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AMAP FORUM 2018:

Aluminium trumps in Lightweight Construction

- **Lightweight construction through flexible rolling of high-strength aluminium**
- **Structural components with functional integration through aluminium hollow castings**
- **New design and calculation methods for high-strength aluminium alloys**

As an engineering material, aluminium is inseparably connected to lightweight automotive design. At the AMAP FORUM on 19th of April 2018 in Aachen, scientific and industry experts demonstrated clearly that the development is not standing still and that the lightweight potential of non-ferrous metals is far from being tapped with examples from innovative successes in research and collaboration in practice. 14 entrepreneurs from industry and five institutions of the RWTH Aachen University joined together to form the AMAP Open Innovation Research cluster. The topics of the interdisciplinary collaboration range from product and material development, modelling and metallurgic process technology to new production technologies.

Light metals like aluminium and magnesium are best placed to fulfil the increasing demands of present and future vehicle generations: compliance with maximum emission limits for cars with conventional internal combustion engines and consumer demand for a wider range of electric vehicles at affordable prices.

Higher strength – lower weight

Aluminium has continually grown in importance as a construction material in recent decades. Today's passenger cars in Europe drive around with an average of 150kg of aluminium, where with 100kg, the lion's share of non-ferrous metal is in castings for powertrain and wheels. Lightweight automobile construction with a complete aluminium Body-in-White (BiW) was the preserve of exclusive manufacturers like Jaguar for a long time. The breakthrough into the mass market was made by Ford in the USA in 2015 with the new version of its classic F-150, as Dr. Jürgen Wesemann of the Ford Research Centre in Aachen explained. This pick-up truck, with its light construction high-strength aluminium body, marked the turning point from the steel construction used for decades in this vehicle, which is almost legendary in America. Almost unknown in Europe, F-series pick-up trucks have been the best-selling vehicle in the USA for 36 years.

Aluminium alloys with 4 different chemical compositions are used in the F-150 BiW's. This enables efficient recycling by separation of production scrap by grade. As Wesemann explained, these 4 alloys become 10 "grades" with different mechanical properties. By using high and highest strength aluminium alloys in the form of panels and extruded profiles, the BiW can be 45% lighter than previous steel constructed models. The gasoline-engine pick-up truck has the best-in-class fuel consumption figures in relation to payload and towing.

Mastering the correct joint technology in the right places plays an important role in the aluminium-intensive construction of the F-150. Processes such as laser-welding, resistance spot welding, self-pierce riveting, FDS-screws, adhesive bonding and clinching spots are used in the F-150.

Ford-Expert Wesemann sees future development focus areas in, for example, the development of new high-strength aluminium alloys to continue weight-reduction, tailor-made material and component properties and in the further development of advanced casting technologies with the aim of further weight savings and cost reduction. In Wesemann's view, there is also development potential in joining processes. Ford thus joined with the RWTH institute ISF in an AMAP project on the promising joining procedure Refill Friction Stir Spot Welding. Other important components of economic aluminium lightweight solutions are CAE and virtual optimisation.

Wesemann could summarise that successful lightweight design is not only down to aluminium as the construction material. To ensure that successful products and solutions come out of innovation, close collaboration between material researchers, aluminium producers, component suppliers and the automotive industry is required. In his presentation the Ford Manager made clear that only a consistent approach over the whole value-added chain of aluminium would lead to the goal – an approach such as that being followed by the AMAP research cluster.

Custom-rolled aluminium sheets

A vivid example of innovative aluminium technologies was given by Dr. Udo Brüx, Director of the Centre for Lightweight Design of the automotive supplier Mubea. As Brüx explained, Mubea is working together with Ford and the aluminium producer Constellium in an AMAP project on transferring the technology of flexible rolling to aluminium, which was originally developed by Mubea for steel sheets.

The technology for so-called Tailor Rolled Blanks (TRB) is a cold-rolling process, in which variable sheet thicknesses can be set according to locally required strength and rigidity by an adjustable roller gap. This innovative technology for custom-made material solutions allows thickness variations for steel of up to 50% within one construction component.

