

Casting Education Opportunities in Germany

Global Casting Magazine asked several Germany-based educational institutions to share their approach to metalcasting training and research.

A GLOBAL CASTING MAGAZINE STAFF REPORT

德国铸造教育的机制

《世界铸造》杂志访问了几个德国的教育机构分享他们铸造方面的培训和研究。

《世界铸造》杂志报道

With the world's best production rate and a reputation for innovation in metal casting, Germany is highly regarded for its industry expertise. A main facet of this technology stronghold is the training and educational background of the country's workforce. *Global Casting Magazine* collected information on a few of its leading casting technology institutions to share their philosophies and educational strategies.

Foundry Technology at Aalen University of Applied Sciences

The Foundry Technology Aalen (GTA) at Aalen Univ., Aalen, Germany, (the "G" stands for the German word for foundry, giesserei), focuses on the development of metalcasting products and processes. The research facility incorporates all major casting processes and casting alloys, including aluminum and magnesium high pressure die casting as well as iron sand castings. Research activities focus on innovations such as the development of salt cores or gas injection technologies for the production of hollow shapes in high pressure die castings. The GTA center also supplies the following services to the industry:

- General support and trainings for metalcasting facilities.
- Process and product development.
- Seminars for design engineers in the range of casting applications and design.
- Production of prototypes and small casting series.
- New alloy testing.
- Running in and optimization of pressure diecasting tools.
- Damage analysis using x-ray and 3D-computer tomography.

在铸造这个专业领域，德国拥有世界上最好的生产效率和创新的声誉，这一声誉主要源于德国的从业人员的教育背景和培训。

《世界铸造》杂志收集了其中一些领先的铸造技术培训机构的信息,以分享其哲学和教育战略。

阿伦科技大学铸造学院

阿伦铸造技术学院 (GTA) 位于德国, 阿伦。(“G” 代表为铸造用德语单词, giesserei), 专注于铸造产品和工艺的发展。研究机构集成了所有主要的铸造工艺和铸造合金, 包括铝, 镁压铸以及砂铸。研究工作主要集中在技术创新, 如中空形状的压铸件生产中的盐芯或注气技术的发展。GTA中心还为铸造业提供以下服务:

- 为铸造厂提供一般的支持和培训。
- 工艺和产品开发。
- 关于铸造应用和设计工程师的研讨会。
- 生产的原型和小铸件系列。



- Material testing for magnesium, aluminum and zinc alloys. The GTA center has a wide range of foundry specific equipment, such as:

- Four high pressure die casting machines, cold and hot chamber.
- Permanent mold, including tilt capability.
- Sand casting laboratory.
- Melting furnaces for iron, magnesium and aluminum.
- Tensile, creep and fatigue testing.

The GTA center is led by Prof. Dr.-Ing. Lothar H. Kallien and Dr.-Ing. Alexander Baesgen and can be contacted at gta@htw-aalen.de.

The Foundry Institute of the TU Mining Academy

Adolf Ledebur (1837-1906), an expert in iron and steelwork, was the founder of research and studies in foundry technology at the Mining Academy. He took up the professorship of a newly established chair in iron metallurgy and also concerned himself with foundry technology (primarily iron and steel casting). Later, in 1942, professor Uhlitzsch established the Freiberg Foundry Institute in the newly constructed building of the Ironworks Institute in 1929. The Foundry Institute of the TU Mining Academy Freiberg, Freiberg, Germany, with its present director Professor Klaus Eigenfeld, now occupies an important place in research and studies in metalcasting technology in Germany.

Traditionally, the areas of iron and steel casting materials, together with molds and the molding process, have been the main focus of the Institute. The two large, existing metalcasting testing rooms have all the equipment necessary for metalcasting operation and make practice-oriented training possible, together with the industry-oriented development of materials and products. The comprehensively-equipped molding laboratory makes provision for the repair, testing and research of all casting-related molding systems. Classical research focus points in mold-making include bentonite-based molding systems and inorganic chemical binders and molding processes. Since the reunification of Germany, classic research focus points in the area of mold materials include molding of light metals in sand and pressure castings, as well as the new field of fine molding processes, which is an area of intense development at the Institute. Through a number of industry contacts, the practical relevance of the Institute's activities is ensured.

Student training at the Institute is currently divided into two fields. First, students can graduate with a master's degree in engineering after ten semesters of study. Or, students may obtain a bachelor's degree in foundry technology after seven semesters of study. Studying at the Institute involves three main areas: foundry process design, casting

- 新合金材料的测试。
- 压铸机的运行优化。
- 用X射线和三维计算机断层扫描进行探伤分析。
- 镁, 铝, 锌合金材料测试。

GTA中心具有很宽的范围的铸造专用设备, 如:

