Highly conductive copper inductors from the 3D printer

- Longer service life
- Shorter delivery times for the inductor
- Shorter tool creation process

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Highly conductive copper inductors from the 3D printer

Inductive heating is commonplace in the metalworking industry. Automotive and industrial suppliers use this powerful heating process to temper components, among other applications. In a collaboration with Altair ProductDesign, PROTIQ is developing geometrically optimized copper inductors that can be delivered within just a few days – and just so happen to accelerate the induction process considerably to boot.

A geometrically optimized inductor from the 3D printer.

PROPERTIES OF RS-COPPER

Density
8,82 g/cm³

E modulus
70 ± 10 GPa

Tensile strength
219 ± 10 MPa

Electric conductivity
Up to 50 MS/m

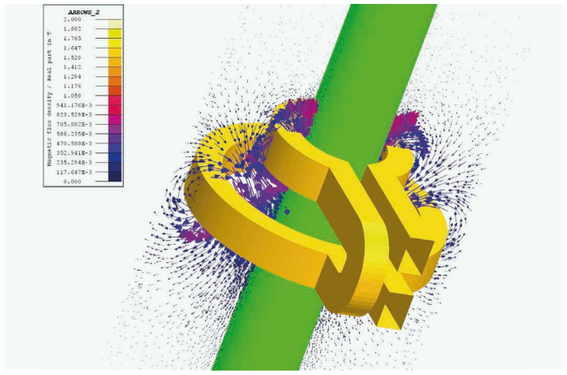
Work pieces that are subjected to heavy loads during operation are partially tempered through induction heating. The inductors used for this are made up of highly conductive copper pipes that need to fully surround the object in order to create the most powerful magnetic field possible. “The efficiency of the thermal output depends, to a major extent, on the inductor’s adaptation to the geometry of the workpiece to be heated”, Stefan de Groot – Technologist Additive Manufacturing at PROTIQ – explains. “Traditionally, shaping was done by manually bending or soldering; as a consequence of this process, only relatively simple geometries could be created. Because of this, as a general rule, heating more complex components is accompanied by a significant loss of output.” Working with Altair ProductDesign, PROTIQ is developing geometrically optimized inductors that reduce cycle times during tool production thanks to improved thermal output.

Highly conductive copper – a challenge for 3D printing

During the selective laser melting process, a laser is used to melt metal powder, which is then built up, layer by layer, into a 3D object. However, one of the properties of copper is its nearly total reflectivity of rays from conventional laser melting systems – which makes selective melting of the material practically impossible. For this reason, many 3D printing providers rely on alloys with relatively low copper content. This, however, decreases the conductivity of the final product. Following two years of intensive development, PROTIQ has been successful in developing its own process enabling additive processing of highly conductive copper. “Thanks to the considerable reduction in manufacturing time, our customers receive their products just a few days after their order,” de Groot comments. “Waiting for weeks or even months is now a thing of the past.”

Geometric optimization with the 3D model

Not only do CAD applications provide the necessary models for 3D printing, they can also be used to simulate applications for the finished 3D object. Summarizing the process, Mirko Bromberger – Director of Marketing & Additive Manufacturing Strategy at Altair ProductDesign – says: “Our ‘FLUX’ software makes it possible to simulate the inductor’s magnetic field, as well as the entire inductive heating process.” “Using just the model and the simulation data as a basis, we can already deduce how the component will behave during operation”, adds Johannes Lohn, Technology Manager of Additive Manufacturing at PROTIQ. “This also helps us determine exactly where heat loss will occur when the magnetic field doesn’t yet fully surround the work piece to be tempered.” Using the data gleaned from the model simulation, PROTIQ can improve the inductor’s geometry and thus increase its output and efficiency.



Simulating the inductor in „Flux“ – a software by Altair ProductDesign.

Freedom of design through 3D printing

Only the use of innovative 3D printing technology makes it possible to even implement the optimized shape in the first place, because only additive construction of a 3D object permits design elements this complex to be achieved in a single manufacturing step. For its industrial customers, PROTIQ develops inductors made of highly conductive copper, which can be optimally shaped to suit the relevant area of application. “Especially when it comes to tempering challenging work pieces, it’s often impossible to work efficiently using inductors in standard shapes. Treating the object takes up an unnecessarily large amount of time”, Johannes Lohn notes. “Thanks to the improved geometry, our customers can also heat and temper components with uneven contours in a targeted way, because the thermal output precisely reaches the areas where it’s required.” ■

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>
> **STEFAN DE GROOT**
> Technologist Additive Manufacturing at PROTIQ

Geometry optimization experts: Max Wissing, Johannes Lohn and Stefan de Groot of PROTIQ (left to right).

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