The aim of the research undertaken is industrial manufacture of custom-made sheets to realise weight-optimised high-strength aluminium structural components. This considers the entire process chain: from FLEXrolling to the subsequent heat treatment and cold-forming to the artificial aging of the component, right up to the joining technology. Development is accompanied by extensive methods for characterisation of materials and prognosis of the forming behaviour up to the crash characteristics of the component.

As Brüx explained, the results of flexible rolling with the aluminium alloys used so far (6xxx) are promising. With appropriate heat treatment, the material attains a high strength with sufficient ductility.

The next step is to create high to highest-strength components with a 7xxx AlZnMg(Cu) alloy. Since this high-performance material has only limited ductility for cold-forming, heat-forming is mandatory. The weight-specific strength of these Tailor Rolled Blanks in combination with artificial aging after the quenching process could approach that of press-hardened steel.

Start-up for E-mobility

The young Aachen company e.GO Mobile AG, under its CEO Prof. Dr. Günther Schuh, Chair of Production Systems at RWTH und Managing Director of Cluster Production Technology, is showing how a standing start in E-mobility can become a start-up. Dr. Gregor Tücks, Vice President Production of e.GO Mobile explained at the AMAP FORUM how the product development of a cost-efficient electric city car e.GO Life is taking place in an Industry 4.0 environment on the RWTH Aachen Campus with an interdisciplinary approach.

The Internet of Production architecture enables fast and flexible development, as Tücks explained. Thus, for example, early simulations led to an above averagely rigid body shell, in which the rigidity of the battery housing is exploited for the passive safety of the whole vehicle. The consistent modular construction contributes to the low manufacturing costs, as the assembly of the Spaceframe made of aluminium extruded section profiles takes place in a multi-stage assembly process. The outer skin of the crash-resistant and light bodywork consists of light and low-cost plastic panelling.

Emission free mobility is an important aspect of the e.GO Life, as Tücks explained, but not the only one. Data based services via user-friendly apps – keyword connectivity - and autonomous driving are also constituent parts for the Aachen developer.

Those who wish to own this city car will have to wait a while yet. e.GO Mobile is setting up the first production sites for assembling the e.GO Life and other vehicles such as the autonomously-driving electric minibus e.GO Mover and the four-door e.GO Booster on the Triwo Technopark on the previous Philips site in Aachen Rothe Erde.

Function Integration with Hollow Aluminium Casting

AMAP member Nemak is a worldwide supplier of aluminium lightweight solutions for passenger cars. Structural castings are an increasingly important growth area. For more than two years, Nemak has been manufacturing structural cast components for German and European OEMs at various production sites. Prof. Dr. Franz Josef Feikus, R&D Manager of Nemak Europe GmbH, presented the dynamic and research-intensive development in this area with the example of a hollow structural component in high pressure die casting.

Today steel mainly dominates in the cost-sensitive mass market, but ultra-high strength steel materials are also used in the premium sector in safety-relevant components. A collaborative research project has been initiated at AMAP to substitute steel components by aluminium castings. It is envisaged that along with weight saving, an increased load capacity is possible with the vacuum assisted high pressure die casting process dedicated to a serial production. This makes the technology interesting as a light construction alternative to the current widespread sheet shell construction methods with press-hardened steels. The current research project focuses to realize an inner ribbing for the Al-castings. This design provides a low weight with minimal wall thickness and increases the rigidity and strength of the component.

Nemak and its consortium partners have chosen an A-pillar as demonstrator for the project. The crash-relevant A-pillar has to preserve the survival space for the occupants.

The wall thickness of the aluminium pressure-casting part is no thicker than 3 mm. The cavity space of the complex ribbed inner structure is formed by salt cores. Despite their filigree structure, the cores must withstand the molten aluminium introduced under high pressure at high mould-filling velocity in the pressure casting process and then be subsequently easy to remove.

The design is based on methods for topology optimisation and extensive simulations including simulation of crash behaviour.

