SMS group GmbH

Wafer-thin layers and a great future – Additive Manufacturing at SMS group

The breakthrough of 3D printing for home use, predicted in 2010, is yet to come. Nevertheless, the revolution is taking place - not as predicted at the homes, but in industry. And it is happening with breathtaking speed. More and more sectors of industry have been recognizing and making use of the advantages of 3D printing and Additive Manufacturing, last but not least the plant and mechanical engineering industry. For many years, SMS group has been very active in the field of Additive Manufacturing. A young and dedicated research and development team is advancing and promoting this innovative technology within the company. The team members do not limit their activities to investigating which new and optimized components could possibly be produced by Additive Manufacturing (AM). They rather dedicate a great deal of their activities to introducing a new way of thinking in the design and engineering departments.

Agile project team for the promotion of Additive Manufacturing

Norbert Gober, initiator of SMS group's AM team: "The AM project team has been given a lot of freedom and lean structures to allow us to test out new approaches, take a critical look at traditional methods and be able to act flexibly and agilely. Since shortly, we have an own powder bed 3D printer for metal printing, which has been provided by our cooperation partner Additive Industries. With this printer, we will in future be able to implement new concepts right here, in-house."

The full range of AM technologies at a glance

As a manufacturer of plants and machinery for the steel and NF-metals industry, SMS group focuses on components made of metallic materials because the machines and equipment will be subjected to extremely high loads during operation. The performance potential of the materials are investigated and tested under field conditions. Besides metals, also alternative materials, such as plastics and ceramics, are examined. Additive Manufacturing means producing an object based on digital 3D design data by adding material layer by layer.

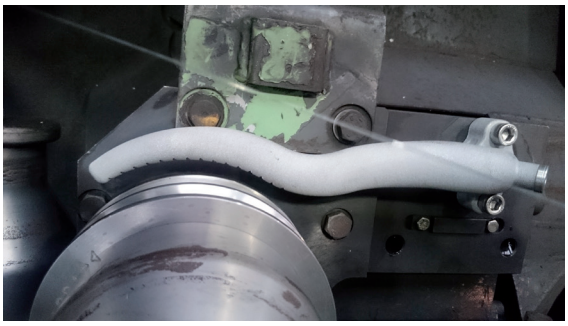
Additively manufactured roll cooling header

The number of available AM techniques is great. However, for the time being two main techniques are commonly used for plant and heavy machinery applications: selective laser melting in a powder bed and the laser melting deposition process. In selective laser melting, layer by layer of a high-purity

homogeneous metal powder is selectively, i.e. at defined positions, melted by a laser. In this way, the component is gradually built up. With the powder bed technique it is possible to produce components of complex and unprecedented structures, which would not be feasible by conventional processes.

In laser metal deposition, metallic powder or wire is fed via nozzles and melted by lasers at defined spots. The unit that accommodates the laser and the nozzle may be actuated by a robot. Laser metal deposition achieves high build-up rates, but it is limited in terms of fineness. For plastics-based components, the selective laser sintering (SLS) process is available. This technique is very similar to the powder bed process using metals, the only basic difference being that it uses a special powder of plastics material melted by a laser.

Conventionally and additively manufactured roll cooling headers



New way of thinking required

Robert Banse, member of the AM R&D Project Team of SMS group: "We adopt an entirely new approach to component designing. We are in no way restricted by any manufacturing constraints. We do not have to consider the geometry of the input stock, e.g. a forging blank, or the specific requirements posed by machining processes such as milling or drilling. Therefore we can start out from the function the component is going to perform. We adopt a creative technological approach to designing. In other words: We develop the perfect shape for the function at hand ready to be produced in the 3D powder bed printer. We have stopped thinking in terms of rectangular bores because in AM flow-optimized channels have become the most natural thing in the world."

Innovative spray heads for forging plants

The advantages of Additive Manufacturing can be illustrated by way of the example of a spray head for cooling the dies in a forging press. Sarah Hornickel, who is also a member of the project team, explains: "The original spray head was a solid and heavy part. We redesigned the part in close cooperation with the responsible technical department and our simulation specialists. Additive Manufacturing allows us to design flow-optimized channels, do away with any superfluous and heavy material and arrange the spray nozzles in such a way that the most intensive cooling takes place exactly where the highest temperatures occur in the die. With the thus produced lighter-weight and individualized component, die cooling takes less time and becomes more efficient – two aspects which will improve the productivity of our customers' operations."

Development within a strong network

Sarah Hornickel, Nina Uppenkamp and Robert Banse form the core AM team. They work with other supporters of AM and the various SMS group departments. Robert Banse: "I completed an apprenticeship and a dual study program at SMS group. During my studies, I specialized in Additive Manufacturing, a topic that fascinates me also outside my job. Within the SMS group community, we are very well networked and we have established a dedicated service network. These networks are just as important for the kick-off of new projects as technological know-how."

