终芯子密度的结果来衡量。然而，芯盒的多个不同变量的改变会导致越来越多的可能实验组合。这可能会导致无法跟踪不同于所选组合的组合，是否会更快地获得所需的结果或产生更好的结果。

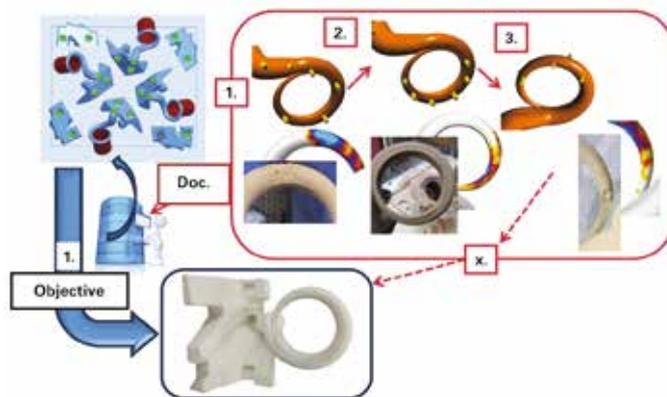


Fig 1. The manual optimization of core boxes through step-by-step variation and testing (red) is time-consuming and does not always lead to the desired result. The systematic documentation of changes and the resulting effects supports the design of robust core boxes that make good cores right from the start (blue).

图1. 人工优化芯盒设计通需要一步一步的修改和测试(红色)，非常耗时，而且并不总是得到预期的结果。更改系统文档，得出验证结果的设计，耐用的芯盒，从一开始就能生产好的芯子(蓝色)。

在大多数情况下，无法追溯芯盒更改的记录。这限制了对问题根本原因及其有效性的评估。大部分情况，人工优化

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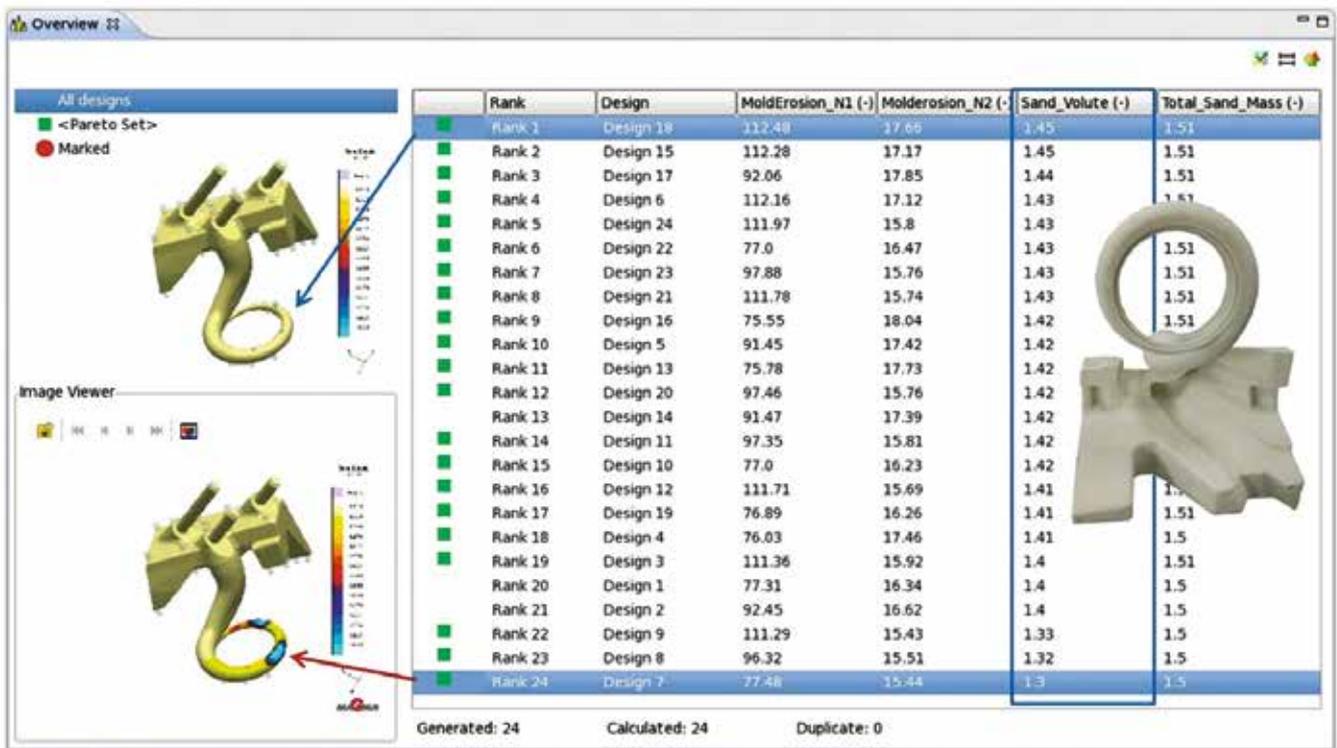


Fig 2. By subsequently weighting the different core quality criteria, it is possible to evaluate the analyzed local wear tendencies of the core box (mold erosion).

图2. 通过对不同的芯子质量标准进行加权, 可以对芯盒局部磨损的趋势分析(模具冲蚀)进行评价。

and their effectivity. Most manual core box optimizations result in an economic output of good cores and a low scrap rate. However, it is not possible to evaluate the quality of the solution quantitatively. It can merely be observed that the final core box design is working. A consequent application of simulation supports the documentation of the changes and the resulting learning effects. This allows the creation of core box design rules based on first principles. The operational procedures as well as the methodological approach change towards process optimization.

Designing a robust core box is crucial for achieving a good quality core that remains stable throughout series production.

Typical design variables in the core box include:

- Number of cores in the core box (depending on the core size and the machine size if applicable).
- Core position and orientation; positions, types and number of nozzles.
- Positions, types and number of core box vents.
- Parting line venting.

芯盒能够降低废品率, 得到良好的经济效益。然而, 无法做到定量的评价解决方案的质量。仅仅可以观察到, 最终的芯盒设计是可行的。模拟技术的后续应用能够记录参数的变化和由此产生的结果。这将有利于创建根据基本原理得出的芯盒设计规则。使作业程序以及方法更优化。

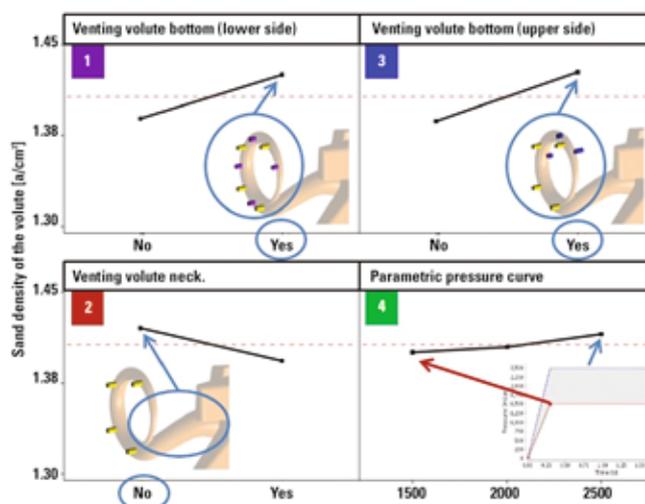


Fig 3. Adding nozzles to the volute bottom as well as reducing the number of vents in the volute neck supports the complete filling of the volute. A pressure increase comparatively only slightly improves the result, but leads to an increased wear tendency.

图3. 在蜗壳底部增加喷嘴, 减少蜗壳颈部的通风口, 实现蜗壳的完全填充。增加压力只能稍微改善结果, 但会导致磨损的增加。

设计可靠的芯盒是始终保持连续生产高质量的芯子的关键。

芯盒的典型设计变量包括:

- 芯盒中的芯子数量(如果适用, 取决于芯的尺寸和机器的大小)
- 芯的位置和方向; 喷嘴的位置、类型和数量
- 芯盒通气口的位置、类型和数量
- 排气通道

These variables result in a great number of possible combinations that influence the core quality as well as cost-effective production. Virtual design of experiments using autonomous engineering enable novel methodologies for core box design and process layout.

### Reducing the Scrap Rate of a Turbocharger Core

In one example of virtual design of experiments, the aim was to optimize the core box used for series production to minimize the high scrap rates. During the manual optimization, adopted measures combined with changing the sand binder mixture did not adequately lead to the desired result. In the virtual optimization, the vent positions and the shooting pressure were automatically varied. Quality criteria, in particular the filling degree of the sand in the volute and the tendency for core box wear below the shoot nozzles, were evaluated (Fig. 2).

The proper filling of the volute had a higher priority than the tool wear below the analyzed shoot nozzles. This allowed a quick identification of the best compromise, in this case, the selection of the nozzle configuration that produces the best cores with minimum shooting pressure for the smallest possible core box wear (Fig. 3).

The interactions between the variable parameters were determined through statistical analysis. The core quality was improved with the addition of vents to the volute bottom as well as by eliminating the vents in the volute neck. From the results, rules and clear instructions were derived for the core box design that could be applied to future applications.

The assessment revealed a pressure increase only moderately improved core quality. In practice, the core box design and the shooting pressure are uncoupled. The core box design determines the robustness of the production process, whereas the variation of the shooting pressure constitutes a variable for improving the quality in case of actual production problems. If the core quality is insufficient, the shooting pressure is increased as a rule. In doing so, an increased core box wear is tolerated.

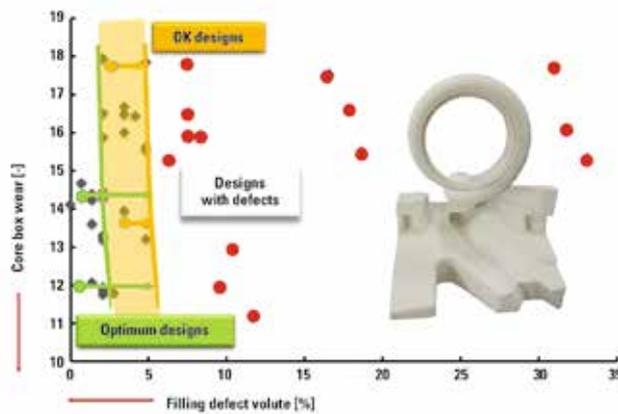


Fig 4. Virtual optimization allows for a robust core box design that leads to a quality core, even in non-optimum process conditions. The designs to the left of the green lines show a high tolerance towards production variations thanks to the buffer zone (yellow area).

图4. 虚拟优化有助于得到可靠的芯盒设计, 即使在非最优的工艺条件下也得到高质量的芯子。绿色线左边的设计显示, 由于缓冲区(黄色区域), 对生产变化具有很高的耐受性。

这些变量能产生大量可能的组合, 影响芯子的质量以及生产的成本效益。采用自主工程的虚拟实验为芯盒的设计和工艺布局提供了新的方法。

### 降低涡轮增压器芯的废品率

以一个虚拟实验设计为例, 目标是优化用于批量生产的芯盒, 最大程度降低原来居高不下的废品率。在人工优化过程中, 采取的措施是改变混砂的粘结剂, 并没有达到预期的效果。在虚拟优化中, 通气口位置和射砂压力自动变化。评估的质量标准主要是随着喷嘴射砂, 芯砂在蜗壳中的填充程度和芯盒磨损倾向(图2)。

蜗壳的填充性比分析喷嘴下方芯盒的磨损有更高的优先级。这样就可以快速识别出最佳的折衷方案, 在这种情况下, 可以选择喷嘴类型, 以最小的射压生产的最好的芯, 从而使芯盒磨损最小(图3)。

通过统计分析确定各变量之间的相互作用。通过在蜗壳底部增加通气口和去掉蜗壳颈部的通气口, 提高了蜗壳芯子质量。根据得出的结果, 规则和明确的说明可应用在今后的芯盒的设计。

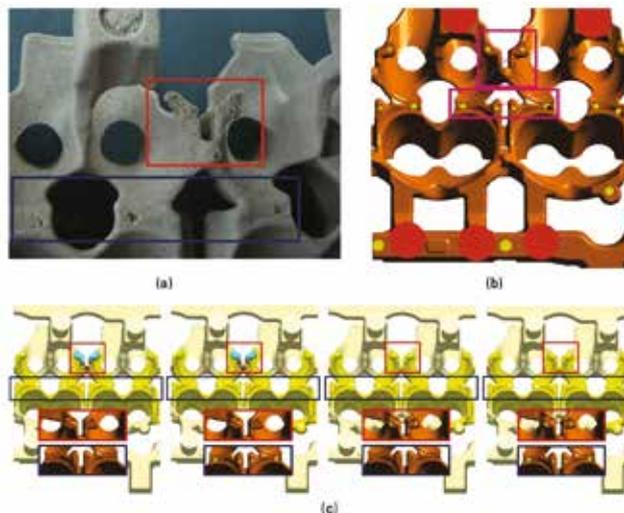


Fig 5. A core with a characteristic defect (a) is shown as a simulation model with highlighted evaluation areas to be automatically and quantitatively assessed (b), along with simulation results for the four nozzle configuration variants for a specific pressure level (c).

图5. (a)所示有特征缺陷的芯子, 在仿真模型中作为重点的评价区域, 进行自动和定量地评估(b), 以及特定压力等级的4种喷嘴结构的仿真结果(c)。

评估结果表明, 增加压力只能略微改善芯子的质量。在实际应用中, 芯盒的设计与射砂压力没有必然联系。芯盒的设计决定了生产的稳定性, 而射砂压力的变化是在实际生产中提高质量的一个变量。如果芯子质量不行, 按原理只能增加射砂压力。这样做, 不可避免的会增加芯盒的磨损。

This knowledge can serve to uncouple core box design parameters and process parameters subordinate in terms of time from one another and simplify the optimization process. If a core box has a robust design, different solutions are available for producing cores (Fig. 4).

### Virtual Core Box and Process Optimization of a Water Jacket Core

In another example, the optimization of a production core box for a thin-walled water jacket was analyzed. The objective of the optimization was designing the core box and controlling the process to enable the production of good-quality cores under favorable economic conditions. Deviating from the previous production conditions, different shoot nozzle types were tested for the core box, all of which show little need for cleaning and were supposed to yield good results with minimum shooting pressure. Under these conditions, the cores showed various defects. This condition is the initial situation for the systematic optimization. The objective is to minimize the defect indications in the simulation. The degrees of freedom for this core box are the shoot nozzle type and the change of nozzle properties, the variation of vents in critical areas and the shooting pressure. The sand density was used as a quantitative quality criterion.

The different core defects at different positions of the sand are not related to each other due to the local fluid flow behavior. At the same time, the root causes of defects at the different locations are comparable. Therefore, the issue can be resolved by analyzing a representative part of the core. The number of variants to be calculated can also be reduced by subdividing the virtual optimization into smaller subtasks.

The DoE results for the variation of both the shoot nozzle and sand flow properties show an established stepped shoot nozzle used with normal core sand yields usable results without requiring improved sand flow properties. When using a simpler nozzle, the cores show considerable defects, so this approach is not further adopted for the practical use.

For the second virtual design of experiments, the nozzles and the sand properties were set as fixed boundary conditions. The aim of the parameter study was to eliminate the core defects both in the segments between the cylinders and in the combustion chamber roof. The degrees of freedom are the vents in the respec-

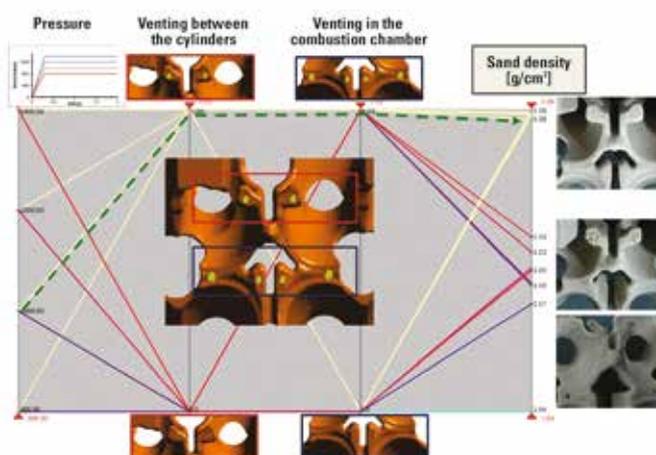


Fig 6. In the parallel coordinate plot, one line with one specified color summarizes the process parameters and resulting sand densities for a virtual design of experiments. Closing the vents in the combustion chamber area (blue) results in improved sand compaction, while the vents in the intermediary area (red) need to be open for good compaction (yellow lines). Open combustion chamber vents often result in defects during the gassing process (bottom right).

图6. 在平行坐标图中，一条具有指定颜色的线概括了工艺参数和由此得出的砂密度，为虚拟实验设计提供了依据。关闭燃烧室区域(蓝色)的通风口会改善砂的压实效果，而中间区域(红色)的通风口需要打开，以便进行良好的压实(黄线)。打开燃烧室通风口经常导致通气过程中的缺陷(右下角)。

区通气口的变化和喷嘴压力的变化。以砂密度作为确定质量质量的指标。

由于局部流体的流动，砂粒之间没有相互关联，芯子不同位置的缺陷不同。同时，不同位置缺陷的根源也是相似的。因此，这个问题可以通过分析一个具有代表性的芯子部位来解决。通过把虚拟优化细分为较小的子任务，可以减少要计算的变量数。



Fig 7. The core for a housing cover is shown before (a-not fully cured) and after optimization (b).

图7. 缸盖芯(a-未完全固化)和优化后(b)对比。

了解这些，可以把芯盒设计参数和工艺参数在时间上相互分离，简化优化过程。如果设计的芯盒非常耐用，可以选择不同的制芯解决方案(图4)。

### 虚拟芯盒与水套芯工艺优化

在另一个实例中，对薄壁水套芯盒的优化进行了分析。优化的目的是在有利的经济条件下，设计芯盒，控制工艺，生产出高质量的芯子。与以往的生产条件不同，对芯盒进行了不同类型喷嘴的试验，结果表明，这些喷嘴基本不需要清理，在最小的射砂压力下取得了较好的效果。在此条件下，芯子出现了各种缺陷。这是系统优化的初始条件。目的是将模拟中的缺陷指标降到最低。该芯盒的变量为喷嘴类型、喷嘴性能的变化、临界

以喷嘴和砂子流动为变量的实验设计结果表明，在不需改善砂流动性能的情况下，使用阶梯式喷嘴得到不错的结果。但是，当使用较简单的喷嘴时，芯子存在较大的缺陷，因此在实际应用中没有再采用这种方法。

在第二次虚拟实验设计中，将喷嘴和砂子特性设为固定的条件。研究该参数的目的是消除在汽缸和燃烧室顶部之间部分的芯子缺陷。自由参数是各缺陷区域的通气口和射砂压力。两组喷嘴的每一个系统地打开或关闭，压力变化分4个步骤，这样就有16个完全计算的设计方案。

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tive defect areas as well as the shooting pressure. The two nozzle groups are each systematically opened or closed, whereas the pressure is varied in four steps. This results in 16 completely calculated designs.

Even individual simulation results provide valuable insights. The defect causes become visible and help derive specific corrective measures (Fig. 5). In the center thin-walled section, all designs present a slightly reduced compaction. The design of experiments reveals that this minor reduction of core compaction can be slightly improved by increasing the shooting pressure. By closing the vents in the combustion chamber roof, the local compaction remains constant in all areas. The core quality in these areas is still acceptable after the shooting process itself. If, however, all vents are active, the core defect occurs during the gassing process when gas is actively injected through the vents. In the combustion chamber roof, sand is displaced directly below the venting nozzles. Therefore, by closing these vents, the core quality is considerably improved. The cores are completely filled in these areas, and due to the closed vents, the gassing defect can no longer occur. Likewise, the results prove the vents at the spaces between the cylinders are required in order to guarantee a completely compacted core in this area (Fig. 6).