It is expected that with the developed design and calculation methods and the high pressure die casting process, it will be shown that hollow structure parts for vehicle bodies can be manufactured on an industrial scale. Together with the lightweight construction aspects of CO_2 reduction, the design is marked out by its higher rigidity and the possibility for function integration. Components, which in steel construction are conventionally made up of several sheet parts welded together, can be cast as a single component in the pressure cast process.

In a next step, the project partners intend to carry out further investigations into the casting process and joining aluminium and steel and develop a business model.

Modelling of the Complete Process Chain

Dr. Thiemo Brüggemann, Project Manager for Process Modelling of Hydro Aluminium Research in Bonn, together with Stephan Hojda, M.Sc., Group Manager Material Modelling at the Institute of Metal Forming of RWTH Aachen University, reported on the results of the completed AMAP project "Modelling of components made of rolled and annealed sheets with particular properties for the automotive industry".

In a consortium of seven partners, (SMS group GmbH, Hydro Aluminium Rolled Products GmbH, Novelis Deutschland GmbH, Aleris Rolled Products Germany GmbH, Mubea, Institute of Metallurgy and Metal Physics, Institute of Metal Forming), the rolling process chain for manufacturing of an EN AW6016 alloy for the automotive industry was investigated. The holistic approach of the project encompassed industrial manufacturing and the associated operational data recorded in Duffel (Aleris) and Neuss (Aluminium Norf GmbH) plants. Alongside this, samples were taken at various points in the production process that were used in laboratory tests for characterisation and validation. The aim of these measures was to develop a good data basis both for the simulation of the entire process chain by means of microstructure and to derive engineering properties for the final product at the end of the chain.

The idea of this "Integrated Computational Materials Engineering" (ICME) thus goes beyond the conventional "Through Process Modelling". On one hand, the link is not just required along the processes but also along the scale. On the other hand, the continuous microstructure simulation is only of any interest to the customer of the semi-finished product if the physical data of the microstructure allows user-relevant characteristics such as a yield stress, a yield locus or statements relating to material failure to be derived. The pre-competitive methods developed together in the consortium and validated for the model process can now be implemented by the specialists involved, tailored to the needs of the single companies. A possible area of use is the automated creation of material cards for the sheet forming simulation from measured or simulated microstructure information.

Prediction of Material Properties

Precise knowledge of the heat treatment of cast aluminium components helps to save energy and exploits the material's potential. This increases the competitiveness of aluminium casting in general. Simulation of the casting process plays a central role in this, as Dr. Marc C. Schneider, President of the Board of MAGMA Gießereitechnologie GmbH explained. Casting process simulation is able to predict the dynamic process of casting and subsequent solidification under realistic process conditions.

Together with knowledge about internal stresses in a cast component, the prediction of the as-cast microstructure is the starting point for the subsequent heat treatment. Knowledge about the local thermal conditions during the whole heat treatment process is the basis for modelling the changes in microstructure and mechanical properties after heat treatment.

To gain precise knowledge about the precipitation of the different phases in aluminium castings, samples of various alloys and microstructures are characterised before and after a defined heat treatment. This characterisation is on the scale of nanometres. The mechanical properties associated with each heat treatment are determined in parallel to this. Starting from the observed precipitation characteristics, a precipitation model is calibrated and verified. The mechanical properties of the cast part can be calculated on the basis of microstructure development, knowledge about the size-dependent contribution to hardening of different precipitate phases and the mixed crystal strength.

To ensure transferability to a broad field of process parameters and alloys, a verification of the developed micro-model is made using real sand and permanent mold cast parts.

Physical Material Design

Prof. Dr. Sandra Korte-Kerzel, Director of the IMM-Institute of Metallurgy and Metal Physics of RWTH, gave a view of the potential of future material development. The Professor and her team are investigating materials across the scales down to atomic level, in order to create new alloys through a better understanding of the physical processes. Korte-Kerzel used the example of magnesium to illustrate the process in her presentation.

Magnesium components can be used both as cast parts and rolled products in automobile construction. With a weight about 30% lower in comparison with aluminium, magnesium alloys are the lightest metallic construction materials. However, a disadvantage is the restricted formability, which limits the extent to which magnesium sheets can be used on bodywork construction. Moreover, an improved creep resistance would be desirable for use in high temperatures, such as in engine components.