- 四台冷, 热室压铸机。
- 可倾转的金属型。
- 砂型铸造实验室。
- 铁, 镁和铝的熔化炉, 。
- 强度, 蠕变和疲劳测试。

GTA中心由Lothar H. Kallien教授、博士和Alexander Baesgen博士领导, 可以联系gta@htw-aalen.de。

TU矿业学院铸造研究所

Adolf Ledebur (1837-1906), 铸铁和铸钢方面的专家, 是矿业学院铸造技术研究所的创始人。他最初获得冶金教授职位, 也涉及铸造技术研究(主要是铸铁和铸钢)。后来, 在1942年, Uhlitzsch教授建立了弗莱堡铸造研究所, 在1929年在新建了铸铁研究所。德国弗莱堡TU矿业学院铸造研究所, 现任所长Klaus Eigenfeld教授, 现在德国铸造技术的研究领域占有重要的一席之地。

传统上, 铸铁和铸钢领域, 连同模具和造型工艺, 已经是研究所主要研究领域。现有的两个大型铸造实验室拥有所有必要的设备, 完成铸造操作, 并面向实践培训, 以及材料和产品产业化发展。全面配备的造型实验室提供的所有铸造造型系统的维修, 测试和研究。传统研究的着力点, 在模具制造包括基于膨润土的造型系统和无机化学粘合剂的造型工艺。自德国统一以来, 经典的模具材料领域的研究侧重点包括砂铸和压铸成型的轻金属, 以及精细造型工艺的新领



materials and molding. These main fields can be supplemented with topics such as solidification simulation or economic and business aspects. Another integral part of the study program is a practical semester in which students must work at a metalcasting facility for six months. Students must furthermore solve technological problems independently, summarize the results and then defend their findings in public. This highlights the practical approach followed by the Institute. The possibility exists, after successful completion of the Bachelor's degree program, to continue with further studies towards the completion of the Master's degree in engineering. At present, about 100 students are studying foundry technology at Freiberg.

In addition to numerous connections with German universities, the Institute also collaborates with foreign universities that offer training in foundry technology, including the Univ. of Miskolc in Hungary, the Mining and Metallurgic Academy of Krakau, Poland, or the Univ. of Johannesburg in South Africa. Presentations at meetings and conferences, joint research projects and student exchange program, including doctoral students, result from these collaborations with other institutions. One of the recent highlights in terms of these international collaborations is the exchange of four students from the Univ. of Johannesburg. These students have been studying in Germany since March 2012, with the goal of completing an engineering degree in foundry technology.

Institute for Foundry-Technology at Kassel University

The new chair for foundry technology at Kassel Univ., Kassel, Germany, is under the leadership of Prof. Dr.-Ing. Martin Fehlbier, who has started work in teaching and research since October 2012.

The chair was implemented by the support of Prof. Dr. Becker from Volkswagen Kassel with the objective to ensure the increasing demand on junior staff of excellent educated metalcasting engineers in theoretical and practical aspects and to expand the technology know-how in the field of lightweight cast components and structure parts. For these reasons, Volkswagen decided to support the installation of the new chair with 1 million euro. Another objective is to lift the quality of cooperation in research and development between university, OEM and supplier on a new and excellent level. For this purpose it is planned to install an industrial research network for innovative lightweight cast technology at the university.

The lectures and teaching of the chair for foundry technology will take place at the campus of Kassel Univ. in the north of the city. The research field and the labors of the new chair are located in the south of Kassel, about 5 minutes distance from the Volkswagen metalcasting facility, the largest in Europe with nearly 70 aluminum and magnesium high-pressure die-casting machines.

**Chair for Foundry-Technology
Prof. Dr.-Ing. Martin Fehlbier**



Prof. Dr.-Ing. Martin Fehlbier

域,这是一个蓬勃发展的领域。研究所通过一系列的产业联系,确保该研究所的活动有实际意义。

目前,学生在研究所的训练分为两个领域。首先,学生可以通过10个学期的学习,毕业后获得工程硕士学位。或者7个学期的学习后,学生可取得铸造技术学士学位。该研究所的研究涉及到三个主要领域:铸造工艺设计,铸造材料和模具。这些主要领域补充凝固模拟或经济和商业方面的课题。另一部分是实习环节,学生必须在一个铸造厂实习六个月。此外,学生必须独立解决技术难题,总结结果并公开发表他们的研究结果。这突出了实用的方法。成功完成学士学位课程后,继续进一步完成工程硕士学位的可能性是存在的。目前,大约有100名学生正在弗莱堡铸造研究所学习铸造技术。

除了大量的联系德国高校,学院还向国外大学提供铸造技术的培训,包括匈牙利米什科尔茨大学,波兰的克拉考采矿和冶金学院,南非约翰内斯堡大学。会议介绍和研讨会,共同研究项目和学生交换计划,包括博士研究生,是与其他机构的合作模式。在国际合作方面近期的亮点之一是约翰内斯堡大学的4名交流学生的。自2012年3月,这些学生在德国学习,完成铸造技术工程师学位。