#### Optimizing Gassing and Purging for PUCB Cold Box Processes

In core production, measuring technology for quantitatively determining the processes taking place during gassing is available only to a limited extent. Even if it is not possible to measure the amine transport throughout the core box, the simulation of the gassing process delivers quantitative results that allow for the evaluation and virtual optimization of the process.

In vertically parted core boxes, gassing typically takes place top down, with possibly very long gas flow paths. The degrees of freedom in the core box particularly apply to the variation of the vents, to ensure the effective amine transport into the lower areas that are critical for curing (Fig. 7).

The quantitative evaluation of a single simulation calculation reveals the problems arising during the gassing process.

For normal venting nozzle configurations viable for core production, a large part of the amine is purged prematurely out of the core box (here 80% in the upper third). Only a little amine reaches the bottom area of the core. Achieving a complete curing of the core without making changes to the core box is only possible by increasing the amine amount, the gassing pressure as well as the gassing time.

Venting design is systematically changed to achieve effective curing without changing the core shooting result. In the

基本上每个模拟结果都提供了有价值的结果。缺陷的原因变得明显，并有助于得出具体的纠正措施(图5)。在中心薄壁部分，所有的设计都呈现出轻微的压缩效果。试验设计表明，通过增加射砂压力，可以稍微提高砂芯的紧实度。通过关闭燃烧室顶部的通风口，所有区域的局部紧实度保持不变。在射砂结束后，这些部位的芯子质量仍然是可以接受的。然而，如果所有的通气口都开放，那么当气体通过通气口进入时，芯子在通气过程中就会出现缺陷。在燃烧室顶部位置，砂子直接进入喷嘴下面。因此，通过关闭这些通风口，芯子质量有了很大的提高。砂子完全填充在这些区域，由于通风口关闭，不再发生通气缺陷。同样，结果证明，在气缸之间的部分设置通风口是必要的，以保证在这一区域的芯子完全压实(图6)。

#### 优化PUCB冷芯盒工艺的通气与清理

制芯工艺，用于定量地确定在通气过程中发生的过程控制技术仅在有限的程度上是可用的。尽管不可能测量整个芯盒中胺的传输，通气过程的模拟提供了允许可以定量评价和优化和工艺结果。

在垂直分型的芯盒中，气体通常是自上而下通入，可能具有非常长的气流路径。芯盒的自由变量是设置适合的通风口，以确保胺的传输有效进入底部对于固化非常关键的区域(图7)。

单一变量模拟计算的定量评价揭示了通气过程中出现的问题。对于通常可行的通气喷嘴设置，大部分的胺过早地被排出芯盒(超过三分之一的情况80%的胺过早离开芯盒)。只有少量的胺到达芯盒的底部。只有通过增加胺量、气体压力和通气时间，才能在不改变芯盒设计的情况下完全固化芯体。

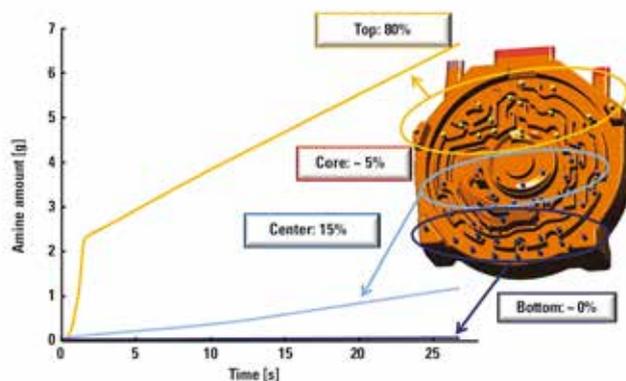


Fig 8. This graph analyzes the amount of injected amine that flows out of the core box in the individual core segments, and thus are not available for gassing of the critical bottom section.

图8. 图表分析了芯盒中芯子各部位胺的数值，因此不能有效到达芯子底部。

在不改变芯子射出效果的情况下，系统地改变通气设计，以达到有效的固化效果。在图8的例子中，为了

example in Figure 8, to ensure that the amine reaches all areas of the core, the number of vents needs to be substantially reduced top down. Virtual design of experiments allows different variants to be analyzed through the automated quantitative evaluation and comparison of the individual variants.

Gassing is a dynamic process where the injected amine first flows into the core box and then is purged out of the core based on the nozzle configuration and the applied process parameters. The simulation results allow for the tracking of the transient behavior of the amine flow as well as the assessment of the local amine amount within the core during the entire process. These criteria thus allow for the quantitative comparison of the different variants as well as for a corresponding evaluation of the gassing effectivity. Compared with the optimized solution, the initial variant has an amine content 40% lower in the critical area. At the same time, reducing the number of vents using the same gassing conditions results in a four times higher back pressure in the core. This implies for the optimized variant, the amine remains in the core box much longer, acting as a more effective catalyst for the curing process.

For horizontally-parted core boxes, both the gassing and the flow situation are fundamentally different. For extensive cores, questions arise particularly regarding the positioning of the cores below the hopper and the nozzle positions. The gas flow through the core strongly depends on the gassing nozzle positions related to the vents as well as on the variation of the core wall-thickness. Therefore, the positions of individual gassing nozzles and vents have a significant impact on the gassing effectivity. The evaluation of the current state by means of an individual simulation is a good starting point for a systematic optimization. Then, the expert defines degrees of freedom for repositioning single nozzles or for changing the vent type. The objective is to better align the gas flow and improve the overall gassing process for the core. A virtual test field also allows for simultaneously examining gassing parameters, such as the pressure of the machine or the amine type, regarding their effectivity. Thanks to the missing variance, a statistically verified design of experiments with 12 designs is sufficient for a process condition to achieve the set objectives and define the measures for practical implementation.

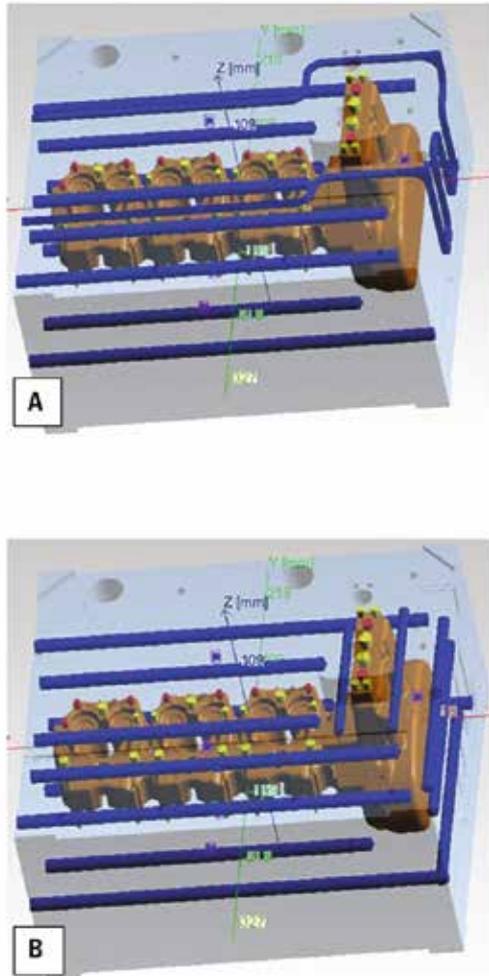


Fig 9. In the first design, a meander heater path in the thick-walled chain case area (a), did not achieve the required temperature profile. An automated simulation includes the process-specific degrees of freedom such as the replacement of the meander heater path (b) and the heating capacities.

图9. 在原设计中, 曲流加热器的加热管在厚壁区域(a), 没有达到所需的温度。自动模拟包括改变特定的参数, 如更换弯曲流加热器 (b)和提升加热能力。

确保胺到达芯子的所有区域, 通气口的数量需要自上而下大幅度减少。虚拟实验设计允许通过对各个变量的自动定量评估和比较来分析不同的结果。

通气过程是动态的, 根据喷嘴的结构和应用的工艺参数, 通入的胺先吹入芯盒, 然后从芯中排出。模拟结果可以跟踪胺流动的瞬态行为, 以及在整个过程中评估芯内的局部胺量。因此, 这些参数允许对不同变量进行定量比较, 并对充气的有效性进行相应的评估。与优化后的方案相比, 初始方案在临界区的胺含量低了40%。同时, 在相同的通气条件下减少通气口的数量会使堆芯的背压提高4倍。这意味着, 对于优化后的方案, 胺停留在芯盒内的时间更长, 可以更有效的催化固化过程。

对于水平分型的芯盒, 通气和流动情况都有本质上的不同。对于大多数的芯子, 出现的问题主要集中在漏斗下方的位置和喷嘴位置。通过芯子的气流量主要取决于与通风口有关的气体喷嘴位置以及芯子壁厚度的变化。因此, 独立的通气喷嘴和通气口的位置对气体的有效性有着重要的影响。用单一变量模拟方法对当前状态进行评估是系统优化的好的开始。然后, 专家定义了重新定位单个喷嘴或改变通风口类型的变量。目的是为了能够更好地调整气体流量, 改善芯子的整体通气过程。模拟试验还可以同时检查气体参数, 例如机器的压力或胺的类型, 以了解它们的有效性。由于缺少方差, 经过统计验证的12种设计的实验设计足以满足过程条件, 以达到设定的目标, 并确定实际实施的措施。

### Thermally Optimized Core Boxes For Hot Curing Processes

Designing the thermal control for core boxes used in hot curing processes can be laborious. The geometry and local wall-thicknesses of the core require the definition of specific temperature levels in certain areas to ensure a reproducible curing process. The temperature distribution in the core box needs to be constant in cycle operation. Therefore, experts in thermal control design are often faced with major challenges. On the one hand, the degrees of freedom for designing heating devices are limited by the restricted available space or core box requirements. On the other hand, core boxes are characterized by cross-sectional transitions and changing wall-thicknesses.

Simulation and virtual optimization are effective tools for designing the thermal control of core boxes. Based on the first design, an individual simulation provides a detailed insight into the temperature balance of the core box in cycle operation. Based on this knowledge, variants for eliminating weak points are derived. Generally, the aim is to achieve a uniform temperature on the core box surfaces relevant to the core. Usually, the degrees of freedom are the geometry, positions and dimensions of the heating devices. The control via thermocouples is another degree of freedom, since the position of control thermocouples strongly influences the uniformity of heating.

In the example in Figure 9, the temperature in the critical thick-walled core area is too low for a proper drying of the inorganic core. The provided meander heater path needs to be replaced by another configuration. The objective of the virtual design of experiments is to define a sufficiently high temperature that will vary only slightly during cyclic operation. The degrees of freedom are the variation of the heating device itself, in this case of the electric heaters, and of their individual capacities. Other degrees of freedom may be the changes to the thermocouple positions. A design of experiments comprising 16 designs already provides clear information about the measures to be implemented. The new heater configuration reliably allows reaching the set temperatures from 120°C to 130°C with different heater capacities.

This article is based on the paper “Virtual Design of Experiments and Optimization of Core Production (18-046) originally presented at the 122nd Metalcasting Congress in Fort Worth, Texas. ■

### 热芯盒固化工艺优化

设计用于热固化过程的芯盒的热控制是非常困难的。芯子的几何形状和局部壁厚要求在某些区域保持特定的温度，以确保固化过程的可重复性。在循环生产中，芯盒内的温度分布需要保持恒定。因此，热控设计专家往往面临着巨大的挑战。一方面，加热设备的设计变量受到有限的可用空间或芯盒要求的限制。另一方面，芯盒的特点是横截面过渡和不断变化的壁厚。

模拟和虚拟优化是芯盒热控设计的有效工具。在原理设计的基础上，通过单变量的模拟，详细地了解芯盒在循环生产中的温度平衡。在此基础上，推导出了消除薄弱环节的变量。一般情况下，目标是在与芯子相关的芯盒表面达到均匀的温度。通常，变量是加热装置的几何形状、位置和尺寸。热电偶的控制是另一变量，因为控制热电偶的位置强烈地影响加热的均匀性。

如图9，芯子内部临界厚壁的温度太低，无法有效地干燥无机粘结剂。原来的曲流加热器需要由另一种配置所取代。虚拟实验设计的目的是定义足够高的温度，在循环生产过程中只允许发生轻微的变化。变量是加热装置本身的变化，在这种情况下是电加热器，以及它们各自容量。其他变量可能是热电偶位置的变化。由16个设计组成的实验设计已经提供了关于将要实施的措施的明确信息。新的加热器结构可靠地允许在不同的加热器容量下达到120°C到130°C的设定温度。

本文是在德克萨斯沃斯堡第122届铸造大会上提交的“制芯(18-046)试验和优化虚拟设计”论文的基础上改编的。■

## BRUSCHI USA PLANS ZINC DIECASTING FACILITY IN MILWAUKEE

### BRUSCHI美国公司计划在密尔沃基投建锌压铸工厂

Bruschi USA is establishing a zinc diecasting plant in Milwaukee.

According to reports, the Italian company Bruschi (Milan, Italy) bought two pieces of land for \$1.1 million.

On its website, Bruschi said it is starting North American production to “bring into the U.S. our vacuum technology in zinc diecasting, our co-design service and innovative surface treatment, integrated in a vertical approach.” ■

BRUSCHI美国公司正在密尔沃基投建锌压铸工厂。

据报道，这家意大利公司Bruschi（意大利米兰）以110万美元的价格购买了两块土地。

Bruschi公司在其网站上称正在启动北美工厂的生产，“将把我们在锌压铸方面的真空技术、协同设计服务和创新的表面处理技术的一体化垂直服务引入美国。” ■

## New Technology for Foundries Cuts Energy Costs and CO<sub>2</sub> Emissions Substantially

### 降低能源成本和CO<sub>2</sub>排放的铸造新技术

The metalworking industry and foundries in particular consume extreme amounts of energy and thus produce large amounts of CO<sub>2</sub> as well. In the future, light metal foundries will be able to cut their energy costs related to production by as much as sixty percent and CO<sub>2</sub> emissions by as much as eighty percent. A new technology developed at the Fraunhofer together with other partners will make this possible. This world first will be presented for the first time ever at this years' Hannover Messe.

“We have developed a completely new design for a distributed, automatable melt supply system based on innovative, modularly upgradable burner technology,” explains Dr. Stefan Scharf from the Fraunhofer IFF in Magdeburg. “We consider this a revolutionary design that will lead the industry into a more sustainable, digitally connected era.”

#### Unconventional New Technology

Foundries in general and nonferrous foundries in particular currently have to repeatedly transfer and constantly heat melt charges in a gradual process. In addition to open-flame gas burners, electricity is predominantly used to melt and heat the metal, despite its obvious economic and environmental drawbacks. Such conventional methods of process control and the related transfer processes detract from casting quality and necessitate complex actions to handle the melt. Established processes typically have correspondingly high energy and resource requirements.

金属加工行业，铸造业是能源使用大户，排放了大量的CO<sub>2</sub>。未来，轻金属铸造厂能够把与生产相关的能源成本降低60%，CO<sub>2</sub>排放减少80%。弗劳恩霍夫研究院及其合作伙伴共同开发的一项新技术将使这些成为可能。这项新技术在今年的汉诺威展会上首次亮相。

“我们已经开发了全新的分布式、自动化的熔体供应系统，这是基于创新的、模块化的可升级燃烧器技术，”弗劳恩霍夫研究院斯特凡·沙夫博士解释说，“我们认为，这是一项革命性的设计，将使该行业进入更可持续、数字化的时代。”

#### 非传统的新技术

一般的铸造厂，特别是有色金属铸造厂，目前都必须反复运输和不断地用电保温熔融金属，这是渐进的过程。除了气体燃烧器外，电主要用于熔化和给金属液保温，尽管它具有明显的经济和环境缺陷。这种传统的工艺控制方法和相关的运输过程降低了铸件质量，需要复杂的操作来处理熔体。现有的工艺通常具有相应较高的能源和资源需求。



With their new approach, the researchers are banking on an unconventional but highly efficient method instead. A newly developed burner system that uses the energy carrier gas for heating delivers control system performance and homogeneity previously only seen in electrically heated units. The waste heat produced can be recovered reliably for the first time ever. The new design based on this development envisions melting, transferring and holding the metal in fully moveable transfer crucibles in the future. This will make it possible to cut the multistage process steps necessary currently necessary down to just one process step. The movable crucibles are supplied with the requisite thermal energy at so-called "heat docks" operated with the new burner. This eliminates the drawbacks of current alternative systems.

An equally new sensor system that monitors the process continuously and completely establishes the basis for connected process control in the foundry industry, which will be automated in the future. This ultimately lightens workers' workloads especially during particularly hazardous works steps and enables companies to transform manufacturing digitally.

#### Higher Quality and Lower Energy Consumption

"This will enable light metal foundries for which the new system was developed to cut energy costs by sixty percent and related CO<sub>2</sub> emissions by as much as eighty percent. At the same time, this will increase manufacturing flexibility and product quality significantly," says Dr. Stefan Scharf. "In principle, the design is transferable to any foundry and its component solutions are transferable to other industries as well."

According to the Bundesverband der Deutschen Giesserei-Industrie, nearly 340 companies in the light metal foundry sector (nonferrous metal foundries) produce around 1.7 million tons of nonferrous metal casts. Around one million tons of CO<sub>2</sub> are produced in the process. Energy costs presently add up to roughly twenty-five percent of their gross value added. Altogether, the foundry industry with around 80,000 employees generates around € 13 billion a year.

The technology was developed in a research consortium consisting of the Fraunhofer IFF, Otto von Guericke University Magdeburg, Promeos GmbH and Leichtmetallgiesserei Bad Langensalza. The project named ETAL is being funded by the Federal Ministry for Economic Affairs and Energy.

The researchers will be presenting the mass manufacturable prototypes of the new transfer crucibles together with the heat dock for the first time ever at the Fraunhofer-Gesellschaft's booth (Hall 2, Stand C22) at this year's Hannover Messe. Right after the trade show, they will be brought to the first implementation tests at participating companies. The manufacturable product should be on the market in early 2020. ■



随着新技术的发展, 研究人员正寄希望于用一种非传统但高效的方法来代替。新开发的燃烧器系统使用气体加热, 所提供的控制系统的性能和均匀性与用电加热的设备相同。产生的余热首次得到可靠的回收。未来, 基于此项研究成果的新设计前景是将金属熔化、运输和保温置于完全可移动的坩埚中。这有可能将当前需要的多步骤流程减少到仅一个步骤。新的燃烧器给可移动的坩埚提供必要的热能, 即所谓的“热装置”。这消除了现有运输系统的缺点。

一个同样新的传感器系统, 能够持续和完整地监测过程, 为铸造工业的连接过程控制奠定了基础, 这将在未来实现自动化, 最终减轻工人的工作量, 特别是在危险的工作环境, 并使企业能够对制造业进行数字化改造。

#### 优质低能耗

"新系统将使轻金属铸造厂减少60%的能量成本, 并使相关的CO<sub>2</sub>排放量减少多达80%, 同时将大大提高制造的灵活性和产品质量。" 斯特凡·沙夫说, "原则上, 该系统可适用于任何铸造厂, 其组合解决方案也可以在其他行业推广。"

据德国工业部门称, 轻金属铸造行业(有色金属铸造行业)有近340家公司, 生产约170万吨有色金属铸件, 并大约产生100万吨CO<sub>2</sub>。目前, 能源成本总计约占其总增加值的25%。约有8万名从业人员的铸造行业每年的营业额约为130亿欧元。

这项技术是由弗劳恩霍夫研究院、奥托·冯·格里克马格德堡大学、Promeos公司和莱赫特金属公司组成的研究项目组开发的。这个名为ETAL的项目由联邦经济事务和能源部资助。

研究人员首次在今年汉诺威展会的弗劳恩霍夫应用研究促进协会展位(2号馆, C22展位)上展示新型可移动坩埚与热装置结合的可批量制造的原型。在展会结束后, 他们将在参与的公司开始第一次实地测试。成熟的产品将于2020年初投放市场。 ■

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## WEIR GROUP ANNOUNCES INVESTMENT IN MISSISSIPPI PLANT

### WEIR集团宣布投资密西西比州工厂

The Weir Group (Glasgow, Scotland) is investing an additional \$15 million in its Newton, Mississippi, manufacturing facility, as part of a total \$50 million plan supporting an additional 150 jobs at the plant.