The mission: Informing and inspiring colleagues

A further task of the project team is to communicate the know-how, and the potential and benefits of AM within the group. Sarah Hornickel: "We organize design workshop, also for external companies, are in direct contact with the design departments and do not miss out on any opportunity to share information about Additive Manufacturing with our colleagues so that they can see the great potential it provides. Only colleagues who are convinced about Additive Manufacturing will make consistent use of the advantages of AM in their daily work. We have tried out new forms of spreading the word: We organize information rounds with our colleagues and have set up information booths at the canteens at the SMS group locations in Germany. Our booth was a great success, with large groups of people stopping by to get first-hand information about this fascinating new technology." Nina Uppenkamp adds: "It is important to demonstrate – both within and outside the company – that SMS group generates added value for its customers by making active use of this future-oriented technology. This is why we work closely and as a trusted partner with our design departments and with our customers. The plant operators are very interested in additively manufactured components and the potential they provide to optimize their production processes.

Installation of the nozzle at BIRLA COPPER

Less weight, higher speed and integrated functions

The project team has already implemented a great number of innovative solutions, which impressively demonstrate what advantages Additive Manufacturing processes provide. Their most important benefits include: significant weight reduction of dynamically actuated components, functional features are directly manufactured into the part during the 3D printing process, improvement of energy efficiency as a result of optimized flow patterns and minimized weight, dramatically shortened delivery periods and the possibility to produce virtually anywhere in the world.

Nina Uppenkamp describes a project which has benefited from the full range of advantages provided by Additive Manufacturing: "In a copper wire rod mill, annular gap nozzles are used for wire cooling and water removal. The conventional component consisted of several parts and the air gap adjustment required the use of a shim. Setting up and properly adjusting the component involved a great effort by our customer. Our task was twofold: First, the component design was to be simplified and, second, the adjustment was to be accomplishable without the aid of a shim. We produced a nozzle by AM which requires only 35 millimeters of installation space – versus the previous 65 millimeters, weighs only 0.85 instead of 2.5 kilograms and is of mono-

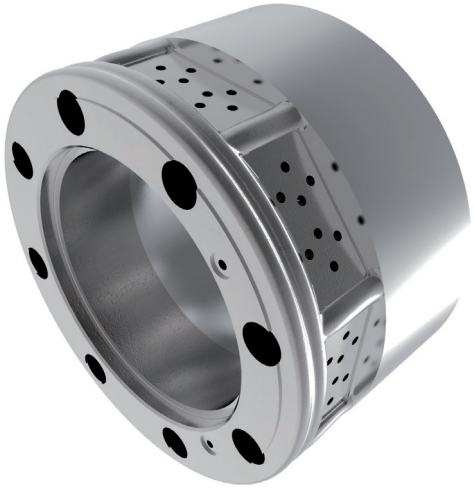
Individual nozzles

lithic design. The nozzle no longer consists of six parts. It is now one piece which does not require preassembly or adjustment of the nozzle prior to its installation in the plant. The new nozzles are already successfully in operation at BIRLA COPPER in India. They are less noisy than the previous ones and meet or even exceed all performance specifications. As we have manufactured the nozzles from a high-strength, wear-resistant material, they can remain in service much longer than their predecessors."

Section through a SIS injector

Applications along the process chain from the meltshop to the rolling mill

Also the other projects implemented so far have provided extremely promising results: A new roll cooling header for wire rod mills featuring a contour-adapted design with integrated nozzles has been performing excellently. By using Alumide, a blend of aluminum powder and polyamide powder, we have made the new component lighter and cheaper than the conventional solution. An example from BOF steelmaking: We have been able to reduce the size of our SIS injectors used in steel melting by 60 percent. The injectors now come in one piece. In the past they consisted of eight individual parts. Tube welding plants made by SMS group will in future be able to produce tubes with diameters down to 14 inches or even less. Thanks to a hybrid design including additive and conventional manufacturing, the oil rings for the expanders can be made smaller – without compromising their performance capacity. And the Technical Service of SMS group benefits from the lower weight and dramatically reduced delivery times of connecting frames for feeding systems in extrusion plants.



Hybrid design of the oil ring

A development characterized by dramatic dynamism

The projects mentioned above show where Additive Manufacturing is heading. Norbert Gober strongly believes that the development will still pick up momentum in the near future: "There are several driving forces. At the universities, future design engineers can nowadays avail themselves of printers to print the parts they design and immediately examine the result in the form of a real component. The growing demand for AM components will in turn spur the development in printer technology. We see several new printer technologies pop up every year. Maybe, another energy source will soon appear on the scene in addition to the laser. The young people coming from the universities will bring with them new ideas, concepts and methods that will change attitudes and strategies in the companies. Nothing is backwards oriented, everything is moving forward at full vigor. I believe that conventional manufacturing will become increasingly open to this trend and that there will be many more links between the two manufacturing methods. First hybrid machines combining LMD and milling are already available on the market. I am pleased to see that SMS group has already made great achievements in this challenging technological field and that it is well positioned for the future."

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