As the scientist showed in her presentation, new knowledge about the mechanical behaviour can be gained by simulations on an atomic level and new alloys for magnesium components developed from them. Using quantum mechanically supported models, Korte-Kerzel and her team investigated plasticity at an atomic level and changes to the properties through the exchange of individual atomic and crystalline components. The researchers simulated, for example, the effect of a large number of elements using quantum-mechanical calculations and were clearly able to predict new alloy compositions with much improved ductility. Suprisingly, this was achieved by purposefully reducing the contents of the cheap and available elements, aluminium (Al) and calcium (Ca), compared with existing conventional alloys and without the use of yttrium or the rare earths, which previously had been thought necessary to achieve the same level of ductility. Furthermore, it was possible to show the potential of intermetallic reinforced cast alloys within the same alloy system Mg-Al-Ca using high-resolution nano-mechanical and electron microcopy methods.

In both cases, the development of ductile alloys for rolled products and high-temperature resistant cast alloys for engine construction, Professor Korte-Kerzel demonstrated impressively the enormous potential of knowledge-driven material development on the atomic scale.

Metallurgic Process Technology

Non-metallic inserts in molten aluminium have a damaging effect on the final product. Materials without non-metallic impurities and with fault-free homogeneous surfaces achieve significantly better mechanical properties and lead to a longer lifetime and improved operational durability even with cyclical loads. Non-metallic inclusions such as aluminium carbide Al_4C_3, aluminium oxide Al_2O_3, titanium boride TiB_2, magnesium oxide MgO and spinel $MgAl_2O_4$ are the most common representatives of unwelcome impurities in molten aluminium.

A metallurgical understanding of non-metallic inclusions is an important prerequisite for improving the cleanliness of molten aluminium, as Cong Li, scientific colleague at the IME Metallurgic Process Technology and Metal Recycling of RWTH Aachen University, explained.

It is true that melt cleanliness has been improved in recent decades by continuous further development of filtration techniques and melt treatments, but there is nonetheless a need for further research in respect of the following subject areas, as Cong Li emphasised:

- Formation mechanisms of critical inclusions
- Inclusion development from the start of their formation to the end product
- Inclusion quantification in the melt
- Effects of the inclusions on the product characteristics

Automated Treatment of Molten Aluminium Improves the Cast Quality

Philippe Kientzler, International Marketing Manager of Foseco, showed how cast quality can be improved with automated treatment of molten aluminium with the example of rotor degassing. In this flushing gas treatment, a submerged injector rotates with great force in the molten mass. Due to its special design, the rotors manufactured by Foseco suck the molten mass from the bottom of the pan or crucible, similarly to a pump, which leads to optimal mixing of the molten mass and a high level of degassing.

This innovative process of rotor degassing can be controlled optimally by software. The software with the name SMARTT is based on a degassing simulation developed by Foseco, with which the rotor degassing can be precisely calculated. The operator needs only set the desired melt quality and the software then suggests the best treatment options, based on the environmental conditions, melt temperature, rotor design and alloy composition.

Kientzler announced a system for online monitoring of rotor performance during operation as the next step of automated melt treatment.

Advances in Recycling

One of aluminium's strengths is its good recyclability. Compared to the production of primary aluminium, recycling of scrap – for example from beverage cans – uses less than 5% of the original energy and causes significantly less CO_2 emission. The process is, however, demanding if the scrap is anything other than homogeneous and uncoated. The partners involved in the completed AMAP Project 5 undertook experimental investigations and modelling of the heating and melting process of aluminium scrap and explored routes to improving technological processes with regard to energy efficiency and environmental sustainability. Oxidation losses must be minimised and the energy efficiency of the recycling process improved. In a presentation, Prof. Dr-Ing. Georg Rombach of Hydro Aluminium Research in Bonn gave an insight into the results of completed research work and the impending tasks.