There will be over 400 employees at the facility after the investment is complete.

The Newton facility produces ground engaging tools for mining and infrastructure needs. The expansion is slated to be complete by August 2019.

“We chose to increase our investment in Newton because it is home to highly skilled people who are passionate about producing world-class products,” Weir Group CEO Jon Stanton said. “The equipment we make in Mississippi is exported around the world and the increased demand from our mining and infrastructure customers gives us great confidence in the future.”

“Our tools are used to extract and move hard rock and ore in very harsh environments,” Travis Wilhelm, the site manager of the Newton foundry, told Mississippi Business Journal. “To operate efficiently in those conditions requires great materials science and excellent foundry and manufacturing skills. Our ability to consistently deliver products that last longer and helps produce more ore is why we have a strong market position and why customers all over the world rely on the products made here in Mississippi.” ■

WEIR集团(苏格兰格拉斯哥)向其密西西比州牛顿市的工厂再投资1500万美元,原计划总投资额达5000万美元、新增150个工作岗位。

投资完成后,工厂将有400多名员工。

牛顿工厂的主要产品是满足采矿和基础设施需求的地面工具,扩建计划将于2019年8月完成。

“我们选择对牛顿工厂追加投资是因为那里有高技能的人才,他们热衷于生产世界顶级的产品。”Weir集团首席执行官琼恩·斯坦顿说,“我们在密西西比州生产的设备出口到世界各地,采矿和基础设施设备客户需求的增加使我们对未来充满信心。”

“我们的设备被用在非常恶劣的环境中开采和移动坚硬的岩石和矿石,”牛顿铸造厂的车间经理特拉维斯·威廉对《密西西比商业杂志》说,“在这些情况下,有效地作业需要很好的材料科学和优秀的铸造和生产技术。我们能够始终如一地交付使用寿命更长并帮助生产更多矿石的产品,这就是我们拥有较高市场地位、以及世界各地的客户都依赖于我们在密西西比州生产的产品的原因。” ■





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## WAUPACA ANNOUNCES SEPARATE PARTNERSHIPS WITH DOTSON, KOHLER

### 沃帕卡宣布与多特森、科勒合作

AFS Corporate Member Waupaca Foundry Inc. (Waupaca, Wisconsin, U.S.), a Hitachi Metals company, announced it has entered into separate manufacturing agreements with fellow Corporate Members Dotson Iron Castings (Mankato, Minnesota, U.S.) and Kohler Industrial Castings (Kohler, Wisconsin, U.S.).

Per the announcement, Waupaca Foundry customers requesting horizontal molding will access Kohler's and Dotson's capabilities with a supply chain managed by Waupaca Foundry.

Waupaca Foundry operates 35 vertical molding machines nationwide, while both Dotson and Kohler recently installed new horizontal molding capacity. In a news release, Waupaca said "offering both horizontal and vertical molding capabilities provides casting buyers the flexibility to source suppliers to best suit their production needs." ■

Waupaca Foundry, a Hitachi Metals Group company, has a reputation as solid as the castings we create. We deliver on our daily commitment to quality and true capacity.

At Waupaca Foundry, capacity is more than volume. It's our capacity to keep promises so our customers can expect tomorrow's deliveries on time, as well as tomorrow's innovations. It's the capacity to contribute value and solve problems at every stage of design and production. It's leveraging integrated services to cut costs and turnaround time, while flexing production for our customers' volume needs. And it's the capacity that our global network to create supply chain efficiencies, bring value added engineering innovations, and offer material solutions—for confidence and peace of mind.

Waupaca Foundry casts and machines iron casting components for global markets including automotive, commercial vehicle, agriculture, construction, material handling and other industrial sectors. We produce gray iron and ductile iron castings including austempered ductile and HNM high-strength ductile, melting more than 10,000 tons a day. Iron casting components up to 350 pounds (160 kilograms) are produced using one of 35 vertically parted, high pressure molding machines by a workforce that puts generations of foundry and machining expertise to work for our customers every day.

Operating seven foundries and two machining and assembly plants, Waupaca Foundry employs more 4,500 people. Locations are strategically concentrated, yet operationally decentralized, which streamlines the metalcasting supply chain.

Since 1955, Waupaca Foundry has continuously improved in the areas of safety, quality, productivity, and reliability. Our design engineering, high volume melting capabilities, custom-built vertical green sand molding equipment, and automated finishing systems minimize post-process machining requirements and maintain controlled chemistry for consistent machining—all resulting in best-in-class iron casting components.

[www.waupacafoundry.com](http://www.waupacafoundry.com). ■

日立金属集团的子公司，美国铸造协会会员

沃帕卡铸造公司（美国威斯康星州沃帕卡市）宣布，已与集团成员公司多特森铸铁公司（美国明尼苏达州曼卡托）、科勒工业铸造公司（美国威斯康星州科勒市）分别签订了生产合作协议。

根据公告，沃帕卡铸造公司的客户要求把科勒公司和多特森公司的水平分型造型线的产能与沃帕卡铸造公司供应链管理结合起来。

沃帕卡铸造公司在美国拥有35条垂直分型造型设备，而多特森公司和科勒公司最近都安装了新的水平分型造型设备。据报道，沃帕卡公司表示：“能够同时提供水平和垂直造型的选择，为铸件买家带来了灵活性，使供应商能够为客户提供最合适解决方案。” ■

沃帕卡铸造厂是日立金属集团旗下公司，在业内享有盛誉。公司可以满足高质量和产能的要求。

对于沃帕卡铸造公司来说，产能比产量更重要。产能是公司对客户及时交付产品的承诺，也是对未来创新的承诺。产能保证使公司能够在设计和生产的每个阶段为客户创造更多的价值并解决各种问题。通过综合服务，公司不仅节约了成本、减少了产品更新时间，同时，还可以灵活地满足客户的产量需求。公司的生产能力还为全球客户创造了高效的供应链，带来了高附加值的技术创新以及不同的材料解决方案，给予客户信心和安心。

沃帕卡铸造公司为全球汽车、商用车、农业机械、建筑、材料处理和其他工业部门的客户铸造和加工铸件产品。公司每天熔炼10000吨铁水，生产灰铁件和球墨铸铁件、等温淬火球墨铸铁以及HNM高强球墨铸铁件；通过使用35台垂直分型高压成型机中的一台、运用几代人的铸造和机加工技术知识和经验，公司每天可以为客户生产重达350磅（160kg）的铸铁件。

沃帕卡铸造公司经营7家铸造厂和2家加工及装配厂，员工人数超过4,500人。不同的工厂在战略管理上是集中制，但在运营上采取分散管理，这样简化了供应链。

自1955年成立以来，沃帕卡铸造公司不断提升安全性、质量、生产率和可靠性。公司的设计能力、熔炼能力、定制的垂直湿砂成型设备和自动化精加工系统可最大限度地减少后处理需求、保持化学成分可控，实现机加工的一致性，从而生产出最佳的铸铁件。

[www.waupacafoundry.com](http://www.waupacafoundry.com) ■



## BODINE ALUMINUM CASTING PLANTS PART OF \$750 MILLION TOYOTA INVESTMENT

### 博迪尼铸铝公司获丰田7.5亿美元投资

Toyota announced investment plans of nearly \$750 million at five of its plants as part of a pledge to invest \$13 billion in its U.S. operations by 2021. AFS Corporate Member Bodine Aluminum's Troy, Missouri, U.S., foundry is set to receive \$62 million and its Jackson, Tennessee, foundry to receive \$50 million.

The infusion of capital at the Troy aluminum casting facility will go toward the purchase of equipment to produce an additional 864,000 cylinder heads for Toyota's New Global Architecture (TNGA). This plant currently produces more than 3 million cylinder heads a year for every Toyota and Lexus made in North America.

In Jackson, the investment will include a building expansion and equipment to double the capacity of hybrid transaxle cases and housings to 240,000 annually and provide equipment to produce an additional 288,000 engine blocks per year for TNGA. Currently, the Jackson aluminum foundry produces 1.7 million engine blocks and 580,000 transmission cases and housings per year.

The TNGA program was announced in 2013, aiming to design vehicles with a common platform and parts shared across multiple models.

The other investments announced include adding the Toyota RAV4 Hybrid and Lexus ES 300h hybrid vehicle production at its Georgetown, Kentucky, manufacturing plant; expanding engine capacity at its Huntsville, Alabama, facility; and doubling hybrid transaxle capacity at its plant in Buffalo, West Virginia.

丰田公司宣布向其下属5家工厂投资近7.5亿美元，作为其在2021年底前在美国投资130亿美元的承诺的一部分。美国铸造协会会员企业博迪尼铸铝公司（美国密苏里州特洛伊市）将获得6200万美元，其在田纳西州杰克逊市的铸造厂将获得5000万美元投资。

特洛伊铝合金铸造厂的投资将用于购买设备，为丰田新全球架构(TNGA)生产新增的86.4万个气缸盖。目前，这家工厂每年为在北美制造的丰田和雷克萨斯汽车配套生产超过300万个气缸盖。

杰克逊工厂的投资将用于新厂房的扩建和设备采购，使混合动力曲轴箱和轴承座的产量翻一番，达到每年24万件。并新增设备，每年为TNGA生产28.8万台发动机。目前，杰克逊铝铸造厂每年生产170万台发动机缸体和58万个变速箱壳体。

丰田新全球架构(TNGA)计划于2013年宣布，其目标是设计可多个车型共享的平台和零部件的车辆。

其他已公布的投资包括在肯塔基州乔治敦的工厂增加丰田RAV 4混合动力车和雷克萨斯ES 300 h混合动力车的生产、扩大阿拉巴马州亨茨维尔工厂的发动机产能，以及将其位于西弗吉尼亚州布法罗的工厂的混合动力曲轴产能提高1倍。



“These latest investments represent even more examples of our long-term commitment to build where we sell,” said Jim Lentz, chief executive officer for Toyota Motor North America. “By boosting our U.S. manufacturing footprint, we can better serve our customers and dealers and position our manufacturing plants for future success with more domestic capacity.”

“These three companies have a strong reputation in our metal-casting industry and with our customers around the globe. This alliance will support Dotson’s growth goals to serve new customers,” Dotson Iron Castings president and CEO Jean Bye said.

One benefit, according to the news release, is that the alliance creates a more sustainable supply chain for both founders’ OEM and Tier I customers.

“Increasingly, our customers want the flexibility to source both vertically- and horizontally-parted iron castings with fewer suppliers,” said John Wiesbrock, executive vice president, Waupaca Foundry. “Buyers want to simplify their supply chain relationships and need reliable suppliers with proven track records such as Dotson, Kohler, and Waupaca Foundry.”

For Dotson and Kohler, the agreements will open new markets through Waupaca Foundry’s existing customer relationships.

“This new agreement maximizes the strengths of two great foundries with high standards for quality manufacturing and exceptional customer service,” said Mike Marbach, vice president of global kitchen products and industrial castings for Kohler Co. “We’re pleased to provide Waupaca customers with access to our new, state-of-the-art horizontal molding line and look forward to serving the needs of this diverse group moving forward.” ■

“这些最近的投资再次表明了公司的发展承诺。”丰田汽车北美公司首席执行官吉姆·伦茨表示，“通过扩大我们在美国市场的投入，我们可以更好地服务于客户和经销商，并使我们的生产厂有更多的国内产能，从而确保未来取得成功。”

“这三家公司在铸造行业 and 我们的全球客户中享有很高的声誉。这一联盟将支持多特森公司的增长目标，为新客户服务，”多特森铸铁公司总裁兼首席执行官让·拜说。

据此报道，联盟的好处是为铸造厂OEM及一级客户创造了更具可持续性的供应链。

“我们的客户越来越希望在保持可选择水平造型和垂直造型灵活性的前提下，减少供应商数量。”沃帕卡铸造公司执行副总裁约翰·威斯布罗克表示，“买方希望简化他们的供应链关系，并需要像多特森、科勒和沃帕卡这样的可靠供应商。”

对于多特森公司和科勒公司来说，这些协议将有助于通过沃帕卡铸造公司现有的客户关系开拓新的市场。

“新的协议最大限度地发挥了两家大型铸造厂的优势，它们都拥有很高的生产标准和出色的客户服务。”科勒公司全球厨房产品和工业铸件副总裁迈克·马尔巴赫表示，“我们很高兴为沃帕卡铸造公司的客户提供使用我们新型且最先进的水平造型线的机会，并期待着为这一多元化集团的需求服务。” ■

## SIGNICAST ANNOUNCES EUROPEAN EXPANSION SIGNICAST铸造公司扩展欧洲业务

Signicast (Charlotte, North Carolina, U.S.), a Form Technologies company, announced it has signed an agreement to acquire CIREX, a European investment casting specialist based in the Netherlands from Amsterdam-based companies Convent and Nedvest.

In a news release, Signicast said “the CIREX acquisition will enable Signicast to better serve its growing international customer base with the highest quality precision cast components in the market. In addition to Signicast’s existing three facilities in the U.S., the combined operation will now have plants in the Netherlands, Czech Republic, and Slovakia.”

“Consistent with the vision when Signicast was acquired by Form Technologies, the addition of CIREX globalizes the footprint outside the United States into European markets, expanding our services into that region. CIREX is the second acquisition to join the Signicast business following the acquisition of Consolidated Casting Corporation in 2018,” said Clayton Tyckowsky, CEO, Signicast. “It provides us the ability to service global customers seeking a Signicast precision engineered solution outside of North America.

“This acquisition is a transformational moment for Signicast, representing our first step toward taking our brand global and adding capacity for both existing and new markets. We are excited to have the CIREX employees join our division.” ■

Signicast铸造公司（美国北卡罗来纳州夏洛特市）是Form Technologies的子公司，宣布已与CIREX公司签订收购协议，CIREX是一家总部位于荷兰阿姆斯特丹的欧洲熔模铸造公司。

据报道，Signicast铸造公司称：“收购CIREX公司将使Signicast铸造公司能够为全球客户提供质量更好的精密铸件产品。除了Signicast铸造公司在美国现有的3家工厂外，合并后的公司还将在荷兰、捷克和斯洛伐克拥有工厂。”

“与Form Technologies公司收购Signicast铸造公司的愿景一致，CIREX的加入使Signicast公司进军欧洲市场、更国际化。CIREX公司是继2018年收购Consolidated铸造公司之后第二个加入Signicast的公司。”Signicast铸造公司首席执行官克萊頓·蒂奇考斯基说，“它使我们有能力为除北美以外的全球客户提供服务，满足他们寻求熔模铸造解决方案的需求。”

“这次收购对Signicast铸造公司来说是一次变革，代表着我们的品牌迈向全球化的第一步，并为现有和新的市场增加了产能。我们很高兴CIREX公司员工加入我们。” ■



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## Successful pitch for KÜNKEL WAGNER in India KW在印度取得新的合同

**KÜNKELWAGNER®**  
WEITER DENKEN.

**Mahindra**  
Rise.

KÜNKEL WAGNER are glad to announce that thanks to a conclusive concept they have been awarded the contract by MAHINDRA & MAHINDRA for the supply of an automatic moulding plant and sand preparation plant.

MAHINDRA Group specialized in the mobility sector and enjoying an excellent reputation based on advanced technology is one of the largest and most important manufacturers in the automotive and farm equipment sector both in India and internationally.

KÜNKEL WAGNER will supply a moulding plant [1.250x900x380/380 mm, 90 mph] incl. sand preparation plant for the production of engine blocks at their Swaraj Foundry Unit in Punjab.

KÜNKEL WAGNER is renowned for system competency along with enhancing process technology. The high-pressure moulding machine KW MASTER Eco® combining outstanding mould quality and precision with energy efficiency, perfectly meets the requirements of MAHINDRA & MAHINDRA.

KW MASTER Eco® is an innovation made in Alfeld accepted by numerous customers all over the world and presents a further milestone within the already 111 years of history and experience of KÜNKEL WAGNER.

KÜNKEL WAGNER feel honoured to be the partner of MAHINDRA & MAHINDRA in this important project and are looking forward to a long and mutually satisfactory relationship. ■

KW在此通报，凭借令人信服的综合方案，KW公司通过MAHINDRA & MAHINDRA集团的招标程序，中标静压造型线和砂处理项目。

MAHINDRA集团专注于汽车车辆行业，凭借先进的技术享有良好的声誉。MAHINDRA是汽车行业最大和最重要的制造商之一，也是印度和全球最大最有影响力的农业机械制造商之一。

KW公司提供一条静压造型线，砂箱尺寸：1250x900x380 / 380，生产能力每小时90整型，还提供配套的砂处理设备，用于该集团在旁遮普省Swaraj的铸造厂生产拖拉机发动机。

KW公司的整体系统方案令人信服。凭借MASTER ECO®静压造型主机，其卓越的成型质量和精度与节能相结合，KW公司以这种先进的设计理念，满足了MAHINDRA的要求。

这种造型主机是Alfeld的一项创新成果，这种型号的主机已经被全球众多的用户证实。KW MASTER ECO®造型主机是KW公司在111年历史中的又一个里程碑。

KW公司能够参与这一重要项目，能够成为MAHINDRA & MAHINDRA集团的合作伙伴，KW公司感到很自豪，并期待双方满意的长期合作。 ■



KW management at Mahindra headquarters in Mumbai from left to right: S. Goradia, R. Schulze, A. Patil (Mahindra), A. Kamdar, G. Montero

KW昆克瓦格纳高管在位于孟买Mahindra公司现场从左到右为: S. Goradia, R. Schulze, A. Patil (Mahindra), A. Kamdar, G. Montero



## Solid As The Castings We Create

At Waupaca Foundry capacity is more than volume. It's the capacity to deliver on time, as well as tomorrow's innovations. It's the capacity to contribute value and solve problems at every stage of design, launch and production. It's leveraging integrated services to streamline your supply chain, while flexing production to meet your needs. And it's the capacity that allows our global network to offer efficiencies, opportunities and material innovations. It's all this and more, giving you the capacity to maintain confidence and peace of mind.



Hall 14 / D36  
[www.waupacafoundry.com](http://www.waupacafoundry.com)

## SUNDARAM-CLAYTON EXPANDING SOUTH CAROLINA, U.S., FACILITY Sundaram-Clayton公司扩建南卡罗来纳州的工厂

Sundaram-Clayton Limited, an Indian manufacturer and supplier of aluminum cast products, announced plans to expand its Dorchester County (South Carolina, U.S.) operations. In a news release, the company said it will invest \$40 million and expects to create 100 new jobs.

SCL, a supplier of aluminum diecastings to the automotive and non-automotive sectors, announced in 2017 it planned to establish its first South Carolina operations in the Ridgeville Industrial Campus in Ridgeville. SCL acquired 50 acres of land, where it manufactures aluminum high-pressure, die-cast products and permanent mold gravity cast parts for its customers.

“To meet increased demand for its products, the company will be expanding its Ridgeville facility by 78,000 square feet,” the company said in a news release. “The additional space will accommodate new equipment, increasing the capacity for the plant. Hiring for the new positions is slated to begin in the second quarter of 2019.”

