



SLM Technology

# LAYERWISE BREAKS NEW GROUND IN ADDITIVE MANUFACTURING

*Digital production of functional models in metal yields distinct product improvements and economic advantages*

Leuven-based LayerWise focuses on selective laser melting (SLM), a powerful technology that shapes any desired metal part geometry by melting metal powder layer by layer. Using this digital approach, the optimum shape of complex circulation parts can be produced in a single manufacturing step. Such a part not only delivers better performance, it is also more reliable than the complicated assembly it replaces. Furthermore, SLM technology is the right choice for small metal products, of which thousands can be produced simultaneously. In addition to countless industrial applications, the company manufactures revolutionary orthopedic, maxillofacial and dental implants.

Design engineers know metalworking processes inside out and take into account their specific limitations up-front. In a way, they design new parts knowing at the back of their minds the production method that will be applied. It would be better if they could concentrate on the functionality of the part to be produced. The geometric limitations of successive metalworking processes force designers to make choices that

devalue the functionality of the part or lead to a complicated assembly instead.

## BUILDING UP PARTS IN LAYERS

"At LayerWise we reverse the entire process," says Jonas Van Vaerenbergh, director of the industrial division of LayerWise, a Leuven-based technology firm. "Our core business is selective



Orthopedic

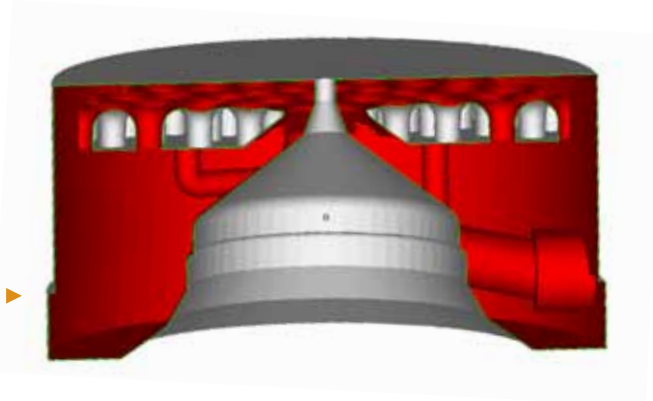


Maxillofacial



Dental

◀ As design rules are packed in, selective laser melting (SLM) removes all obstacles in favour of extreme part optimization.



▶ Injection moulding quality and speed can be increased by producing injection mould inserts with optimal cooling channels.



▲ By building up metal parts in layers, the most complex part shapes can be produced, including recess, ribs, cavities and internal features.

laser melting (SLM), a technology developed to build up material in layers instead of removing it in different steps. In the meantime, we have optimised the process for a variety of metals and alloys, such as rust-proof steel, hardenable steel, titanium, aluminium and inconel."

In the machine, a high-precision laser is directed to metal powder particles in order to selectively build up a 20 to 40 micron horizontal metal layer. The metal powder particles pinpointed by the laser quickly and fully melt so that the new material properly attaches to the previous layer, without glue or binder liquid.

The powerful fiber laser with high energy intensity operating in the inert area inside the machine guarantees that metal parts being built up exhibit a dense and homogenous material structure. CAD directly drives the machine without requiring any programming, clamping or tooling. The SLM approach is capable of simultaneously producing metal parts of different shapes in series of up to 2500 pieces.

### UNLIMITED FREEDOM OF SHAPE

In addition to producing small components efficiently and cost-effectively, SLM hardly imposes any limitations in terms of geometry. Van Vaerenbergh explains that the layered approach ensures that the laser gains systematic access to any location while building up parts. In this way,

the most complex part shapes can be produced, including recess, ribs, cavities and internal features. "Usually, the products leaving our facility cannot be produced any other way. This is a different ball game for manufacturers because design rules are packed in, removing all obstacles in favour of extreme part optimisation."

Take the burner component LayerWise produced for Diametal. Similar to machine manufacturers for food and pharmaceutical companies, this company is regularly challenged with producing complex circulation pieces such as mixers, inlet and outlet components, dispensers, coupling parts and heat exchangers.

The Diametal burner component contains 9 undercuttings and 6 internal cavities. LayerWise applied SLM to manufacture this component as one unit in a single production step. This is called function integration, because this SLM-produced component replaces multiple parts manufactured using conventional metalworking processes. Assembling these parts takes time, particularly because they need to be connected hermetically, reducing reliability altogether.

Van Vaerenbergh explains that function integration makes SLM fit for resolving miniaturisation, leakage and assembly issues. "Diametal was not charged for the shape complexity of the part because the production cost is dependent on the weight of the part, showing that SLM offers superior products at a reasonable cost."



▲ In replacement of a complex assembly, LayerWise produced a single burner component containing 9 undercuttings and 6 internal cavities.