An important process in the recycling chain is melting of aluminium scrap, which requires a detailed consideration of all mechanisms involved. A better understanding of, for example, heat transfer or pyrolysis is a prerequisite for further optimisation of the energy efficiency. Questions of metal loss through oxidation especially caused by organic contamination of the aluminium scrap were investigated in the AMAP project. In the pyrolysis process – thermo-chemical decomposition at temperatures of 450 – 550°C) – the coatings are separated from the aluminium surface.

As Rombach explained, an important aspect of the work was the investigation of pyrolysis gas emission rate and its calorific value during heating of various organically contaminated scrap types.. The pyrolysis gas emissions were also characterised by considering the interactions between these gases and the molten aluminium. The obtained empirical description was integrated into CFD simulations of the combustion and heating process.

As a result of the work and as focused approaches, Rombach suggested closer investigation of:

- Indirect heating (induction/ convection), as this promises a smaller quantity of higher concentrated pyrolysis gas
- Energetic coupling of pyrolysis and melting (post-combustion of volatile organic compounds in the melting furnace)
- Alternative pyrolysis heating concepts (for example, microwaves)

As Rombach reported an application for research funding is currently being evaluated by the BMWi.

Recycling expert Rombach can conclude that “the work on recycling carried out by AMAP was the nucleus of a new research project, even if some new partners are not (yet) AMAP members.”

Key Technology Joint Technology

The stronger developments like material mix in automobile manufacture or battery construction come into the frame, the greater the importance of joint technology, as Dr. Simon Olschok of the Welding and Joining Institute of RWTH explained. It demands an economic joining technology which can be integrated into existing manufacturing infrastructure on an industrial scale and guarantees mechanically strong and durable joints. In electrically conducting elements such as batteries and electric motors, requirements such as electrical conductivity, the lowest possible energy losses and avoidance of overheating of components are added to this.

Some challenges have to be overcome when joining aluminium with copper or steel. Positive connections have a high electrical resistance, welded connections with a metal melted into a liquid state tend to be fragile and corrosion between steel and aluminium is a fundamental problem.

There is a whole range of technical solutions to the problem of joining such different materials such as aluminium with copper and steel. These includes force-locking and positive connections such as screws, rivets and clinches along with substance to substance bonds in the solid state, including stir-welding and friction spot welding, or in molten metal with techniques like laser beam welding and electron beam welding. According to Olschok, the metal protective gas process CMT welding proves to be a cost effective and reliable joining technology.

The joining technology experts of the Institute have set up extensive investigations into a wide range of mixed connections and joint technology. According to Olschok, the results show that with precise knowledge of the process, suitable joint technologies are available both for aluminium-copper and aluminium steel mixed joints. The research results at the Aachen Institute do, however, indicate a need for further research, as Olschok pointed out:

- Aluminium and copper as well Al and Fe are only partially soluble in the solid state

- Intermetallic phases are unavoidable in a joining process and must be specifically influenced
- Both Al-Cu and Al-Fe connections can be produced with various joining technologies
- Fusion welding and friction welding processes form different weld seams. But the same intermetallic phases are always formed.
- The joining zone in the fusion welding process is always similar

Olschok stated that the effect of the influencing variables time, temperature and degree of mixing, on the formation of the intermetallic phase fringing must be even more closely investigated.

Forming Technology Unlocks the Potential of Aluminium

Prof. Dr-Ing. Gerhard Hirt, Institute of Metal Forming IBF of RWTH Aachen University, demonstrated that shaping technology also has innovation potential for working aluminium with four topic areas: rolling of sheet products, open die forging, sheet forming and the use of simulation, modelling and data analysis.

Modifications and further developments make customised surface properties and local distribution of material thickness according to requirement and mechanical strength possible in the rolling processes. An extended range of shapes can be opened up in open die forging with a new control concept and incremental sheet shaping enables the economic production of complicated sheet components, even as individual parts. Amongst other things, an understanding of the changes to the micro joints occurring in the formation can be gained with detailed numerical simulation and used for process optimisation. If a flexible response to deviations in the production procedure is wanted, this is possible today with very fast reduced models together with operational measurement data and machine learning methods.