“Sundaram-Clayton Limited’s presence in Dorchester County has made a tremendous impact on our community, and we are already seeing its effects,” said Dorchester County Council chairman Jay Byars. “Their expansion of 100 additional jobs for our residents is a testament to their commitment and confidence in their initial investment and beyond.” ■

Sundaram-Clayton有限公司是一家印度的铝合金铸件生产企业，宣布计划扩建其位于美国南卡罗来纳州多切斯特县的工厂。据报道，该公司将投资4000万美元，并预计新增100个就业岗位。

Sundaram-Clayton公司为汽车行业和非汽车行业的客户提供铝合金压铸产品。公司于2017年宣布，计划在南卡罗来纳州里奇维尔市的里奇维尔工业园区建立第一家工厂。Sundaram-Clayton公司购买了50英亩土地，用来为客户生产铝合金压铸产品和金属型重力铸造产品。

“为了满足客户日益增长的产品需求，公司将把里奇维尔工厂的面积扩大78000平方英尺（约7246平方米）。”公司在报道中称，“增加的场地将安装新设备，提高工厂的产能。新岗位的招聘计划于2019年第二季度开始。”

“Sundaram-Clayton公司在多切斯特县的投资对我们的社区产生了巨大的影响，我们已经看到了它的影响，”多切斯特县议会主席杰伊·拜尔斯说，“这一扩建项目为社区居民提供了100个工作岗位，证明了他们最初投资的承诺和信心。” ■

### Production - Imprint

Global Casting Magazine for  
Publisher: Thomas Fritsch  
Senior Editor: Viviane Mößmer  
(verantwortlich i.S.d.P./responsible)  
Editors International: Oanh Larsen  
Translation: Übersetzungsbüro  
Schnellübersetzer GmbH / CFA  
Phone: +49 (0) 83 62 / 9 30 85 -40  
Fax: +49 (0) 83 62 / 9 30 85 -20

E-Mail: vm@foundry-planet.com  
Web: www.foundry-mexico.com  
Layout: Mrs Köhl, Druckerei Wagner GmbH,  
Mindelheim  
Pictures: Work pictures of the press  
Publishing company: Foundry Planet Ltd.  
CEO Thomas Fritsch  
Sebastianstraße 4 · D-87629 Füssen  
Tax number: 125/104/35026  
VAT-Nr.: DE241247752

Trade register: 05357464, Cardiff/GB  
Design & Artwork: Druckerei Wagner GmbH,  
Mindelheim  
The digital version can be found on: www.foundry-mexico.com  
Copyright: The Foundry-Planet-Online Magazine contains pre-authorized editorial contributions, publications and announcements.  
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## CEO PURCHASES OMAHA STEEL CASTINGS 公司CEO收购OMAHA铸钢公司

CEO Kevin Brown has bought Omaha Steel Castings (Wahoo, Nebraska, U.S.).

According to the Lincoln Journal-Star, Brown purchased the company from Allan Lozier. Brown had been running the company since June 2014.

“I am very appreciative of the confidence shown in me by Allan with this sale,” Brown said in a news release. “His belief in and support of Omaha Steel has been critical over these last four years.”

Omaha Steel was founded in Omaha, Nebraska and moved to Wahoo in 2014. ■

CEO凯文·布朗购买了OMAHA铸钢公司（美国内布拉斯加州瓦胡市）。

据《林肯星报》报道，布朗从阿兰·洛泽手中收购了该公司。布朗自2014年6月以来负责运营该公司。

“我非常感谢阿兰在这次购买中对我表现出的信心。”布朗在报道中表示，“在过去的4年里，他对OMAHA铸钢公司的信任和支持是至关重要的。”

OMAHA铸钢公司创立于内布拉斯加州奥马哈市，并于2014年迁往瓦胡市。 ■

## MAGALDI HITS THE MARK WITH A NEW ORDER FOR ITS CASTING COOLING TECHNOLOGY

### Magaldi的铸造冷却技术获得新订单



What a better way to usher in its 90th year of business if not with a new order?

At the dawn of this special year, Magaldi Group confirms its leadership in dependable solutions for the metalcasting industry by signing a contract to supply its casting cooling technology (MCC®) to Pilenga Baldassarre Foundry (PBF).

After the merge in EF-Group, the Italian foundry had launched an impressive investment plan which led to the start-up of a new molding line for large iron castings (> 100kg) and the modernization of two DISA vertical lines for medium-small pieces.

Following the revamping of this area, Magaldi had been asked to supply an MCC® to perform cooling and de-gating while moving castings from the punch-out to the shot-blasting machine.

In order to reach an outlet temperature <math><120^{\circ}\text{C}</math> to allow operators to de-gate and sort castings, Magaldi previously performed cooling tests in the R&D area of its factory in Buccino, thus validating the design data and the system configuration.

In PB foundry, after the punch-out, two vibrating conveyors will discharge castings on a Superbelt® conveyor placed orthogonally. Equipped with a suitably-shaped unloading section, the vibrating conveyors will distribute the castings on two lanes to keep separately the different types of iron (gray / spheroidal) pieces.

如果没有新订单，还能以什么更好的方式庆祝公司成立90周年呢？

在这个特殊的年份到来之际，Magaldi集团签订了一份合同，向Pilenga Baldassarre铸造厂(PBF)提供其铸造冷却技术(MCC®)，确定其为金属铸造行业提供可靠解决方案中的领导地位。

在与EF集团合并后，这家意大利铸造厂启动了一项重要的投资计划，为大型铸铁件(>100kg)的生产安装一条新造型线，并对两条生产中小型铸件的DISA垂直线进行了现代化改造。

在对造型工部进行改造后，Magaldi公司有了安装MCC®设备的需求，用以在铸件从抛丸处理后的运送过程中对铸件进行冷却和去除浇口的处理。

为了达到出口温度小于 $120^{\circ}\text{C}$ ，以便作业人员去除铸件浇冒口并进行分类，Magaldi公司先在布奇诺工厂的研发区进行了冷却试验。

在PB铸造厂，两台振动传送设备在Superbelt®式输送机上以正交方式下件。振动传送设备配有适合的卸料段，将铸件分布在两条传输带上，以区分不同类型的铸铁件（灰铸铁/球墨铸铁）。



Held under negative pressure, the cooling tunnel will be crossed by a stream of cooling air flowing at controlled speed to avoid thermal shocks to the castings. Ambient air will be drafted through two inlet hoods placed at the extremities of the cooling tunnel and sucked from the center. The cooling air flow speed will not exceed 12 m/s to prevent any residual sand from being dragged.

The MCC® will be integrated by the MISS® (Magaldi Integrated Supervision System) to optimize the cooling process according to the performance of the upstream DISA lines.

Equipped with a dedicated PLC, the MISS® will receive identification data (ID) from castings on the molding line along with all status signals from the MCC®, to eventually adjust the process parameters according to the set logic.

Optical pyrometers located along the tunnel will monitor castings temperature and allow a series of nozzles to further cool those castings that, due to specific features (high thermal module, heavy weight and/or large dimension), have a temperature higher than a given threshold.

Specific values for belt speed and forced airflow will be associated to all types of castings in production, categorized according to the cooling module and the mold frequency.

After the cooling tunnel, operators will carry out de-gating and sorting operations on the uncovered part of the belt. Once completed such activities, castings will be conveyed into special boxes by means of lateral chutes, while gates will fall automatically in two boxes located at the head section, to be transferred by operators to the melting area (Magaldi's scope of supply will also include this boxes handling system).

On the occasion of GIFA, part of such casting cooling system will be exhibited at our booth #16D24. Come to take a close look and meet our passionate team to learn more on our latest innovations.

Stay up-to-date visiting our website ([www.magaldi.com](http://www.magaldi.com)), our LinkedIn page (Magaldi Power SpA) and YouTube channel. ■

在负压下，控制冷却隧道中通过的冷却气流的流动速度，以避免对铸件形成热冲击。周围空气的两个入口置于冷却隧道的末端，并从中心吸入。冷却气流速度将不超过12米/秒，以防止残余砂被带出。



MCC®将与MISS® (Magaldi公司集成监控系统) 集成，以根据上游DISA造型线的性能来优化冷却过程。配备专用的PLC，MISS®将接收来自造型线上铸件的标识数据(ID)以及来自MCC®的所有状态信号，从而根据固定逻辑最终调整工艺参数。

位于隧道中的光学高温计监测铸件温度，并通过一系列喷嘴进一步冷却那些由于某些特性（高温模块、重量和/或尺寸大）而温度高于给定阈值的铸件。

传送带速度和冷却气流的具体数值将与生产的所有铸件类型相关联，按冷却模块和铸型速率分类。

通过冷却隧道，作业人员将对传送带上的铸件进行去浇冒口和分类操作。一旦完成这些工作，铸件将通过横向滑槽输送到特殊的箱子中，而浇冒口将自动落在位于前端的两个箱子中，由作业人员将其转运到熔炼工部（Magaldi公司的供货范围也包括这些箱运输系统）。

部分铸件冷却系统将在GIFA展会期间展出。



[www.magaldi.com](http://www.magaldi.com)

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香港鑄造業總會  
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# 第十四届中国国际压铸工业展览会

The 14<sup>th</sup> China International Die Casting Industry Exhibition

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## Pig Iron Leader LFS will Exhibit at NEWCAST 2019 生铁龙头企业龙凤山铸业将参加NEWCAST展

Founded in 1999, and located in Wuan Qinglong Industrial Park, Handan City, Hebei Province, China, Longfengshan (LFS) Casting Industry Co., Ltd. is the biggest innovation manufacturing enterprise on high purity pig iron, ultra high purity pig iron and hypoeutectic pig iron for foundry in China. The quality of high purity pig iron and hypoeutectic pig iron has reached the international advanced level, and the quality of ultra-high purity pig iron has reached the international leading level. At present LFS has an annual production capacity of 2 million tons and total assets of 5.1 billion Yuan.

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LFS牌铸造用超高纯生铁、高纯生铁、亚共晶生铁，具有高纯净度、高稳定性、高一致性等特点，主要应用于超低温（-60℃）铁素体球墨铸铁件，厚大断面球墨铸铁件，风电铸件，高强高韧性汽车铸件。



期待2019年6月25-29日与您在杜塞尔多夫展览中心会面交流，公司展位号：13号馆B08。 ■

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## Qingdao Xinghe Graphite will Exhibit at GIFA 2019 青岛兴和石墨有限公司将参加GIFA2019

Qingdao Xinghe Graphite Co., Ltd is a comprehensive enterprise integrating the development, production, and processing of natural flake graphite. Since established in 1996, we have insisted on the management principle of “quality first and customer supreme”, and we always offer customers the most rigorous test and quality control for customers. Now, we can produce more than 500 series graphite, such as medium carbon graphite, high carbon graphite, micro powder graphite and expandable graphite. Besides, our annual output is more than 50,000 tons and our output amounts achieve 230,000,000 Yuan. Our products are now selling to more than 1,000 companies in domestic 31 provinces, cities and municipalities, and also sell well in distant markets such as the USA, South Korea, India, and other more than 60 countries and regions, covering such industries as steel and iron, retardant materials, metallurgy and so on.

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青岛兴和石墨有限公司是以非金属石墨矿开采、生产加工、销售为一体的综合企业，自1996年建厂以来，我们以“质量第一、用户至上”的经营方针，过硬的质量服务于客户。下属平度富康石墨厂可生产中碳、高碳石墨、高纯石墨、微粉石墨、膨胀石墨等十大系列500余个品种，年产量50000多吨，产值2.3亿元。产品销往国内31个省、市、自治区的1000多个单位，远销美国、韩国、印度等60多个国家和地区，覆盖钢铁、耐材、冶金、汽车摩擦材料、石油、涂料等十几个行业。

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我公司将参加2019年德国杜塞尔多夫铸造展，展位号：Hall 12E23-1，期待您莅临展位参观洽谈。

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Contact: Jason Li

Email: [jason@xhgraphite.com](mailto:jason@xhgraphite.com)

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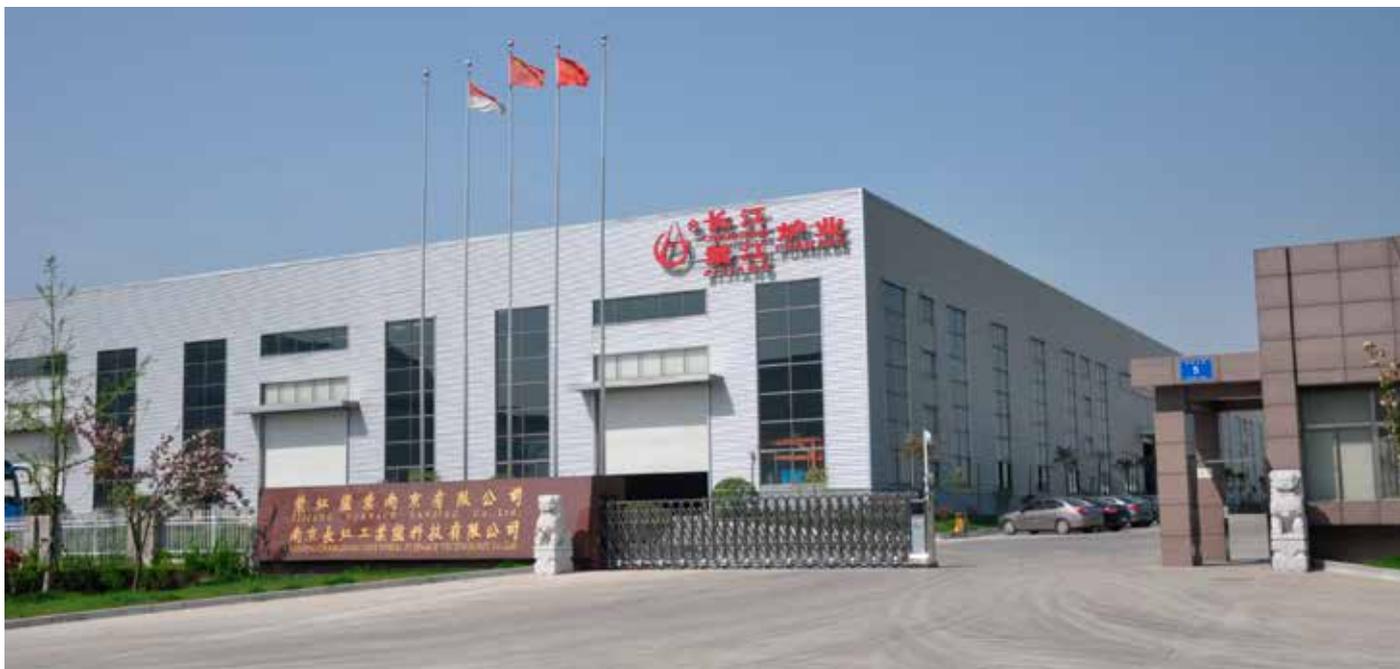
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## ZIJIANG FURNACE NANJING (ZFN)

## 紫江炉业南京有限公司(ZFN)

**Introduction**

ZIJIANG FURNACE NANJING (ZFN) has become quite popular abroad especially in the aluminium wheel sector. In the domestic market, ZFN is the undisputed leader in the heat treatment field up to the extent that its furnaces can be seen almost everywhere. We felt there was sufficient material for an interview with the rather young General Manager, Mr. Zhou Hao who welcomed us in its Nanjing headquarter.

The first question we posed was linked to recent success achieved especially outside China.

**Q: What is the key for such a success?**

**R:** Our company is in the market since the mid 70's when my father founded the CHANGLU Group. Since then we have been very active in the specific heat treatment sector especially for the aluminium industry, in particular wheels. Initially our company learned a lot from the European technology but after giving our contribution to the modernization of China, we have started to develop our own products and technology and their performance attracted the interest from customers and competitors outside China.

**Q:** In China there are many companies building heat treatment furnaces, but you are still the undisputed leader. What is the secret for such a leadership?

**R:** Contrary to what many competitors may think, we do not copy from the competition and do not compete with the many local Chinese low cost competitors. We operate in the market having as a benchmark our main competitors from Europe and this has been made possible thanks to the efforts of our staff and engineers.

**介绍**

紫江炉业南京有限公司(ZFN)在国外很受欢迎,特别是在铝车轮行业。在国内市场,紫江炉业一直是热处理领域无可争议的领导者,其所生产的炉子几乎随处可见。我们觉得有足够的材料采访年轻的总经理周皓先生,他在南京总部欢迎我们。

我们提出的第一个问题与最近取得的成功有关,特别是在国际市场上。

**问: 成功的关键是什么?**

**答:** 我们公司从70年代中期开始进入市场,那时我父亲创建了长炉集团。从那时起,我们一直在热处理行业非常活跃,特别是铝行业中的铝车轮。最初,我们公司从欧洲的技术中学到了很多东西,但在为中国的现代化做出贡献之后,我们开始开发我们自己的产品,而我们所开发产品的性能吸引了大量国外客户和竞争对手的兴趣。

**问: 在中国有很多制造热处理炉的公司,但贵公司仍然是无可争议的领导者。请问处于这种领导地位的秘诀是什么?**

**答:** 与许多竞争对手的想法相反,我们不抄袭竞争对手,也不与许多中国本土低成本竞争对手竞争。我们以欧洲的主要竞争对手为基准,在市场上开展业务,而这一切成为可能得益于我们的工作人员和工程师的努力。



**Q:** From wheels to structural parts, is this going to be a new challenge for the heat treatment furnace manufacturers?

**R:** In a continuously changing world, a metal like aluminium is going to play a predominant role and our strategy is to further improve our equipment with an eye in particular to the Customer's needs. The cars of the future will be electric and increasingly lighter. That is the reason for which the car makers will increasingly need aluminium components like subframes, knuckles, control arms, etc., with enhanced mechanical properties achieved through an efficient heat treatment process.

**Q:** How do you see the future of ZFN?

**R:** Nowadays, the aluminium foundry industry is requiring suppliers with the capability to fulfill the most stringent requirements coming from the Customers who no longer want simple suppliers but real partners that can propose new ideas and concepts for increasingly efficient heat treatment furnaces. This together of course with an timely after sales service. These are the guidelines we are following which will for sure bring added value to both Customer and partner supplier. ■

**问：从车轮到结构件，这对热处理炉制造商来说是一个新的挑战吗？**

**答：**在一个不断变化的世界中，像铝这样的金属将发挥主导作用，我们的战略是进一步改进我们的设备，特别是着眼于客户的需求。未来的汽车将是电动的，而且越来越轻。这也是汽车制造商越来越需要铝部件的原因，比如副车架、转向节、控制臂等，通过有效的热处理工艺提高产品的力学性能。

**问：你如何看待紫江炉业的未来？**

**答：**如今，铝铸造行业要求供应商具备满足客户最严格要求的能力，这些客户不再需要简单的供应商，而是可以为日益高效的热处理炉提出新的想法和概念的真正的合作伙伴，当然及时的售后服务必不可少。这些是我们遵循的指导方针，肯定会为客户和合作伙伴供应商带来增值效应。 ■



# TIHO

## TIHO



### Introduction

Recently the name of TIHO became quite popular in the aluminium foundry sector and in particular in the low pressure die casting industry. This has drawn our curiosity and attention and asked therefore an interview to the founder and leader of this company that is playing a role of leadership. So, we decided to travel to Danyang for a conversation with the founder, Mr. Zhang Pei Jun, to try and understand the reasons for such a success.

The reception by Mr. Zhang was very warm and in line with the Chinese hospitality tradition. The first question we posed was linked to its steady growth.

### Q: Any secret for such a growth?

R: I have been in the aluminium wheel and foundry industry in general for quite a while, but one day, exactly in 2008 I decided it was time to start a company with an initial capital constituted just by my experience and the selected number of specialists with decades of activity whom I hired. These specialists brought experience and creativity and things started to work.

**Q: In China there are many companies building low pressure die casting machines, most of the are very similar to those from the European competitors, is this also your case?**

R: Contrary to what many competitors may think, we have never copied their low pressure die casting machine because by doing so you also risk to reproduce the same mistakes. Thus we have always tried to bring into our machines some innovation though in the specific machine sector it is quite risky to bring novelties. We've made some bold innovations especially in the field of equipment production efficiency and energy consumption. The cycle time of LPDC machine with a full set of movement is less than 25 seconds and the power consumption for hydraulic unit is 1.5 kW per hour.