在卡塞尔大学铸造技术研究所

一个新项目正在德国卡塞尔的卡塞尔大学铸造技术研究所Martin Fehlbier教授、博士的领导下进行,他从2012年10月已经开始教学和研究工作。新项目在大众汽车(卡塞尔)贝克尔博士教授的支持下实施,其目的是确保作为初级员工的受过理论和实践方面优秀教育的铸造工程师们不断增加的需求和扩大在实现铸造零部件和结构件轻量化领域的技术诀窍。由于这些原因,大众汽车决定支持投入100万欧元到

新项目。另一个目标是提升大学,OEM厂商和供应商之间研究和开发合作的质量到一个新水平。为了这个目的,计划为轻量化铸造技术的创新在大学内安装工业化研究网络。铸造技术的教育和培训,将在卡塞尔大学校园进行,在城市

Fehlbier earned his doctorate at RWTH Aachen Univ. under Prof. P.R. Sahm and has worked for the last four years at Volkswagen Kassel as the leader of the Technology-Center of the plant and was responsible for production of lightweight structure components, especially for Volkswagen and Audi. Previously, he has worked for Kolbenschmidt-Pierburg AG in Nettetal-Gemany, where he was responsible for the foundry, tooling, construction/simulation and cast development.

The scientific orientation of the subject consists in the development and characterization of new lightweight materials and applications and in the development of innovative technologies and processes for their production and processing with a focus on high-pressure diecasting and chill casting.

Institute of Metal Forming and Casting, Technische Universität München

The Institute of Metal Forming and Casting (utg) of the Technische Universität München (TUM) is located in Garching, Germany, approximately 20 km north of Munich.

The utg works in the field of production engineering, which is associated with the Faculty of Mechanical Engineering. The institute's four research groups focus on casting, metal forming, sheet metal cutting and simulation technologies.

Besides fundamental research, the majority of the projects at the utg are financed by third-party funds and industrial partners. This gives us the possibility to apply our scientific practice close to industrial requirements.

The casting technology group is made up of 10 research associates, who focus on continuous casting, residual stress, tool and die technology, and molding materials.

With the onsite continuous casting rig, the utg can investigate and optimize a wide range of horizontal and vertical nonferrous casting processes. These processes are backed by state of the art simulation models.

Besides classical methods of residual stress analysis (e.g. incremental hole-drilling), the cooperation with the Forschungs-Neutronenquelle Heinz Maier-Leibniz (FRM III), Garching, gives the utg the opportunity for material characterization by neutron diffraction.

The tool and die technology for permanent mold casting processes and the analysis of mold materials is of major interest. With a 3D printing system, the institute can produce inorganically-bound sand molds and cores. These new binders bring sustainable advantages with respect to core and mold production, as well as less gas emission during casting compared to organically-bound sand molds and cores.

The utg offers mechanical engineering students a large variety of lectures and practical courses in metalcasting.

While students work on their theses (about 25 diploma, bachelor and master theses per year), they are extensively involved in the institute's projects and have the chance to combine hands-on practical work with university research methods. ■

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的北方。研究场地和新项目的工作位于卡塞尔的南部，距离大众汽车铸造厂约5分钟，这是欧洲最大的铸造厂，有近70台铝合金和镁合金高压压铸机。

Fehlbier在亚琛工业大学获得博士学位。师从PR SAHM教授，曾在过去的四年里的担任大众卡塞尔工厂的技术中心领导，负责轻量化的结构件和铸造零部件生产，特别是对于大众和奥迪。在此之前，他曾在德国内特塔尔市Kolbenschmidt-Pierburg AG公司工作，在那里他负责的铸造，模具，结构/模拟和铸造发展。

新项目科学的定位和新型轻质材料和应用的发展，创新的技术和工艺的发展，生产和加工专注于高压压铸和冷硬铸造工艺。

慕尼黑工业大学金属造型与铸造研究所

慕尼黑工业大学（TUM）金属造型与铸造研究所（UTG）位于德国慕尼黑以北约20公里的Garching市。UTG的研究领域是生产工艺，属于机械工程学院。研究所的4个研究小组分别研究铸造，金属成形，金属板材切割和仿真技术。

除了基本的研究，多数在UTG的项目资金由第三方资金和产业的合作伙伴提供。这使我们的科学实践应用能贴近行业需求。

铸造技术组是由10个研究机构组成，专注于连铸，残余应力，模具技术，造型材料。

由于有现场连铸装置，UTG可以进行审查并优化多种水平和垂直的有色金属铸造工艺。这些工艺由最先进的仿真模型支持。

除了常规的残余应力分析（例如逐层钻孔法），与Garching市Heinz Maier-Leibniz中子资源研究所合作的，给了UTG机会通过中子衍射了解材料特性。

模具技术主要研究金属型铸造工艺的和模具材料的分析。使用3D打印系统，研究所可产生无机粘结的砂型和型芯。这些新的粘合剂在生产芯子和砂型方面带来可持续的优势，与有机粘结砂造型与制芯相比，减少气体排放。UTG给机械工程专业学生提供了大量的各种讲座

和铸造厂中实践课程。当学生准备他们的毕业论文（每年约25学士和硕士毕业），他们广泛地参与在研究所的项目中，并有机会把大学的研究方法用于实际工作中。 ■

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