Additive Manufacturing using Aluminium Alloys

Dr. Andreas Weisheit of the Fraunhofer-Institute of Laser Technology ILT deals with aluminium alloys for additive manufacturing (AM, also known as 3D printing). The Fraunhofer researcher presented two processes, Laser-Powder Bed Fusion (L-PBF) and Laser Metal Deposition (LMD).

In the L-PBF process, a selective laser beam melting process, a 30-50 µm thin layer of metal powder is spread out on a base platform and melted by the laser beam according to the CAD data of the part. After finishing one layer the platform is lowered, a new layer of metal powder is applied and the process is repeated until the part is completed. Finally the finished component is removed from the powder bed.

In LMD, a build-up welding process, the metal powder is fed through a nozzle into the interaction zone of the laser beam and the substrate completly melted. The component is formed then layer by layer.

Both processes achieve a homogeneous and fine-grained microstructure, which is due to the high cooling rates in laser 3D printing. The small melt pool (typically a few mm^3) cools much faster than the molten mass in casting due to the large surrounding solid volume.

Conventional alloys such as AlSi10Mg can be easily processed in LMD as well as L-PBF. The resulting microstructure is slightly harder than the cast alloy due to the finer-grained microstructure. However, the mechanical properties can be anisotropic, due to directional solidification. The highest strength is achieved parallel to the build direction.

When increasing the build-up rate in L-PBF, the samples show the same strength and ductility compared to low power L-PBF. The roughness of the as-processed surface requires a post machining of the part especially when the part is exposed to dynamic loads. On the rough surface the initiation of cracks is easier which reduces the fatigue life.

L-PBF with the novel scandium-alloyed alloy Scalmalloy®RP, a lightweight construction alloy for 3D-printing developed by EADS (now distributed by the subsidiary APWorks) attains a significantly higher strength compared to AlSi10Mg. It can only be processed via 3D printing because it requires rapid cooling to trap Sc in the Al matrix. After aging the alloy achieves a tensile strength up to 520 MPa due to nano-scaled precipitation of a Sc-containing intermetallic phase.

Despite high strength, the high costs due to the rare metal Sc prevents broader use of high-performance alloys. Fraunhofer-researcher Weisheit thus made a plea for further research into alloy development for AM. As substitutes for the expensive scandium, other metals such as nickel (Ni) or calcium (Ca) could be used as the alloy elements, which form eutectics with Al.

These challenges are addressed with the start of the BMBF project MAYFEST on hybrid manufacturing (casting + AM) end of the year. Partners from science and industry will investigate the combination of casting and additive manufacture with novel alloys on a cylinder head as a demonstrator.

Aluminium Alloys with Scandium

As Elvira Ivanova of RUSAL explained at the AMAP FORUM in Aachen, even a small additive of scandium (a few tenths of a percent) increases hardness and strength of aluminium alloys as well as a refinement of structure. Aluminium-scandium alloys can also be well welded and are thus very promising for application in the mechanical engineeringindustry. However, the high price of scandium is a disadvantage which raises the cost of materials containing Sc.

The high price of aluminium-scandium alloys determines the necessity of developing new alloy compositions with a lower Sc-content in comparison to the commonly commercially available alloys. The Russian united company RUSAL realises successful innovative R&D projects aimed at the development and industrial implementation of low-alloyed Al-Mg-Sc alloys.

As Ivanova explained, RUSAL has developed the complete production chain for extraction and processing of scandium. It begins with the extraction of 99.5% pure scandium oxide from red mud, continues through the manufacture of the master alloys in an energy-efficient process developed in-house, and ends with the production of advanced aluminium alloys with a Sc-content of 0.09 – 0.11%. Experiments confirmed excellent properties of the developed material.

Additive manufacturing is a new field for the Russian aluminium concern. RUSAL has developed an AlMgSc alloy especially for metallic 3D-printing. The low-alloyed Sc-material has, according to Ivanova, the same properties as an alloy with 2.5 times greater Sc-content. The optimized parts manufactured from the AlMgSc alloys are 26 % lighter than the casted parts from the A356 alloy with the same geometry.