### 介绍

最近，TIHO的名称在铝铸造行业中变得相当流行，特别是在低压压铸工业中。这引起了我们的好奇心和注意，并请求了对该公司创始人和领导的一次采访。因此，我们决定前往丹阳，与创始人张培军先生进行对话，试图找出这种成功的原因。

张先生的接待非常热烈，符合中国的好客传统。我们提出的第一个问题与其稳步增长有关。

### 对这种增长有什么秘密？

我在铝车轮及铝铸件行业已经有很长一段时间了，但在2008年的一天，我决定成立一家由我的个人经验构成初始资本的公司并雇用了一批从事几十年行业工作的专家。这些专家带来了经验和创造力，并开始运作。

**在中国，有许多公司生产低压铸造机械，其中大部分与欧洲竞争对手非常相似，这也是你的情况吗？**

与许多竞争对手的想法相反，我们从来没有复制过他们的低压压铸机，因为这样做你也有可能重复同样的错误。因此，我们一直在努力给我们的机器带来一些创新，尽管在特定的机器领域，带来创新是相当危险的。我们特别是在设备的生产效率和能耗方面进行大胆的创新，低压机一个全动作的循环时间在25秒以内，液压单元的耗电每小时在1.5 kW



**Q: From wheels to structural parts, is this the new challenge for the aluminium casting machines manufacturers?**

R: In a continuously changing world, a metal like aluminium is going to play a predominant role and our strategy is to further improve our equipment with an eye in particular to the Customer's needs. The cars of the future will be electric and increasingly lighter. That is the reason for which we have started sometimes ago to diversify our low pressure casting machine configurations with the aim to face the new challenges posed by the evolving automotive industry such as structural components like subframes, knuckles, control arms, motor casings for new electric vehicles, etc. Meanwhile, besides manufacturing LPDC machines and peripheral process automation, we also produce fettling equipment and process automation, such as decorating, trimming, desprue and deflashing, etc with a full set of production line from design, fabrication, installation and commissioning to after sales service and so on.

**Q: How do you see the future of TIHO?**

R: Nowadays, the aluminium foundry industry is requiring suppliers with the capability to fulfill the most stringent requirements coming from the Customers who no longer want simple suppliers but real partners that can propose new ideas and concepts together with an efficient after sales service. This is the path we are following which will for sure bring added value to both Customer and partner supplier. At the same time, we give our contribution to the global aluminum casting machinery development. ■

**从车轮到结构件，这是铝铸造机械制造商面临的新挑战吗？**

在一个不断变化的世界中，像铝这样的金属将发挥主导作用，我们的战略是进一步改进我们的设备，特别是着眼于客户的需求。未来的汽车将是电动的，而且越来越轻。这也是我们在前些时候开始实行低压铸造设备多样化配置的原因，目的是为了面对不断发展的汽车工业带来的新挑战，如副车架、转向节、控制臂、新能源汽车电机壳等结构件。而且我们除了制造铸造机及自动化外，还做铸造后处理设备及其自动化，如震砂、切边、切冒、去飞边等全套生产线的设计、制造、调试、服务等。

**你怎么看TIHO的未来？**

如今，铝铸造行业正在要求供应商具备满足客户要求的最严格的要求，这些要求不再需要简单的供应商，而是真正的合作伙伴，可以提出新的想法和概念，并提供有效的售后服务。这是我们所走的道路，肯定会为客户和合作伙伴带来增值效应，并为全球的铝铸造装备发展作出贡献！ ■



# Development of NHT Alloys with Good Hot Cracking Resistance for Automotive Applications via ICME Approach

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## ICME方法开发具有良好抗热裂性能的汽车用NHT合金

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**ABSTRACT:** A NHT (Non-Heat Treatable) alloy that develops the required strength and toughness with no, or minimal, heat treatment can eliminate or minimize numerous production problems associated with thin wall high pressure die casting components, such as distortion, blistering, property variations, and heat treatment logistics. 560 is an Al-Mg-Mn based NHT alloy developed by Alcoa in the late 1990s for high pressure die cast structural components and has excellent fracture toughness and fatigue performance. The application of this alloy is limited to simple-shaped components due to its high hot cracking tendency.

Using the ICME approach, the hot cracking resistance of the 560 alloy was significantly improved. ICME (Integrated Computational Materials Engineering) is an approach to design products, the materials that comprise them, and their associated materials processing methods by linking materials models at multiple length scales. A hot tearing model for multi-component aluminum systems is presented in this paper. The model directly couples the Scheil solidification simulation with phase diagram calculation via PanEngine, a multicomponent phase equilibria calculation interface. The predicted hot tearing tendencies correlated very well with the experimental results of multicomponent aluminum alloys. Besides the development of aluminum foundry alloys, this model can also be used for many other applications, such as welding filler alloy development and additive manufacturing alloy development.

### 1. Introduction

Aluminum components are being widely used by auto manufacturers around the world as aluminum offers the fastest, safest, most environmentally-friendly and cost-effective way to boost fuel economy and cut total carbon emissions<sup>[1]</sup>. It is projected that aluminum usage in cars and trucks will reach average content levels of 500 pounds per vehicle by 2025<sup>[2]</sup>.

Alcoa has a very long history in providing aluminum alloys for automotive industries. Alcoa developed the all-aluminum space frame for Audi A8 in 1994<sup>[3]</sup>. As shown in Figure 1, the Audi A8 aluminum space frame consists of links and nodes. The links are thin-walled, hollow aluminum extrusions, and the nodes are aluminum die castings. A cast node typically consists of a structure with one or more connection points to which a cast, extruded, or sheet member can be connected by various joining techniques, such as riveting, welding, adhesive bonding, or mechanical devices<sup>[4]</sup>. As these casting nodes are often crash relevant and/or are riveted with self-piercing rivets, higher elongations and good crashworthiness are required while

### 摘要:

NHT (不可热处理)合金,不能或极少通过热处理得到所需的强度和韧性。热处理可以消除或减少许多与薄壁压铸件生产有关的问题,如变形、起泡、性能变化和热处理物流。560是美国铝业公司于20世纪90年代末研制的Al-Mg-Mn基NHT合金,用于压铸结构件,具有优良的断裂韧性和疲劳性能。由于该合金热裂倾向比较大,所以仅应用于形状简单的零件。

通过ICME方法,显著提高了560合金抗热裂的性能。ICME(集成计算材料工程)是将计算手段所获得的材料信息与产品性能分析和制造工艺模拟相结合的方法。本文提出了多元铝合金系的热裂模型。该模型通过PanEngine热力学计算开发平台将凝固模拟与相图计算直接结合起来,得到多元相平衡的计算界面。预测的热裂倾向与多元铝合金的实验结果有很好的相关性。该模型除了开发铸造铝合金外,还可用于焊接填充合金的开发和增材制造合金的开发。

世界各地的汽车制造商正在广泛使用铝合金部件,因为铝合金部件以最快、最安全、最环保和最具成本效益的方式来提高燃料经济性和减少总碳排放<sup>[1]</sup>。预计到2025年,汽车和卡车的铝合金平均使用量将达到每辆车500磅的水平<sup>[2]</sup>。

美国铝业公司在为汽车工业供应铝合金方面有着悠久的历史。美国铝业公司在1994年为奥迪A8开发了全铝车身框架<sup>[3]</sup>。如图1所示,奥迪A8铝车身框架由连接件和承载件组成。连接件为薄壁中空铝型材,承载件为铝合金压铸件。铸造的承载件为结构件,通常连接一个或多个点,可以通过各种连接技术(例如铆接、焊接、粘合或机械装置)将铸件、挤压件或薄板构件连接到一起。由于这些铸造的结构件经常与碰撞相关,铆接自穿孔铆钉,因此要有更高的延伸率和良好的耐撞性,同时要保持可接受的强度,抗应力腐蚀开裂,以及其他重要的性能,以满足车辆“车身框架”的应用。

also maintaining acceptable strength, stress-corrosion cracking resistance, and other properties important to vehicle “space frame” applications.

To achieve higher elongations for die casting nodes, Alcoa invented its proprietary vacuum die casting process (or “AVDC”) [5], developed a series of ductile die casting alloys, and successfully applied the AVDC process and ductile alloys to manufacture many different structural components in cars in the 1990s.

This high vacuum die casting technology significantly extends the applications of HPDC products, and creates a new technological field for metal casting engineering and industries [6].



Figure 1. Audi A8 aluminum space frame

The ductile die casting alloys, which were developed for the AVDC process in the 1990s, include C119, C611, C601, C448 and C60K. These Alcoa C-alloys are Al-Si-Mg-Mn based heat treatable HPDC alloys that require solution heat treatment to produce optimum tensile properties and crush performance. The standard process route includes solution heat treatment for 45 minutes at 490°C, followed by quenching into warm water, and aging for 90 minutes at 225°C.

The solution heat treatment has two primary effects: first, to ensure that as much of the Mg and Si as feasible are in solid solution and available for precipitation during aging, and second, to spheroidize the eutectic Si particles in order to improve alloy toughness. However, the heat treatment and quench also produce distortions in the castings that must be subsequently removed by hand working. The high cost of this rework has provided the driving force to develop non-heat treatable alloys to minimize this distortion.

A non-heat treatable (NHT) alloy that develops the required strength and toughness with no, or minimal, heat treatment can eliminate or minimize numerous production problems associated with thin wall high pressure die casting components, such as distortion, blistering, property variations, and heat treatment logistics. As aluminum castings are normally used without cold work (no work hardening), the strength of the non-heat treatable aluminum foundry alloys is only produced by solid solution strengthening by alloying the aluminum with additions of other elements. Mg, Mn and Cu are the most effective solid solution strengthening elements. 560 (aka C446) is an Al-Mg-Mn based NHT foundry alloy developed by Alcoa in the late 1990s for high pressure die cast structural components and has excellent fracture toughness and fatigue performance. The application of this alloy is limited to simple-shaped components due to its high hot cracking tendency.

Hot cracking is also referred to as solidification cracking, hot tearing, hot shortness, super-solidus cracking, and shrinkage brittleness. In general, it is defined by the formation of a macroscopic fissure in the casting as a result of stress and associ-

为了提高承载压铸件的延伸率，美国铝业公司发明了其专有的真空压铸工艺（简称“AVDC”）[5]，开发了一系列可延展的压铸合金，并在20世纪90年代成功地将AVDC工艺和可延展合金应用于汽车制造的多种不同的结构部件。

这种高真空压铸技术极大地扩展了压铸产品的应用范围，为金属铸造工程和工业创造了新的技术领域[6]。

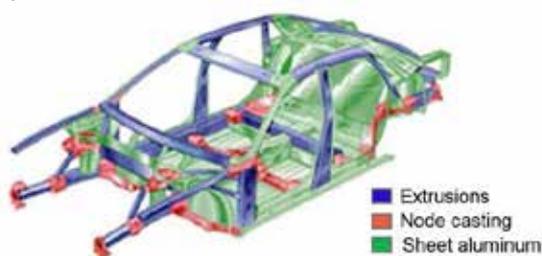


图1：奥迪A8铝制空间框架。

可延展的压铸合金，在20世纪90年代成功地用于AVDC工艺，包括C 119、C 611、C 601、C 448和C60K。这些C系列铝合金是Al-Si-Mg-Mn基的可热处理的压铸合金，需要固溶热处理才能获得最佳的拉伸性能和压碎性能。标准工艺路线包括在490°C的溶液中热处理45分钟，然后在温水中淬火，在225°C下时效90分钟。

固溶热处理主要有两种效果：一是保证Mg和Si尽可能多地处于固溶体中，在时效过程中可用于沉淀；二是使共晶Si颗粒球化，以提高合金韧性。然而，热处理和淬火也会使铸件产生变形，随后必须通过人工来消除这些变形。这种返工的高成本是发展非热处理合金的动力，所以应尽量减少这种变形。

NHT（不可热处理）合金，不能或极少通过热处理得到所需的强度和韧性。热处理可以消除或减少许多与薄壁压铸件生产有关的问题，如变形、起泡、性能变化和热处理物流。由于铝合金铸件通常不经冷加工（无加工硬化）而使用，因此，提高非热处理铝合金的强度只能通过加入其他元素，通过固溶体强化。Mg、Mn和Cu是最有效的固溶体强化元素。560（又名C 446）是美国铝业公司于20世纪90年代后期研制的一种Al-Mg-Mn基NHT铸造合金，用于压铸结构件，具有优良的断裂韧性和疲劳性能。由于该合金具有较高的热裂纹倾向，其仅用于简单形状的零件。

热裂又称凝固开裂、热撕裂、热脆、超固相开裂和收缩脆性。一般来说，它的定义是在铸件中形成可见的裂缝，这是由于冷却过程中，温度高于非平衡固相线产生的应力和伴随的形变造成的。热裂是铝合金铸造过程中最常见和

ated strain, generated during cooling, at a temperature above the nonequilibrium solidus. Hot cracking is one of the most common and serious defects encountered during the casting of aluminum alloys. In most cases, the castings cannot be salvaged for further processing because of the hot cracking. Therefore, the control and elimination of hot cracking are very important in casting alloy, process, and product designs.

Hot cracking tendencies of aluminum alloys are significantly affected by alloy compositions. High silicon aluminum alloys, such as A356, normally have no hot cracking issues for any casting process, while high strength 7xxx alloys, such as 7055/7085, are extremely prone to hot cracking, and thus are not castable for shape castings. As shown in figure 2, Cu content showed obvious impact on the hot cracking tendencies of Al-Cu alloys. Other alloying elements, such as Mg, Si, Zn and Mn, also have various impact on hot cracking tendencies of aluminum alloys[7]. It is believed that the hot cracking resistance of an aluminum alloy can be improved by optimization of alloy composition.

It is very time consuming to screen alloy compositions with the least hot cracking tendency by running experimental hot cracking evaluations in the lab. This is because commercial aluminum alloys generally contain multiple alloying elements, at least 5 to 7 elements in most cases. For example, if we want study the effect of each alloying element on hot cracking tendency for a 6-component aluminum alloy and we select 4 levels for each element, the complete testing matrix will have 1024 ( $4^5$ ) composition combinations. As a result, the experimental evaluation may take almost a year to complete if we can have three alloys evaluated every day (1024/3 ~ 341 working days)!

Integrated Computational Materials Engineering (ICME) is a relatively new discipline that has begun to show great promise in reducing the cost and time to design and deploy new materials [8]. At Alcoa, ICME is enabling Alcoa engineers to accelerate the development of new alloys, new products and manufacturing processes. We have developed a hot tearing prediction approach which directly couples the hot cracking tendency calculation with the phase equilibrium calculation for multicomponent aluminum systems. In addition to the development of aluminum foundry alloys, this approach has also been successfully used for many other applications, such as welding filler alloy development and additive manufacturing alloy development.

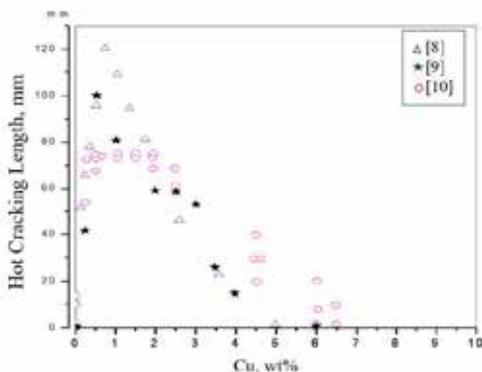


Figure 2. Effect of Cu content on hot cracking tendency for the Al-Cu System  
图2: Cu含量对Al-Cu体系热裂倾向的影响。

最严重的缺陷之一。在大多数情况下,铸件由于热裂而无法挽救,进入下一道工序。因此,控制和消除热裂在铸造合金、工艺和产品设计中都具有十分重要的意义。

铝合金的热裂倾向受到合金成分的显著影响。高硅铝合金(如A 356)在任何铸造过程中通常不存在热裂的问题,而高强度7 xxx合金(如7055/7085)极易出现热裂,因此无法铸造成形的铸件。如图2所示,Cu含量对Al-Cu合金的热裂倾向有明显的影 响。其他合金元素,如Mg、Si、Zn和Mn,对铝合金的热裂倾向也有不同的影响[7]。通过对铝合金的优化,可以提高铝合金的抗热裂性能。

通过在实验室中进行热裂实验评估,筛选具有最小热裂倾向的合金成分非常耗时。这是因为商业铝合金通常包含多个合金元素,在大多数情况下至少5至7个元素。例如,如果我们想要研究每个合金元素对6元铝合金热裂倾向的影响,并且我们为每个元素选择4个含量水平,则完整的测试基质将具有1024( $4^5$ )种组合。因此,如果我们可以每天对3种合金进行评估,则实验评估可能需要将近一年(1024/3~341个工作日)才能完成!

集成计算材料工程(ICME)是一门较新的学科,在新材料的设计和利 用方面已显示出减少成本和时间的巨大潜力。在美国铝业公司,ICME方法使美铝工程师能够加快新合金、新产品和制造工艺的开发。我们开发了一种预测热裂的方法,直接将热裂纹倾向的计算与多元铝合金系的相平衡计算结合起来。除了铸造铝合金的开发外,该方法还成功地应用于其他许多应用领域,如焊接填料合金的开发和增材制造合金的开发。

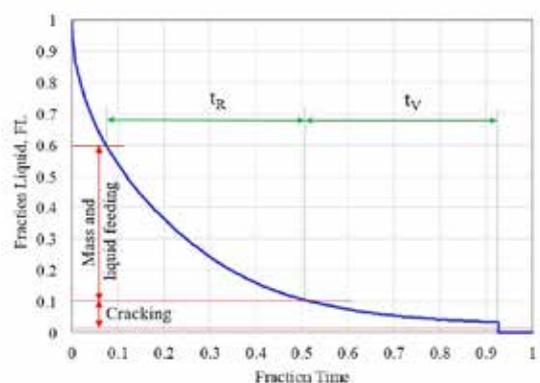


Figure 3. Graphic outline of the derivation of  $t_R$  and  $t_V$  for the C446 alloy (Al-3.6wt% Mg-1.2wt%Mn-0.12wt%Fe)

图3: C446合金 (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe) 的 $t_R$ 和 $t_V$ 的推导图示。

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2. Hot Cracking Model

2.1 MODEL DESCRIPTION

The Hot Cracking Model [7] uses a cracking susceptibility coefficient (CSC) to describe the effect of alloy composition on hot tearing. The CSC is defined as:

$$CSC = \frac{t_v}{t_R} \quad (1)$$

Where  $t_v$  is the time during solidification in which the casting is “vulnerable” to cracking, and  $t_R$  is the time available for the stress relief process.

As shown in Figure 3, the time spent in 60% to 10% liquid volume range is defined as  $t_R$ , as mass and liquid feeding will readily occur at this liquid fraction level. A volume fraction of liquid between 10% and 1% was chosen as the vulnerable regime, and the time spend here is defined as  $t_v$ . At very low volume fractions of liquid, the material will be too strong to crack.

In order to predict the variation of the cracking susceptibility coefficient with alloy composition, it is necessary to obtain the fraction liquid ( $f_L$ ) vs. time curves corresponding to a range of initial alloy compositions. To achieve this end, PanEngine [13] and PanAluminum Thermodynamic Database [14] were used to calculate the  $f_L$  vs. temperature curves. Figure 4 shows the fraction liquid versus temperature curve for the C446 alloy (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe).