## OPTIMISING CIRCULATION CHANNELS

A perfect example of efficient and flexible design was the production of a component that connects cooling ducts. Firstly, the additive manufacturing process realized 75% weight reduction. Secondly, designers were able to drastically reduce flow resistance by defining channel geometry using freeform surfaces. LayerWise produced the part exactly according to the functional CAD design, resulting in an improvement of the circulation properties by 80%.



“Thanks to SLM’s freedom of shape, the cooling channels can be positioned in conformity with the mould shape. This is a major improvement compared to conventionally drilled holes. Optimized channel geometry and location ensure a better controlled cooling process that delivers higher-quality parts that do not warp and contain fewer hot spots. Imagine the economic advantage of reducing the serial production cycle time of moulded plastic parts by 15%.”

## FOCUS ON TECHNOLOGY LEADERSHIP

LayerWise is the first production centre in Belgium that exclusively focuses on this additive production process for metal parts. The company

was founded by Jonas Van Vaerenbergh and Peter Mercelis, both of whom were closely involved in the development of selective laser melting at the Catholic University of Leuven.

“By bringing together technological expertise, production capacity and customer support, LayerWise occupies an unique position on a European level.” indicates Van Vaerenbergh. “Our engineers control SLM to such an extent that they are capable of perfecting the technology and realize the most challenging specifications. Today we are able to produce with 15 micron geometric accuracy and build up walls as thin as 0.2 millimeters, something that is extremely difficult – if not impossible – using conventional technologies. Also the implementation of process control tools in and around the melting zone is important to guarantee highest part quality.”

After parts are taken out of the production machines, finishing actions start. If desired, conventional metalworking actions can be applied, such as drilling, cutting and EDM. It is also possible to have certain components surfaces hardened. As a concluding step, customers can opt for a high-gloss polishing finish.

## DENTAL SUPRASTRUCTURES

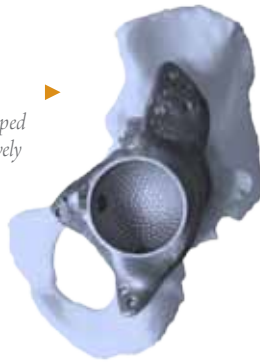
LayerWise is also heavily involved in medical industries, for which the company manufactures implant-supported suprastructures, for example.



▲ *Through patented DentWise technology, geometry and surface retention related limitations set by traditionally moulded or milled suprastructures no longer apply.*

► *Usually, the products leaving the LayerWise facility cannot be produced any other way. Shape complexity is not charged because the production cost is dependent on the weight of the part.*

Personalised orthopedic prostheses are generally produced in titanium, equipped with a fine surface geometry that actively encourages surface retention.



Courtesy of MobeLife

On the basis of patient-specific geometry data, acquired through medical imaging or three-dimensional scanning, the personalised structure is designed in software and printed in titanium straight-away. As a concluding step, the dental technician finishes off the structure and completes the final prosthesis.

“Through digital SLM technology, geometry and surface retention related limitations set by traditionally moulded or milled suprastructures no longer apply,” says Peter Mercelis, director of the medical division. “In addition, the implant connections are completed with highest precision.”

DentWise suprastructures are manufactured using ultra strong titanium alloy (Ti6Al4V, grade V), which outperforms the commonly used titanium grade II in terms of mechanical properties.

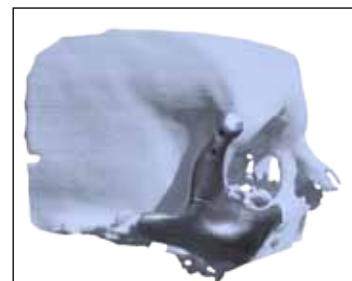
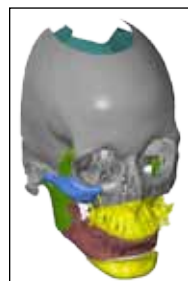
## ORTHOPEDIC AND MAXILLOFACIAL IMPLANTS

There are more medical applications LayerWise specializes in. During a major maxillofacial reconstruction, surgeons inserted a zygoma manufactured by LayerWise. The complex shape of the implant was digitally derived through medical imaging and produced using SLM technology. This approach offers the ability to restore the facial symmetry of patients nearly perfectly.

Concerning orthopedic implants, the process of building up metal in layers offers the possibility to design porous bone-replacing structures and integrate them into prostheses. This allows for an excellent long-term fixation. In addition to personalised implants, designed on the basis of medical imaging, the SLM technology is used for manufacturing medical instrumentation. For this purpose, LayerWise offers a number of biocompatible metal alloys.

“With SLM, geometry and surface retention related limitations set by traditional suprastructures no longer apply.”

*Peter Mercelis, director of the medical division of LayerWise*



▲ On an implant LayerWise manufactured for a major maxillan reconstruction, it integrated a titanium layer structure that stimulates surface retention and strengthens the implant to withstand surgical manipulation.