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Additive Manufacturing

Redefining Design With Additive Manufacturing

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Sandvik Additive Manufacturing, with its base in Sandviken, Sweden, serves the whole Sandvik Group and has the ability to provide a complete offering, from idea to finished product, at a time when many companies are starting to realize the benefits of additive manufacturing (AM).

Sandvik Additive Manufacturing, the Sandvik Group's latest product area, is constantly developing and growing with more resources, capabilities, employees and customer requests, as the competitive landscape within additive manufacturing rapidly evolves.

"The metal additive manufacturing market is still very young and small, but it's an attractive high-growth market. In 2015, metal additive manufacturing was just beginning to move beyond an R&D and prototyping tool into a manufacturing tool. In 2017, the move towards becoming a full-fledged production technology accelerated, for example, within aerospace, medical and tooling," says Kristian Egeberg, President of Product Area Additive Manufacturing at Sandvik Machining Solutions, the business area to which Sandvik Coromant belongs.

Mikael Schuisky, Operation Manager at Sandvik Additive Manufacturing, says Sandvik Group has a unique position.

"The Sandvik Group has the competence to provide a complete offering, from an idea to a finished product," he says, also referring to the business area of Sandvik Materials Technology, which is a world-leading supplier of metal powder used in additive manufacturing. "You can't find many other companies with competence in everything from in-house powder production and development, AM design, AM process selection and leading expertise in post-processing technologies, such as machining or sintering."

Sandvik Group's capability within both additive manufacturing and traditional, subtracting manufacturing through CNC machining, is also unique, says Egeberg, referring to Sandvik Materials Technology's neighbor in Sandviken, Sandvik Coromant.

"Additive manufacturing is fantastic for certain applications, but for others, subtractive manufacturing will remain more cost-efficient," he says. "We have the capability in-house to offer products and advice related to both areas."

Schuisky says the initial discussion with customers around manufacturing method is central.

"Ask a metal cutting company and then a printing company, and you will get completely different answers to the most suitable manufacturing method for your component," he says. "As we have competence in both methods, our customers will get unbiased recommendations."

Generally, additive manufacturing is the better choice when producing components with complex designs.

"Additive manufacturing totally redefines our approach to design and to what's possible to produce in one piece, but it takes an open mind and quite a bit of designing skills," Schuisky says.

To clarify, he shows a component made from traditional metal cutting, and its equivalent, additively manufactured. They look like two completely different components.

ASTM International’s seven standardized AM technologies

- **Powder Bed Fusion:** A laser or electron beam is used to fuse the powder in a powder bed under a protective atmosphere or in vacuum.
- **Binder Jetting:** A binder is added to the powder bed in the shape of the component to be produced, and in the following step, the binder is cured and the green body sintered to full density.
- **VAT Photopolymerization:** Liquid photopolymer in a vat (container) is cured by light-activated polymerization.
- **Material Jetting:** Building a structure by dropping the material.
- **Material Extrusion:** The material is dispensed through a nozzle.
- **Sheet Lamination:** The component is created by bonding sheets of material
- **Directed Energy Deposition:** A laser or electron beam melts the powder or wire as it is deposited on the surface.

“With a true understanding of what the component must achieve, you can design the part with structural strength and toughness exactly where it’s needed, without the restraints from traditional manufacturing design,” Schuisky explains. “Printing something that is designed for subtractive machining just doesn’t give you those advantages.”

Sustainability is a driving force

Components that benefit from being light will also find advantages in additive manufacturing. Weight reduction is a constant key issue for the aerospace industry, driven both by fuel cost and carbon footprint. The same is true for cars and trucks, and everything else that moves.

“Fuel consumption is one thing, but don’t forget handheld tools and other things that we are carrying, where lighter weight would save shoulders and backs,” Schuisky says.

Apart from reduced fuel consumption and health benefits, additive manufacturing offers several additional advantages. Fewer transports and production steps than traditional manufacturing, as well as the fact that it utilizes a lot less material than traditional manufacturing, both thanks to a design that requires less material, and to the actual production.

“When printing a component, approximately 95 percent of the powder you put into the process is used. The rest can be recycled in a new melt,” Schuisky says. “Compare that to traditional manufacturing where you start off with a chunk of material and produce large amounts of chips.”

The possibilities with additive manufacturing are growing as the technologies mature. Meanwhile, Egeberg, Schiusky and their colleagues are fine-tuning the offering to ensure that it provides as much value for the customers as possible.

“Metallurgists, world leading powder producers, post-processing and metal cutting experts. With 150 years in the metal industry, few understand the additive manufacturing value chain like we do. We have also made extensive investments in Research & Development in different AM process technologies, and today, we’re developing components for industrial use," Egeberg concludes.

The additive manufacturing pow(d)er

Without the right powder, additive manufacturing wouldn’t work. The quality and properties of the powder strongly influence the properties of the component. Simply put, there are three major aspects to consider: selection of raw material, particle size and morphology.

There are five major alloy groups used in the additive manufacturing processes today: steel, cobalt chrome, nickel, aluminum and titanium.

“Depending on the manufacturing method and specification, the melt is transformed into the correct particle size and morphology in a so-called gas atomization process,” explains Peter Harlin, Senior Engineer for Powder Technology R&D at Sandvik Materials Technology. “The powder needs to be tailored based on the additive manufacturing process so the particles can be used in the process.

“For example, powder bed fusion laser requires the smallest particle sizes to be around 100 microns, while directed energy deposition machines can handle substantially larger particle sizes.”

This is also confirmed by Lars-Erik Rännar, Research Leader for Additive Manufacturing at Sports Tech Research Center, Mid Sweden University, who says that a clear trend going forward is the introduction of new alloys and tailored powder for additive manufacturing.

“For Sandvik, with its metallurgical expertise and comprehensive competence within powder solutions and additive manufacturing, this is a natural development. I am looking forward to ordering tailored powder from them in the future,” Rännar says.

Previously Featured on Sandvik's Metalworking World.