PanEngine is a collection of C++ classes, which performs thermodynamic and equilibrium calculations. An application program was written in the current study to perform the Scheil solidification simulation and CSC calculation for multicomponent aluminum alloys using PanEngine. The composition- and temperature-dependent liquidus slope and partition coefficient were obtained from PanEngine at each time-step during the simulation. The heat evolution during the solidification process was also obtained from PanEngine. Based on the heat evolution of the alloy, the cooling rates were estimated with a heat flow proportional to the square root of time,  $dQ/dt \propto t^{-1/2}$ . Figure 5 shows the calculated cooling curve for the C446 alloy (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe).

Once the  $f_L$ -T curve (Figure 4) and the T-time curve (Figure

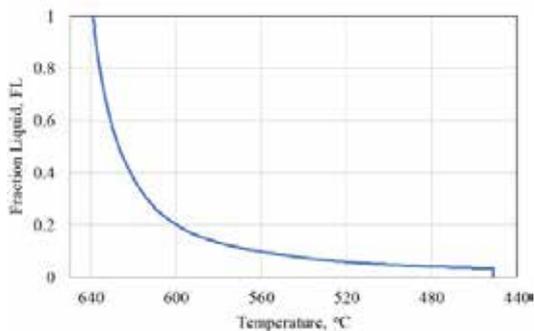


Figure 4. Fraction liquid versus temperature curve for the C446 alloy (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe)

图4: C446合金 (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe) 的部分液体与温度曲线。

5, cooling curve) are calculated, the fraction liquid versus time ( $f_L$ -time) curve can be easily obtained (Figure 3). The CSC can then be obtained from the fraction liquid versus time ( $f_L$ -time) curve and Eq. [1].

2. 热裂模型

2.1 模型描述

热裂模型[7]用裂纹敏感性系数(CSC)描述了合金成分对热裂的影响。CSC的定义:

$t_v$ 是铸件在凝固过程中“易裂”的时间,  $t_R$ 是用来缓解应力的时间。

如图3所示, 在金属液体积范围60%至10%内所用的时间被定义为 $t_R$ , 因为在这个体积范围固相形成和金属液补充很容易发生。在金属液体积分数10%到1%之间的被视为脆弱的阶段, 在此阶段所用的时间被定义为 $t_v$ 。在金属液体积分数非常低的情况下, 材料已经足够强而不会开裂。

为了预测热裂敏感系数随合金成分的变化, 有必要获得对应的系列初始合金组成的金属液体积分数 ( $f_L$ ) 对时间的曲线。为实现这一目的, 使用PanEngine[13]和PanAluminum热力学数据库[14]计算 $f_L$ 与温度的曲线。图4是C446合金的金属液体积分数对温度的曲线 (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe)。

PanEngine是C++类的数据库平台, 执行热力学和平衡计算。目前的研究中编写了一个应用程序, 用于使用PanEngine对多元铝合金进行Scheil凝固模拟和CSC计算。与成分和温度有关的液相线斜率和分配系数从PanEngine模拟期间的每个时间步骤获得。凝固过程中的热量释放也从PanEngine获得。基于合金热量演变, 用与时间平方根成正比的热流来估算冷却速率,  $dQ/dt \propto t^{-1/2}$ 。图5是计算得出的C446合金 (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe) 冷却曲线。

一旦计算出 $f_L$ -T曲线 (图4) 和温度-时间曲线 (图5冷却

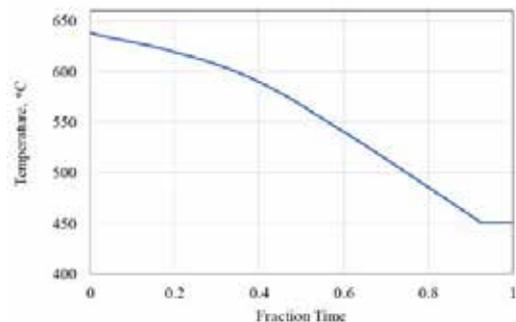


Figure 5. Calculated cooling curve for the C446 alloy (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe)

图5: 计算的C446合金 (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe) 冷却曲线。

曲线), 就可以容易地获得金属液体积分数与时间的 ( $f_L$ -时间) 曲线 (图3)。然后可以从金属液体积分数对时间 ( $f_L$ -时间) 的曲线和等式获得CSC[1]。

2.2 MODEL VALIDATION

2.2 MODEL VALIDATION

The hot cracking model has been validated with experimental data for various binary, ternary and high order systems. As an example, figure 6 compares the model predicted hot cracking tendencies with the experiments for the AlCuSi ternary system with a fixed Cu value of 0.7wt%. The predicted hot tearing tendencies are in very good agreement with available experimental data. For Al-Si-0.7wt%Cu alloys, hot cracking tendency increases at a low solute content and has a maximum at a composition of around 0.25 wt.% Si.

We have also used this model in high performance 7xxx and 6xxx wrought alloy development, and good correlations between predicted and experimental data were obtained. Thus, this model can be used as a useful tool in alloy design to select alloy compositions with reduced hot cracking tendency.

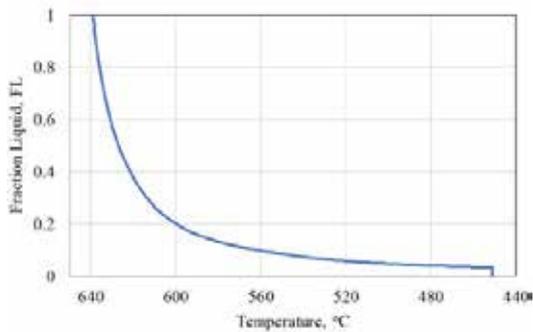


Figure 6. Comparison of the predicted and experimental hot tearing tendencies for the AlCuSi system with a fixed value of 0.7wt% Cu.

图6: AlCuSi系统的预测和实验热裂趋势的比较, 固定值为0.7wt%Cu。

3. Development of new NHT alloys with good hot tearing resistance

3.1 OPTIMIZING C446 ALLOY COMPOSITION TO ACHIEVE THE BEST HOT CRACKING RESISTANCE BY THE ICME APPROACH

To study the effects of alloying elements on the hot cracking tendencies of C446-type alloys, a software program was developed to automatically search the composition space for alloy compositions with low hot cracking tendencies. The composition space covered Si from 0 to 4wt.%, Mg from 2 to 6wt.%, Mn from 0 to 2wt.%, Fe from 0 to 1 wt.%. Thousands of alloy compositions can be evaluated quickly by this approach.

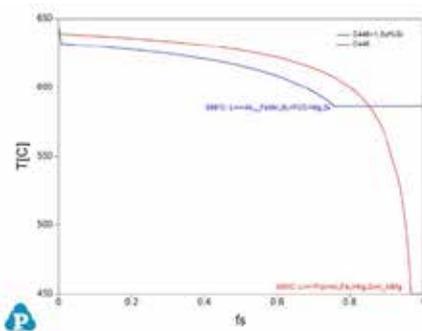


Figure 8. Effect of silicon addition on solidification path of the C446 alloy

图8: 添加硅对C446合金凝固路径的影响。

2.2模型验证

热裂模型已经通过各种二元、三元和高阶系统的实验数据进行了验证。例如, 图6比较了模型预测的热裂趋势与固定Cu值为0.7wt%的AlCuSi三元体系的实验。预测的热裂趋势与可用的实验数据非常一致。对于Al-Si-0.7wt%Cu合金, 当溶质含量较低时, 热裂解倾向增大, 当组成在0.25wt.%Si左右时最高。

在高性能7xxx和6xxx锻造合金开发中使用该模型, 并获得了预测数据和实验数据之间的良好相关性。因此, 该模型可用作合金设计中有用的工具, 以选择具有降低的热裂倾向的合金组合。

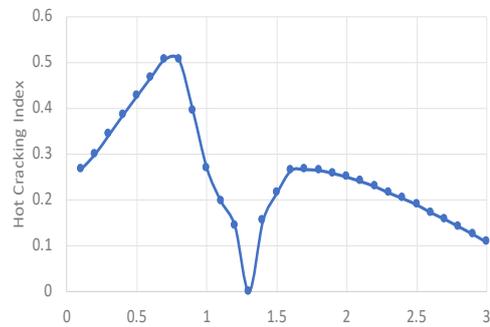


Figure 7. Effect of Si on hot cracking tendency of the C446 alloy (Al-3.6wt.%Mg-0.12wt.%Fe-1.2wt.%Mn-Si)

图7: Si对C446合金 (Al-3.6wt%Mg-0.12wt%Fe-1.2wt%Mn-Si) 热裂倾向的影响。

3. 开发具有良好抗热裂性能的新型NHT合金

3.1优化C446合金成分, 通过ICME方法实现最佳的抗热裂性能

为了研究合金元素对C446合金热裂倾向的影响, 开发了一款软件来自动搜索具有低热裂倾向的合金组合物的组成选项。组合物选项覆盖重量0-4%的Si, 重量2-6%的Mg, 重量0-2%的Mn, 重量0-1%的Fe。通过这种方法可以快速评估数以千计的合金成分。

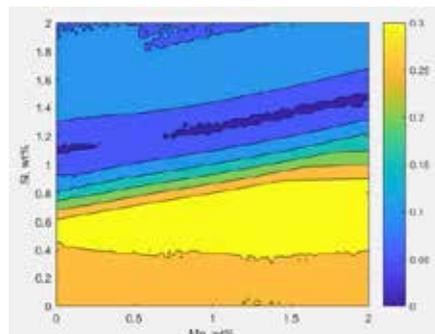


Figure 9. Effects of Si and Mn content on hot cracking tendency of the Al-3.6wt.%Mg-0.12wt.%Fe-Mn-Si alloys

图9: Si和Mn含量对Al-3.6wt%Mg-0.12wt%Fe-Mn-Si合金热裂倾向的影响。

Figure 7 shows the effect of silicon content on the hot cracking tendencies of Al-3.6wt.%Mg-1.2wt.%Mn-0.12wt.%Fe-Si alloys. Adding less than 0.75wt.% Si will increase the hot cracking tendency of the C446 alloy (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe). Alloy that contains ~1.0wt%Si may have a similar hot cracking tendency as the C446 base alloy. These conclusions are in good agreement with our historical production trial data: adding up to 1wt.% silicon had no obvious improvement on the hot cracking tendency of the C446 alloy.

Figure 7 also shows that there is a local minimum of hot cracking index around 1.3 wt%Si. This can be explained by the change of solidification path for the C446 alloy due to silicon addition. As shown in Figure 8, solidification of the C446 alloy ends up at 450oC with the reaction  $L \rightarrow FCC + Al_{13}Fe_4 + Mg_2Si + \beta-AlMg$ . Adding 1.3wt% Si to the C446 alloy increased the solidification ending temperature from 450oC to 586oC, which lowered the solidification temperature range by 136oC!

Figure 9 is a hot cracking index contour plot showing the effects of Si and Mn content on the hot cracking tendency of Al-3.6wt.%Mg-0.12wt.%Mn-Si alloys. Regions with lower hot cracking tendencies can be easily identified in this plot. The silicon content required to achieve lower hot cracking tendency in these alloys increases as the Mn content increases. This is because more silicon will be tied up with Mn to form  $\alpha-Al_{15}FeMn_3Si_2$  particles as the Mn content increases.

Similar hot cracking index plots were also created for other element combinations, such as Mg/Mn, Mg/Si, Mg/Fe, Mn/Fe and Fe/Si. Besides the hot cracking index, some other properties, including solidification shrinkage, freezing range, die soldering tendency, sludge formation tendency and yield strength, can also be predicted at the same time by the program. Figure 10 illustrates the solidification shrinkage contour plot for Al-3.6wt.%Mg-0.12wt.%Fe-Mn-Si alloys.

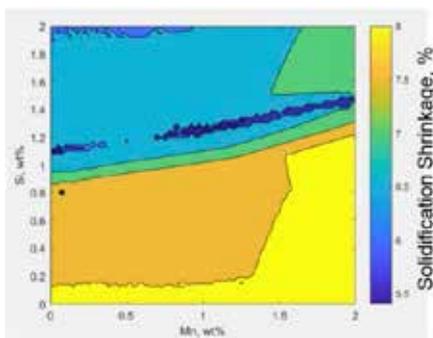


Figure 10. Effects of Si and Mn content on solidification shrinkage of the Al-3.6wt.%Mg-0.12wt.%Fe-Mn-Si alloys

图10: Si和Mn含量对Al-3.6wt%Mg-0.12wt%Fe-Mn-Si合金凝固收缩的影响。

### 3.2 EVALUATION OF HOT CRACKING TENDENCY

To validate the hot cracking prediction results for Al-Mg-Mn-Si-Fe based alloys, hot cracking susceptibility assessments were conducted at Alcoa Technical Center using the so called "Pencil Probe Mold". As shown in Figure 11, the pencil probe mold produces "I" shape castings with the connection rod diameters ranging from 2 to 16 mm. The hot cracking tendency index (HCTI) of an alloy is defined as

$$HCTI = \frac{\sum \text{diameter of the cracked rod}}{(2 + 4 + 6 + 8 + 10 + 12 + 14 + 16)}$$

图7显示硅含量对Al-3.6wt.%Mg-1.2wt.%Mn-0.12wt.%Fe-Si合金的热裂解倾向的影响。添加少于0.75wt.%的Si会增加C446合金的热裂倾向 (Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe)。含有~1.0wt%Si的合金可具有与C446基础合金类似的热裂倾向。这些结论与我们的历史生产试验数据非常吻合: 加入超过1wt.%的硅对C446合金的热裂倾向没有明显改善。

图7还显示, 在含Si量1.3wt%时, 局部热裂指数最小。这可以解释为由于添加Si而改变了C446合金的凝固路径。如图8所示, C446合金的凝固在450°C时停止, 反应为  $L-FCC + Al_{13}Fe_4 + Mg_2Si + \beta-AlMg$ 。向C446合金中添加1.3wt%的Si, 使凝固停止的温度从450°C升至586°C, 凝固温度范围降低了136°C!

图9是热裂指数等线图, 显示了Si和Mn含量对Al-3.6wt.%Mg-0.12wt.%Mn-Si合金的热裂倾向的影响。在图中可以容易地识别具有较低热裂倾向的区域。随着Mn含量的增加, 在这些合金中实现较低热裂倾向所需的硅含量增加。这是因为随着Mn含量的增加, 更多的Si将与Mn结合形成 $\alpha-Al_{15}FeMn_3Si_2$ 颗粒。对于其他元素组合也得出了类似的热裂指数图, 例如Mg/Mn, Mg/Si, Mg/Fe, Mn/Fe和Fe/Si。除热裂指数外, 该程序还可以同时预测其他一些性能, 包括凝固收缩率、冷冻范围、模具焊接倾向、沉淀物形成趋势和屈服强度。图10显示了Al-3.6wt.%Mg-0.12wt.%Fe-Mn-Si合金的凝固收缩等高线图。



Figure 11. Pencil Probe Mold and Castings for Hot Cracking Evaluation

图11: 用于热裂纹评估的铅笔探针模具和铸件。

### 3.2热裂趋势的评估

为了验证Al-Mg-Mn-Si-Fe基合金的热裂预测结果, 使用所谓的“铅笔探针模型”在美铝技术中心进行热裂敏感性评估。如图11所示, 铅笔探针模型产生“I”形铸件, 连杆直径范围为2至16mm。合金的热裂倾向指数 (HCTI) 定义:

If no cracking is found on any connection rods, the HCTI value will be 0. If cracking is found in all 8 connection rods (from 2mm to 16 mm), the HCTI value will be 1. Therefore, a smaller HCTI indicates a higher hot cracking resistance for a specific alloy. Five sets of pencil probes were cast for each composition in this study. The mold temperature was controlled at 300°F (~149°C) and pouring temperature was at 1330°F(704°C).

The experimentally determined hot cracking tendencies for Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe alloys with various silicon contents are plotted in Figure 12. Alloys with around 1.2 to 1.6wt% Si showed the best hot cracking resistance. The experimental results are in good agreement with the predicted results that were shown in Figure 7.

### 3.3 HIGH PRESSURE DIE CASTING TRIALS OF THE NEW NHT ALLOYS

#### 3.3.1 HPDC Casting of New NHT Alloys

High pressure die casting trials were conducted at Canmet Materials, Canada, on a 1200-ton vacuum-assisted high pressure die casting machine with the side impact beam die. A fast shot speed of 4m/s was used. A vacuum level of 8mBar was achieved in the die cavity. After ejection from the die, castings were cooled alternately by water quench and in air.

Two new NHT alloys, A152 and A153, were tested. A152 and A153 are two Alcoa patent pending A-alloys. Alloy A152 contains about 3.0wt% Mg, and Alloy A153 contains about 4.0 wt% Mg. These two alloys were designed with good hot cracking resistance by the ICME approach. The melt temperature of each alloy was set to about 115°C above its liquidus, while the die temperature was kept at 120°C.

Figure 13 shows two side impact beam castings of the new NHT alloy(alloy A153). Based on feedback from the die casting operator, both A152 and A153 alloys had very similar castability as the A380 alloy. Both alloys showed good hot cracking resistance in high pressure die casting.

#### 3.3.2 Microstructures of the New NHT Alloys

As shown in Figure 8, adding Si to the C446 alloy will alter its solidification path to a different direction. For both A152 and A153 alloys, upon cooling, phases coming out of the liquid are first the  $\alpha$ -Al15(Fe, Mn)<sub>3</sub>Si<sub>2</sub> particles, followed by the Al fcc solid solution phase, and finally a mixture of fcc phase,  $\alpha$ -Al15(Fe, Mn)<sub>3</sub>Si<sub>2</sub> and Mg<sub>2</sub>Si.

Figure 14 is the typical as-cast microstructure of alloy A152. It consists of aluminum dendrites, uniformly distributed small  $\alpha$ -Al15(Fe, Mn)<sub>3</sub>Si<sub>2</sub> particles, and the eutectics. Figure 15 shows the eutectic microstructure at higher magnification. The dark (black) particles are Mg<sub>2</sub>Si, and the white ones are  $\alpha$ -Al15(Fe, Mn)<sub>3</sub>Si<sub>2</sub>.