In summary, Ivanova could state that it is possible to reduce the Sc content and replace it with other elements to extend the range of application of aluminium-scandium alloys and lower their price. The development and application of the proper process and processing parameters of alloys enables the manufacture of products which exceed the traditional aluminium material in their properties. Ivanova is also convinced that the costs of the AlSc master alloy will continuously fall and the development and introduction of new alloys with a low Sc-content will lead to a constant growth market for new aluminium alloys.

Additive Manufacturing in Industrial Application

The plant constructor SMS can demonstrate the practical usefulness of additive manufacturing with the example of a spray head for drop-forge presses created by 3D-printing. The spray head fulfils an important function in drop-forging: it removes the scale from dies, cools the die upper surface, applies lubricant and dries the die. As Axel Roßbach, Technology Extrusion and Forging Presses SMS group showed, the tool spaces in drop-forge presses are so complex in parts that conventional manufacture of spray heads reaches its limits here. It is here that additive manufacture shows its strengths: low material weight and a weight-optimised design with free geometry, because the material only reaches the areas where it is needed. The 3D-spray heads are extremely light, which provides the advantages of lower wear and higher cycle times in forging.

3D-printing enables the manufacture of a great variety of nozzle shapes and orientations. The positioning of the nozzles is highly flexible and is defined by the customer, as Roßbach reported. At the same time, the 3D-spray heads have a low construction height, so that the tool space can be used in other ways.

SMS has developed its own expertise for creating the 3D-spray head, which reduces construction time to a minimum, as Roßbach explained. Thanks to automated production, a spray head can be delivered overnight depending on the material. The spray heads are manufactured either in plastic (polyamide) or in metal (aluminium) depending on the customer's wishes.

AMAP – the Open Innovation Research Cluster – Efficiently and Perfectly Formed

The name says it all: AMAP – Advanced Metals and Processes. The Open Innovation Research Cluster AMAP is dedicated to material technology of non-ferrous metals and especially the manufacturing and processing of aluminium into innovative products for the automotive industry. The network connects a group of 14 industrial enterprises with five university institutes of RWTH Aachen University.

"We are an efficient network", said Dr. Klaus Vieregge, Chairman of the AMAP Advisory Board and Head of the Hydro Aluminium Research and Development Center in Bonn. New members are always welcome, but a high number of members is not the focus of the AMAP cluster, we want to convince people by the efficiency of the work and the research results. With the ambition "Open Innovation", AMAP follows a R&D and innovation strategy in which the university institutes of RWTH Aachen and industrial organisations are sharing their technologies and competences beyond their own boundaries and intellectual property rights. New ideas are generated and the complex knowledge of the RWTH institutes and company research partners is brought into project work with this interdisciplinary collaboration of industry and university institutions on current problems in the area of non-ferrous materials. This efficient sharing of risks between industry and science is an important basis of the win-win partnership.

Based at RWTH Aachen University, the research cluster follows the evolutionary thought of common research in one place, across industry and institutes. Dr. Christian Bollmann from ALERIS Rolled Products Germany reported that, "The different organisation philosophies of industry and academic institutions form a common understanding of a successful collaboration". The collaboration does not just help the companies involved to save costs in pre-competition research but thanks to their interdisciplinary work together, the partners also learn how to look at a problem from different perspectives, Bollmann confirmed.

And it is not just incidental that the proximity to one of the most renowned technical universities in Germany opens the most important resource up to the involved companies – well-educated young academics. Dr. Klaus Vieregge confirmed: "The proximity to RWTH Aachen University opens up an opportunity to find talents in the very competitive area of engineering."

Dipl.-Ing. Gerd Krause, Mediakonzept, Düsseldorf

This press release and press pictures (Marcel Dohmen, pictures of life) can be found at: www.amap.de/News

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AMAP GmbH
The Open-Innovation-Research Cluster AMAP concentrates in the area of materials technology on manufacture and processing of non-ferrous metals, especially those with an aluminium basis. The founding members are ten industrial enterprises and four university institutes of RWTH Aachen University.
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