如果在所有连杆上没有发现开裂，则HCTI值为0。如果在所有8个连杆（从2mm到16mm）中都发现开裂，则HCTI值将为1。因此，对于这种特定的合金，较小的HCTI值表示抗热裂的性能较高。在该研究中为每种合金组合浇铸了5组铅笔探针。模具温度控制在300°F (~149°C)，浇注温度为1330°F (704°C)。

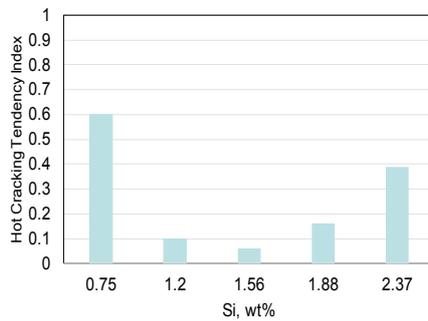


Figure 12. Effect of Si on hot cracking tendency of the C446 alloy (Al-3.6wt.%Mg-0.12wt.%Fe-1.2wt.%Mn-Si) determined by experiments

图12: 通过实验确定的Si对C446合金 (Al-3.6wt%Mg-0.12wt%Fe-1.2wt%Mn-Si) 的热裂倾向的影响。

实验确定的具有不同Si含量的Al-3.6wt%Mg-1.2wt%Mn-0.12wt%Fe合金的热裂趋势绘制在图12中。Si含量约1.2-1.6wt%的合金显示出最佳的抗热裂性。实验结果与图7中显示的预测结果非常一致。

#### 3.3新型NHT合金的压铸试验

##### 3.3.1新型NHT合金的压铸实践

压铸试验在加拿大Canmet材料公司的1200吨真空辅助压铸机上进行，带有侧面冲击梁冲头。使用4m/s的快速射速。在模腔中实现了8mBar的真空水平。从模具中取出后，通过水淬和空气交替冷却铸件。

测试了两种新的NHT合金A152和A153。A152和A153是两种美国正在申请专利的A型合金。合金A152的Mg含量约3.0wt%，合金A153的Mg含量约4.0wt%。通过ICME方法设计这两种合金具有良好的抗热裂性。每种合金的熔融温度设定在其液相线以上约115°C，而冲头温度保持在120°C。

图13是新NHT合金（合金A153）的两个侧面碰撞梁铸件。根据压铸操作员的反馈，A152和A153合金的铸造性与A380合金非常相似。两种合金在压铸中都表现出良好的抗热裂性。

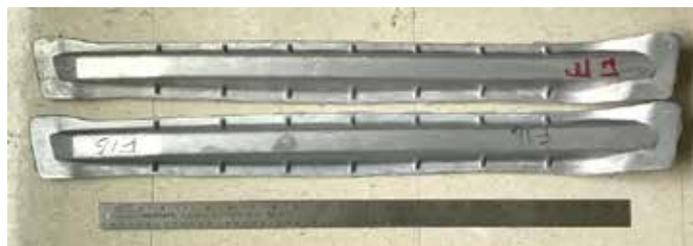


Figure 13. High pressure die cast side impact beam castings

图13: 高压压铸侧面冲击梁铸件。

##### 3.3.2新型NHT合金的微观结构

如图8所示，向C446合金中添加Si会将其凝固路径改变为不同的方向。对于A152和A153合金，冷却后，从金属液中析出的相首先是 $\alpha$ -Al15 (Fe, Mn)<sub>3</sub>Si<sub>2</sub>颗粒，然后是Al fcc固溶体相，最后是fcc相， $\alpha$ -Al15的混合物。(Fe, Mn)<sub>3</sub>Si<sub>2</sub>和Mg<sub>2</sub>Si。

图14是合金A152的典型铸态微观结构。它由铝枝晶、均匀分布的小 $\alpha$ -Al15 (Fe, Mn)<sub>3</sub>Si<sub>2</sub>颗粒和共晶组成。图15显示了在更高放大倍数下的共晶微观结构。深色（黑色）颗粒是Mg<sub>2</sub>Si，白色颗粒是 $\alpha$ -Al15 (Fe, Mn)<sub>3</sub>Si<sub>2</sub>。

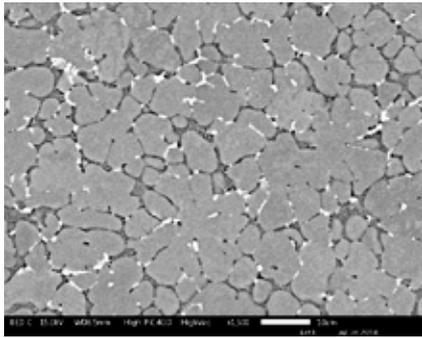


Figure 14. Typical as-cast microstructure in the HPDC NHT alloy (Alloy A152)  
图14: 高压压铸NHT合金 (合金A152) 中的典型铸态显微

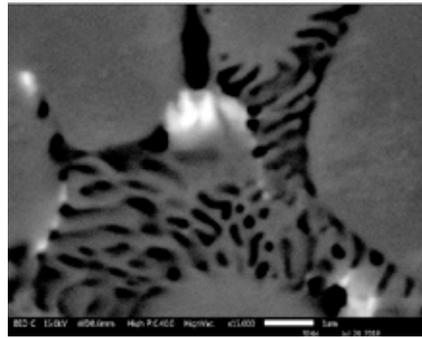


Figure 15. The eutectic microstructure in the HPDC NHT alloy (Alloy A152)  
图15: 高压压铸NHT合金 (合金A152) 中的共晶显微组织。

### 3.3.3 Mechanical Property

Tensile properties were determined for each alloy in the as-cast condition according to the ASTM B557 method. All tests were conducted at Westmoreland Mechanical Testing & Research(WMTR). Sub-size flat tensile specimens were cut from different locations on the HPDC side impact beam castings.

Figure 16 shows the effect of alloy composition and after-ejection cooling approach, water quench or air cool, on as-cast mechanical properties. The water quenched specimens showed about 5 to 10 MPa higher average yield strength and 10-15MPa higher average tensile strength than the air cooled specimens. The impact of the after-ejection cooling approach on elongation can not be conclusively determined due to scattered data distribution.

Increasing Mg content in these NHT alloys will increase strength and decrease elongation. For water quenched castings, alloy A152 can achieve average yield strength of 150MPa, average tensile strength of 265MPa and average elongation of 11%. Alloy 153 can achieve average yield strength of 170MPa, average tensile strength of 280MPa and average elongation of 9% for water quenched specimens.

Mechanical properties for heat treated and non heat treatable high pressure die casting alloys are compared in Table 1. The achievable mechanical properties are strongly dependent on the casting process used. Data shown in table 1 are typical properties obtained in thin-walled high pressure die casting components.

### 3.3.3力学性能

根据ASTM B557方法测定铸态条件下每种合金的拉伸性能。所有测试均在威斯特摩兰机械测试和研究所(WMTR)进行。从压铸的侧冲击梁铸件上的不同位置切割出小尺寸的扁平拉伸试样。

图16显示了合金成分和喷射冷却方法, 水淬或空气冷却对铸态力学性能的影响。水淬样品的平均屈服强度比空气冷却样品高5-10MPa, 平均拉伸强度高10-15MPa。由于分散的数据分布, 不能最终确定喷射冷却方法对延伸率的影响。

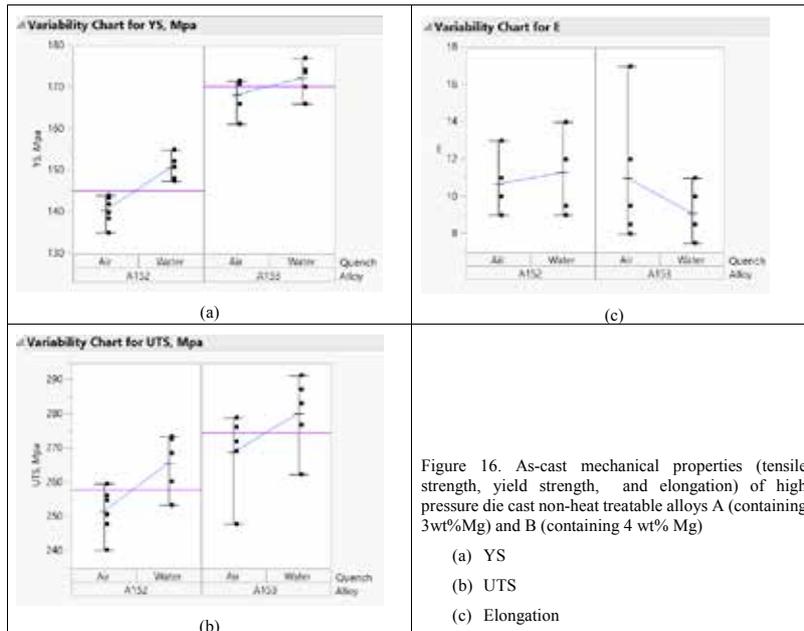


Figure 16. As-cast mechanical properties (tensile strength, yield strength, and elongation) of high pressure die cast non-heat treatable alloys A (containing 3wt%Mg) and B (containing 4 wt% Mg)

- (a) YS
- (b) UTS
- (c) Elongation

Table 1. Comparison of mechanical properties of heat treated and non heat treatable high pressure die casting alloys

Alloy		Temper	Yield Strength, Mpa	UTS, Mpa	Elongation, %
Heat Treated	370 (EZCast)	T5	150-220	245-310	5.5-10
Heat Treated	370 (EZCast)	T6	135-250	195-300	7.0-16
NHT	A152	as-cast	135-155	240-270	9.0-14.0
NHT	A153	as-cast	160-175	250-290	7.5-17

增加这些NHT合金中的Mg含量将增加强度并降低延伸率。对于水淬铸件, A152合金的平均屈服强度为150MPa、平均抗拉强度为265MPa、平均延伸率为11%。对于水淬铸件, A153合金的平均屈服强度为170MPa、平均抗拉强度为280MPa、平均延伸率为9%。

表1中比较了热处理和不可热处理的压铸合金的力学性能。可实现的力学性能在很大程度上取决于所用的铸造工艺。表1中所示的数据是在薄壁压铸部件中获得的典型性能。

#### 4. Summary and Conclusions

The ICME approach has been used to accelerate non-heat treatable alloy development for automotive applications. Effects of various alloying elements on the hot cracking tendency of the Al-Mg-Mn-Si-Fe alloys have been investigated. The following conclusions can be obtained.

1. The Model predicted hot tearing tendencies correlated very well with the experimental results of multicomponent aluminum alloys.
2. The hot cracking resistances of the Al-Mg-Mn type of non-heat treatable alloys can be significantly improved by adding the proper amount of silicon. The optimal silicon content is affected by Mg, Mn and Fe contents, and can be determined by the ICME approach.
3. Two new NHT alloys, A152 and A153, showed good resistance to hot cracking. This is validated by lab hot cracking evaluation and by HPDC casting trials with an automotive door crash rail casting;
4. Alloy A152 can achieve average yield strength of 150MPa, average tensile strength of 265MPa and average elongation of 11%.
5. Alloy 153 can achieve average yield strength of 170MPa, average tensile strength of 280MPa and average elongation of 9%.
6. Besides the development of aluminum foundry alloys, this model can also be used for many other applications, such as welding filler alloy development and additive manufacturing alloy development. ■

#### 5. Reference

1. <https://energy.gov/articles/545-mpg-and-beyond-materials-light-en-load-fuel-economy>
2. <http://www.drivealuminum.org/aluminum-advantages/efficiency/>
3. 1994-The first all-aluminum automobile, <http://www.alcoa.com/global/en/who-we-are/history/default.asp>
4. Aluminum Automotive Manual <http://european-aluminium.eu/resource-hub/aluminium-automotive-manual/>
5. Die casting process and equipment, US patent US5370171, <https://www.google.com/patents/US5370171>
6. Patrick S. Cheng, Yeou-Li Chu, Ben Ueda and Xinyan Yan, Development of heat treatment process of a ductile casting alloy for high vacuum die cast automotive structural components, 2015 Die casting congress & Exposition
7. Xinyan Yan and Jen Lin, Prediction of Hot Tearing Tendency for Multicomponent Aluminum Alloys, Metallurgical and Materials Transactions B, 2006, Vol. 37B.
8. Integrated Computational Materials Engineering (ICME): Implementing ICME in the Aerospace, Automotive, and Maritime Industries, A Study Organized by The Minerals, Metals & Materials Society Warrendale, PA 15086, [www.tms.org](http://www.tms.org)
9. I.I. Novikov: Goryachelomkost Tsvenykh Metallov i Splastov (Hot Shortness of Non-Ferrous Metals and Alloys), Nauka, Moscow, 1966, pp. 220-40.
10. W.I. Pumphrey: "The Aluminum Development Association Report No. 27," Aluminum Development Association, London, 1955.
11. D. Warrington and D.G. McCartney: Cast Met., 1989, vol. 2,
12. PanEngine API, [http://www.computherm.com/index.php?route=product/product&path=71&product\\_id=1](http://www.computherm.com/index.php?route=product/product&path=71&product_id=1).
13. PanAluminum Thermodynamic Database, [http://www.computherm.com/index.php?route=product/product&path=59\\_83&product\\_id=9](http://www.computherm.com/index.php?route=product/product&path=59_83&product_id=9)
14. J.C. Ramseyer, Aluminium, 1982, vol. 58 (10), pp. 581-85.

#### 4. 总结和结论

ICME方法已被用于加速汽车应用的非热处理合金的开发。研究了各种合金元素对Al-Mg-Mn-Si-Fe合金热裂倾向的影响。可获得以下结论:

1. 该方法预测热裂倾向与多元铝合金的实验结果非常相关;
2. 通过添加适量的Si, 可以显著提高Al-Mg-Mn型不可热处理合金的抗热裂性能。最佳Si含量受Mg、Mn和Fe含量的影响, 可通过ICME方法确定;
3. 两种新的NHT合金A152和A153显示出良好的抗热裂性, 可以通过实验室热裂评估和压铸试验与汽车门碰撞轨道铸件进行验证;
4. 合金A152的平均屈服强度为150MPa、平均抗拉强度为265MPa、平均延伸率为11%;
5. 合金A153的平均屈服强度为170MPa、平均抗拉强度为280MPa、平均延伸率为9%;
6. 除了铸造铝合金的开发外, 该方法还可用于许多其他应用, 例如焊接填充合金开发和增材制造合金开发。

#### 5.参考文献

1. <https://energy.gov/articles/545-mpg-and-beyond-materials-light-en-load-fuel-economy>
2. <http://www.drivealuminum.org/aluminum-advantages/efficiency/>
3. 1994-The first all-aluminum automobile, <http://www.alcoa.com/global/en/who-we-are/history/default.asp>
4. Aluminum Automotive Manual <http://european-aluminium.eu/resource-hub/aluminium-automotive-manual/>
5. Die casting process and equipment, US patent US5370171, <https://www.google.com/patents/US5370171>
6. Patrick S. Cheng, Yeou-Li Chu, Ben Ueda and Xinyan Yan, Development of heat treatment process of a ductile casting alloy for high vacuum die cast automotive structural components, 2015 Die casting congress & Exposition
7. Xinyan Yan and Jen Lin, Prediction of Hot Tearing Tendency for Multicomponent Aluminum Alloys, Metallurgical and Materials Transactions B, 2006, Vol. 37B.
8. Integrated Computational Materials Engineering (ICME): Implementing ICME in the Aerospace, Automotive, and Maritime Industries, A Study Organized by The Minerals, Metals & Materials Society Warrendale, PA 15086, [www.tms.org](http://www.tms.org)
9. I.I. Novikov: Goryachelomkost Tsvenykh Metallov i Splastov (Hot Shortness of Non-Ferrous Metals and Alloys), Nauka, Moscow, 1966, pp. 220-40.
10. W.I. Pumphrey: "The Aluminum Development Association Report No. 27," Aluminum Development Association, London, 1955.
11. D. Warrington and D.G. McCartney: Cast Met., 1989, vol. 2,
12. PanEngine API, [http://www.computherm.com/index.php?route=product/product&path=71&product\\_id=1](http://www.computherm.com/index.php?route=product/product&path=71&product_id=1).
13. PanAluminum Thermodynamic Database, [http://www.computherm.com/index.php?route=product/product&path=59\\_83&product\\_id=9](http://www.computherm.com/index.php?route=product/product&path=59_83&product_id=9)
14. J.C. Ramseyer, Aluminium, 1982, vol. 58 (10), pp. 581-85.

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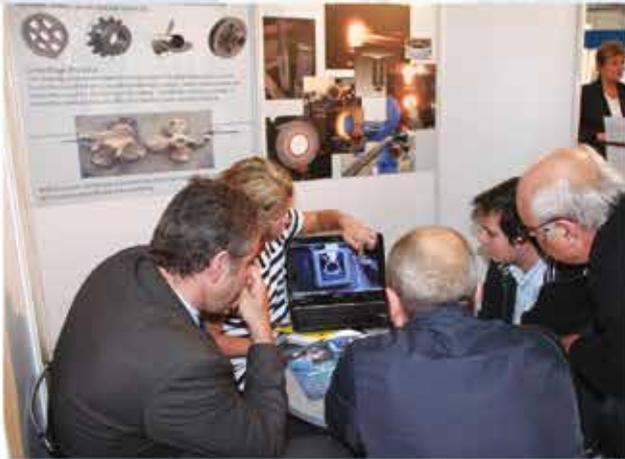
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作为行业发展的风向标——中国国际铸造博览会（以下简称“铸博会”）与中国国际压铸工业展览会（以下简称“压铸展”）正在通过不断整合全行业上下游资源促进行业发展方式由高污染、高耗能、高排放向“绿色、安全、环保、智能”方向转变。集展示、交流、贸易、洽谈于一体，2019年3月13-16日，“双展”合璧再次释放出行业博览会的魅力，1180家展商、86492人次专业观众走进展会，其成功、精彩与难忘远超预期！



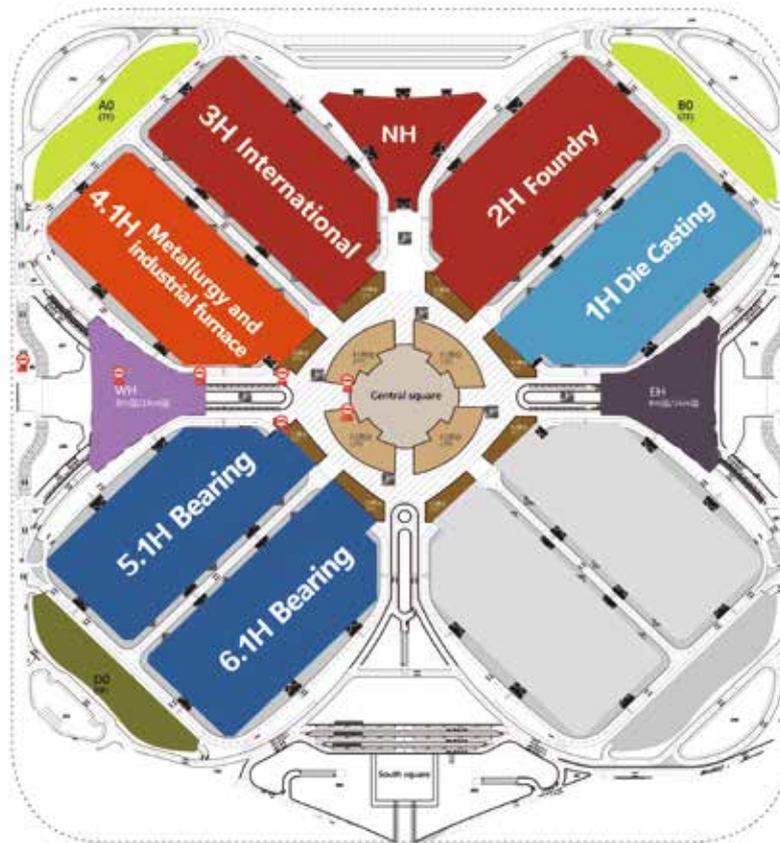


With the purpose to further enhance the internationalization level of the foundry exhibition and promote the globalization of the industry, China Foundry Association resolutely made a major strategic decision to jointly move the “Metal China” and “CIDC” to Shanghai, with the aim of creating a stronger and more professional international exhibition. Through extensively inviting international exhibitors and audiences, integrating the resources of the upstream and downstream industrial chains of the whole industry at home and abroad, building a green supply chain together, the effectiveness of the exhibition will be improved and China’s foundry industry will be pushed into the fast lane of high-quality development.

为进一步提升铸造展的国际化水平，助力行业全球化发展进程，中国铸造协会毅然做出将“铸博会”“压铸展”联合移师上海的重大战略决策，旨在打造出更强更专业的国际化大展，通过广泛邀约国际展商和观众、整合海内外全行业上下游产业链资源，协同构筑绿色供应链，提升展会实效性，推动中国铸造业驶入高质量发展的快车道。

**Joint Exhibit Area of 170,000sqm, Foundry Shocks the World**

From May 13 to May 16, 2020, the 18th China International Foundry Expo (Metal China) and the 14th China International Die Casting Industry Exhibition will be open in the National Exhibition and Convention Center(Shanghai). Meanwhile, the 18th China International Industrial Furnace and Thermal Technology Exhibition, the 20th China International Metallurgy Industry Exhibition and the 20th China International Bearing Industry Exhibition will be held jointly with a scale of 170,000 square meters. The number of exhibitors and professional visitors will continue to rise on the basis of 1,180 and 86,492 in 2019. At that time, the upstream and downstream industries will resonate at the same frequency and interact effectively, with frequent bright spots and unlimited business opportunities.



**四方联展17万 铸造震撼全球**

2020年5月13-16日，第十八届中国国际铸造博览会与第十四届中国国际压铸工业展览会将于国家会展中心（上海）领航开幕，同期第十八届中国国际工业炉及热工技术展览会、第二届中国国际冶金工业展览会、2020中国国际轴承及其专用装备展览会将实现四方联展，展会规模达17万平方米，展商数量与专业观众人数将在2019年1180家和86492人次的基础上持续攀升，届时上下游行业同频共振、有效互动，亮点频出，商机无限。

**Scope of exhibits:**

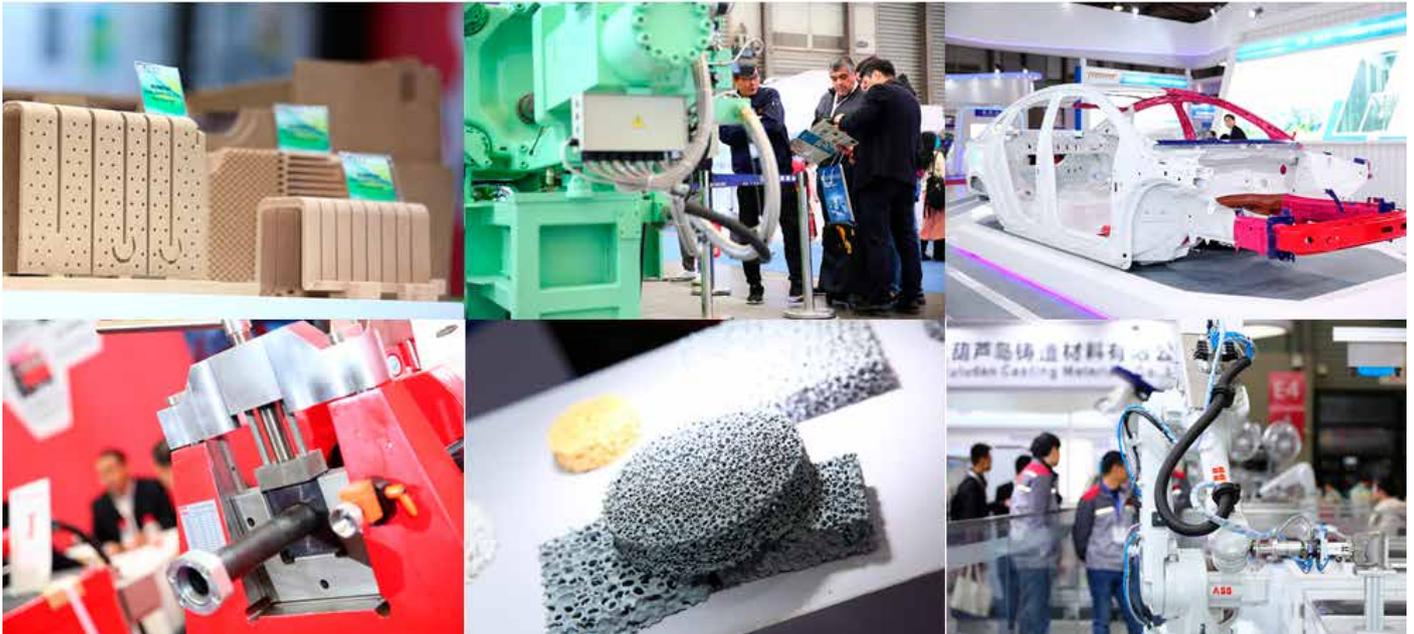
**The 18th China International Foundry Expo (Metal China)**

- Castings
- Foundry equipments
- Casting quality testing equipments
- Foundry materials
- Foundry moulds and patterns
- Foundry jigs and fixtures
- Casting machine tool equipment
- Automation equipments and peripheral equipments
- Environmental protection equipment
- Clean production and waste treatment
- Safe operation and environment
- Foundry technology
- Computer applications
- Special robots for foundry
- Others about casting
- Energy-saving technology and equipment

**展品范围:**

**第十八届中国国际铸造博览会**

- 铸件
- 铸造设备
- 铸件质量检测设备
- 铸造材料
- 铸造用模具
- 铸造用工装、夹具
- 铸件加工机床设备
- 自动化配套及周边设备
- 环保装备
- 清洁生产及废物处理
- 安全操作与环境
- 铸造技术
- 计算机应用
- 铸造专用机器人
- 节能技术与装备
- 其他



**The 14th China International Die Casting Industry Exhibition  
The 14th International Nonferrous and Special Casting Exhibition**

- Die casting
- Die casting machine
- Ancillary equipment
- Alloy and auxiliary material
- Die casting island and robots
- Post treatment equipment
- Die and tooling & fixture
- Gravity casting technology and equipment
- Wheel
- Low pressure casting technology and equipment
- Differential pressure, extrusion and semisolid casting technology and equipment

**第十四届中国国际压铸工业展览会  
第十四届国际有色及特种铸造展览会**

- 压铸件
- 压铸机
- 压铸机周边设备
- 压铸合金及辅助材料
- 压铸岛及专用机器人
- 压铸件后处理设备
- 压铸模具及工装夹具
- 重力铸造技术与设备
- 轮毂
- 低压铸造技术与设备
- 差压、挤压及半固态铸造技术与装备



**Concurrent activities:**

- 4th China Foundry Festival
- The 16th Annual Congress of China Foundry Association
- China Foundry Sourcing Alliance Meeting
- “Belt and Road” Forum on International Foundry Capacity
- The Award Ceremony of the 4th Single Champion Enterprise
- Lifetime Achievement Award and Craftsman Award of China Foundry Industry
- The 6th Green Foundry Demonstration Enterprises Award Ceremony
- Awarding Ceremony of the 10th Foundry Credit Rating Enterprises
- Honorary Award Ceremony of Specialty Industry Clusters and Specialty Production Bases
- Gold Awards for High-quality Castings, Innovation Foundry Equipment and Foundry Materials, New Foundry Technology Selection
- 8th BRICS Foundry Forum
- China Foundry Photography Competition
- On-site Industry Experts Consultation

**同期活动:**

- 第四届中国铸造节
- 第十六届中国铸造协会年会
- 中国铸造采购商联盟大会
- “一带一路”国际铸造产能合作发展论坛
- 第四批中国铸造行业单项冠军企业评选表彰
- 中国铸造行业终身成就奖、中国大工匠等表彰活动
- 第六批中国绿色铸造示范企业评选表彰
- 第十批铸造行业企业信用等级评价企业授牌
- 特色产业集群、特色生产基地荣誉称号授牌
- 优质铸件金奖、铸造装备创新奖、铸造材料金鼎奖、铸造“四新”技术评选
- 第八届金砖国家铸造论坛
- 中国铸造行业摄影大赛
- 权威行业专家现场咨询等百余项行业系列活动
- 2020中国国际压铸高层论坛暨第三届压铸CEO峰会
- 优质压铸件金奖评选及颁奖典礼
- 中国国际压铸件采购洽谈会
- 中国国际压铸人才交流会





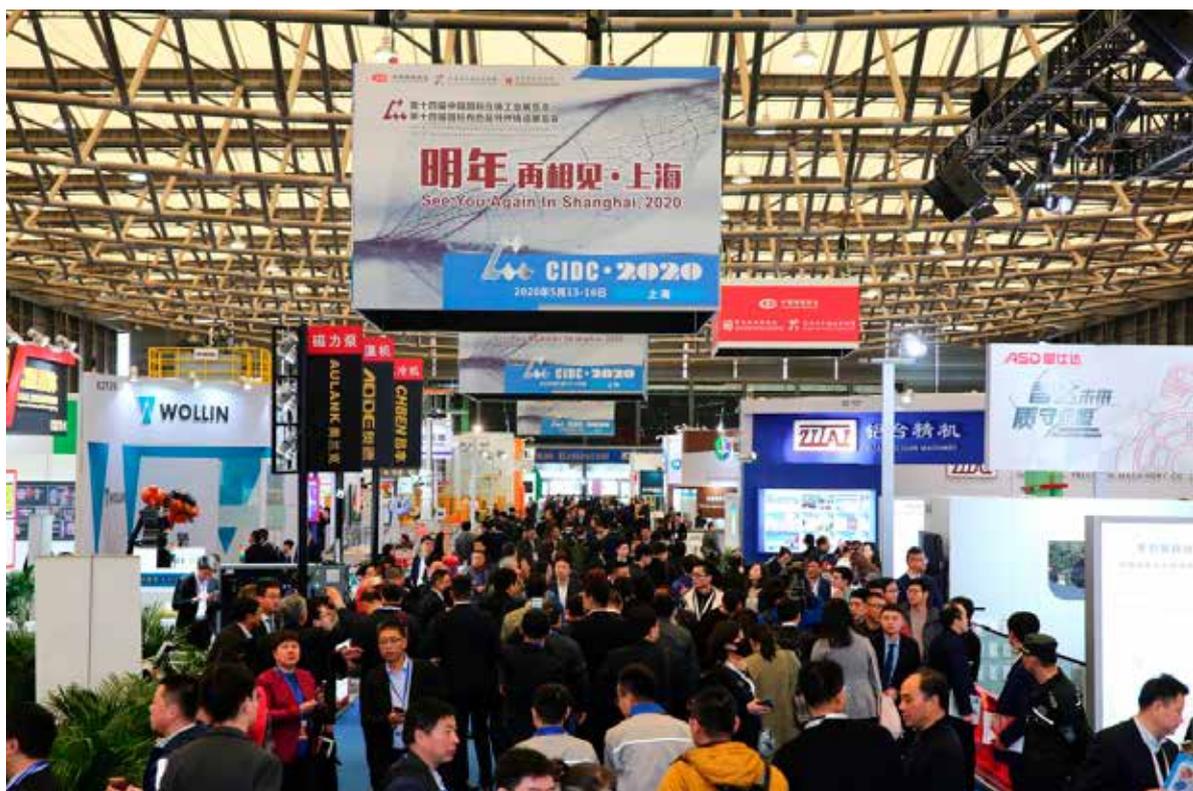
- 2020 China International Die Casting Congress & the 3rd CEO Forum
- Gold Awards for High-quality Die Castings
- China Die Casting Sourcing Fair
- China International Die-casting Talent Exchange

At present, all kinds of exhibitor invitation and investment promotion work at the exhibition are proceeding in an orderly manner so as to seize business opportunities in the industry.

For more information, please contact:  
 China Foundry Association  
 Beijing Zhongzhu Century Exhibition Co., Ltd.  
 Contact: Qiu Wenjing  
 Tel: 86 10-52592246-807  
 Email: qiuwenjing@foundry.com.cn  
<http://www.expochina.cn/>

目前展会的各项招展招商工作正紧锣密鼓、有序推进，抢占行业商机。  
 联系我们：

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<http://www.expochina.cn/>



# 第十八届中国国际铸造博览会

The 18<sup>th</sup> China International Foundry Expo ( Metal China )



Settle in Shanghai  
More International



## Metal China · 2020

May 13-16, 2020 National Exhibition and Convention Center (Shanghai)

Strong industrial base strengthens national power,  
Joint exhibition area up to **170,000** sqm  
Bearing rotates the world, foundry shocks the globe



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[www.foundry.org.cn](http://www.foundry.org.cn) [www.expochina.cn](http://www.expochina.cn)



## Metal+Metallurgy (Thailand) & the Smart Manufacturing Will Make its Debut in Sep.

**国际铸造冶金暨智能制造展将于今年9月首次登陆泰国**



Sponsored by China Foundry Association, co-Sponsored by Metallurgical Council of CCPIT and Industrial Furnace Institution of CMES, Metal+Metallurgy (Thailand) 2019 & The Smart Manufacturing Expo(Thailand) which is sponsored by CMEC International Exhibition Co., Ltd., will make its debut from Sep. 18-20, 2019 at BITEC, Bangkok, Thailand. It will be held concurrently with other themed exhibitions, including International Tube & Wire Southeast Asia (Bangkok, Thailand) 2019, International Trade Fair for the Plastics and Rubber Industries 2019 and the 7th International Packaging and Printing Exhibition for Asia at the same venue.

### About the exhibition:

There are 6 major themes of the Metal+Metallurgy (Thailand) 2019 & The Smart Manufacturing Exhibition (Thailand): Foundry, Die-casting, Metallurgy, Industrial Automation, Motion & Drives, Machine tools & Metalworking. The exhibition is aiming to create a professional event in the field of metal processing and intelligent manufacturing in Southeast Asia. During the exhibition, there will be a series of forums, technology release and promotion, China-Thailand entrepreneur's communication, Casting Sourcing Fair and other attractive supporting activities, which will attract exhibitors and trade visitors from Thailand and neighboring countries and even the entire Southeast Asia.

With the coordinated development of the global foundry industry, and with „Belt and Road“ initiative, it's time to carry out cooperation with Southeast Asian countries. The steady development of Southeast Asian countries and huge investment potential give rise to the potential demand of metal industry. Based on Southeast Asia, taking advantage of the opportunity of Thailand industry 4.0, this show will play its comparative advantage to build a comprehensive trade platform for all aspects of metal and smart manufacturing industry, and achieve win-win cooperation.

由中国铸造协会、中国国际贸易促进委员会冶金行业分会、中国机械工程学会工业炉分会主办的“2019年泰国国际铸造冶金展览会”以及由西麦克国际展览有限责任公司主办的“2019泰国国际机械与智能制造展览会”将于2019年9月18-20日首次在泰国曼谷国际贸易展览中心举办。同期还将举办“2019年东南亚（泰国曼谷）国际管件管材、线材线缆展览会”、“2019年泰国国际塑胶工业展览会”以及“2019年泰国国际包装印刷展览会”。

### 展会介绍:

展会涵盖铸造、压铸、冶金、智能制造、自动化、机床和金属加工六大主题，旨在打造东南亚金属加工及智能制造领域的专业盛会。展会期间将举办一系列行业高峰论坛、技术交流和推广、精品发布、中泰企业家交流会、东南亚采购商对接会等极具吸引力的配套活动，届时将吸引泰国及周边国家乃至整个东南亚的参展企业及观众。

随着全球铸造产业协同发展，借助“一带一路”倡议的政策利好，开展与东南亚国家的项目合作，时机已经成熟；而东南亚各国的稳步发展及巨大的市场投资潜力则催生了金属工业的潜在需求。借泰国工业4.0之机遇，展会将发挥比较优势，为中国及东南亚国家打造铸造、压铸、工业炉、冶金、智能制造等金属工业全方位的综合性交易平台，实现合作共赢。

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**Exhibition highlights:**

- Organizing advantages: with more than 30 years of industry exhibition experiences, the organizer has a good understanding of the industry development and has rich industry resources, with a professional team as well as supports of industry organizations and media at home and abroad.
- Based on Southeast Asia and face to the global market.
- Attract a large number of international visitors. Especially Southeast Asia and the entire Asia-Pacific.
- Focus on 6 major themes of foundry, die casting, metalurgy, industrial automation, motion & drives, machine tools & metalworking high-end casting products and foundry suppliers demonstrate the complete industry chain.
- Highlighted by a series of supporting activities.
- Match making programs.

**For more information, please contact:**

China Foundry Association  
 Beijing Zhongzhu Century Exhibition Co., Ltd.  
 Website: www.expochina.cn  
 Contact: Qiu Wenjing  
 Email: qiuwenjing@foundry.com.cn

CMEC International Exhibition Co., Ltd.,  
 Website: www.cmecexpo.com  
 Contact: Shelley Chen  
 Email: chenjh@cmecexpo.com ■

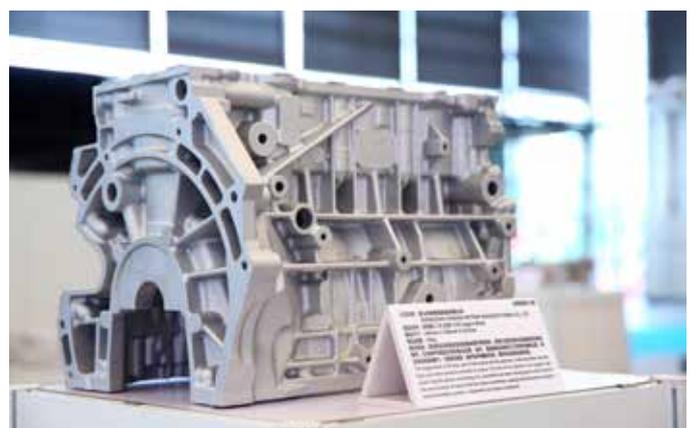
**展会亮点:**

- 集聚办展优势: 30余年行业办展经验, 行业及产业链资源丰富权威, 行业领先的大型展会专业策划团队, 海内外权威行业组织及媒体大力支持;
- 立足东南亚、辐射全球市场;
- 国际资源丰富、专业观众覆盖东南亚乃至整个亚太地区;
- 聚焦铸造、压铸、冶金、智能制造、自动化、机床和金属加工六大主题, 中、高端铸件产品琳琅满目; “轻、精、优” 高端铸造产品演绎完整产业链;
- 展会配套系列活动丰富多彩;
- 展会同期举办多场系列行业高峰论坛、技术交流和推广、精品发布、中泰企业家交流会、东南亚采购商对接会等极具吸引力的配套活动。

**更多信息, 请联系我们:**

中国铸造协会  
 北京中铸世纪展览有限公司  
 网址: www.expochina.cn  
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 网址: www.cmecexpo.com  
 联系人: 陈金花  
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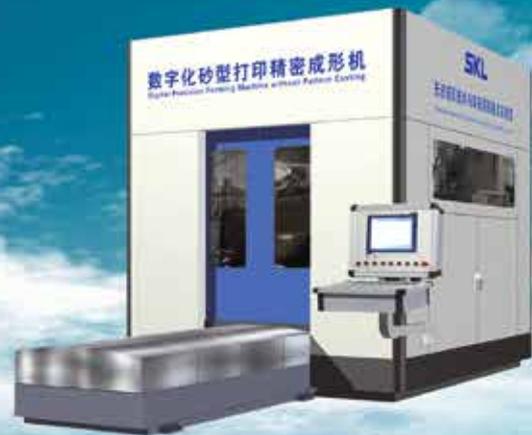
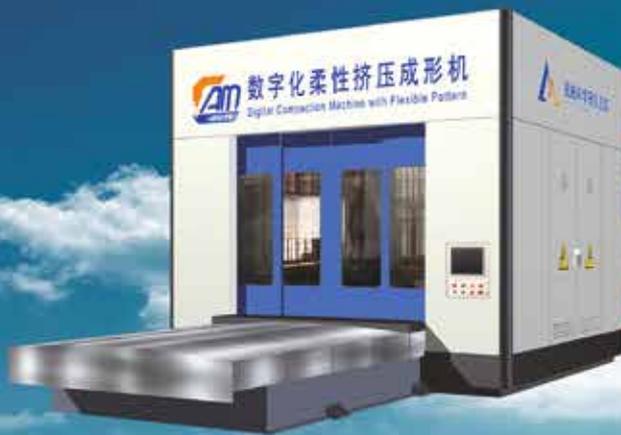
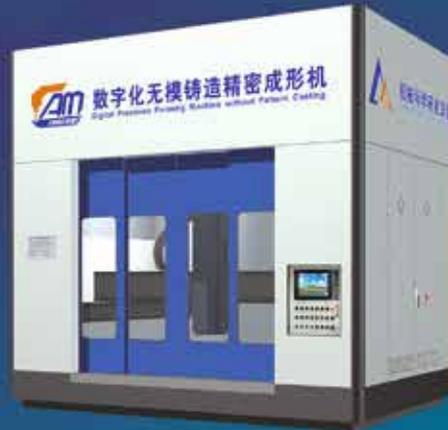




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High speed train volute



复杂云纹铜鼎  
Moire tripod



V6柴油机机体  
V6 diesel engine block



V-16柴油发动机缸体  
V16 diesel engine cylinder block

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