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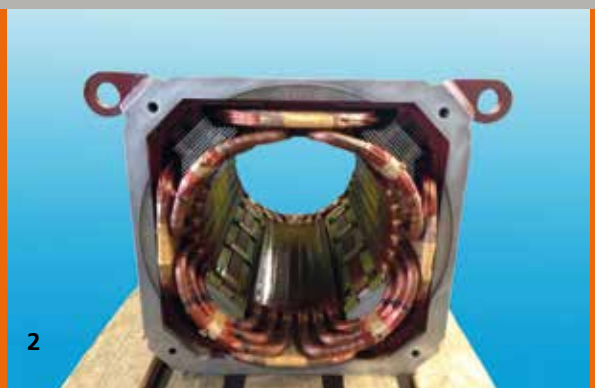


1 *Build-in cast coil made of aluminum in a crane motor.*
2 *Crane motor with four cast aluminum coils.*

COILS MADE OF ALUMINUM INSTEAD OF COPPER – FAVORABLE IN PRICE, LIGHT IN WEIGHT, AND EFFICIENT

In collaboration with Lloyd Dynamowerke GmbH & Co. KG (LDW) in Bremen, Fraunhofer IFAM has manufactured for the first time aluminum coils for a large electric motor using the lost foam casting and installed these in industrial machinery. The result is a technically improved alternative to traditional wound copper coils. The fill factor and cooling performance are enhanced using the design freedom of casting technology. The use of aluminum coils also means a huge reduction in the raw material costs and reduced weight and lower overall losses of electric motors.

Lost foam casting has been used by Fraunhofer IFAM to manufacture the complex shape of coils as cast components, with key advantages over all the winding techniques. The main challenge for the casting process was the small thickness (4 mm) relative to the long flow distance (700 mm). For the casting, the polymer foam pattern is coated and covered with binder-free molding sand (quartz sand). Decomposition of the pattern by the hot melt results in production of the cast component. In order to fill in the molding sand, the conductor geometry is stretched and is fitted with a gating system.

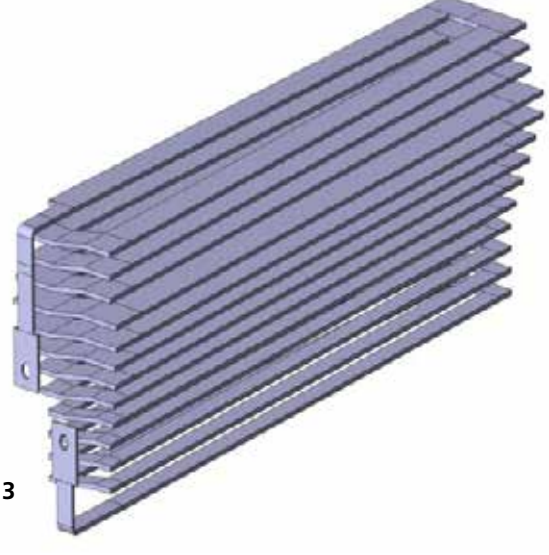
Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM
Shaping and Functional Materials

Prof. Dr.-Ing. habil. Matthias Busse
Wiener Strasse 12
28359 Bremen | Germany

Contact
Dipl.-Ing. (FH) Daniela Pille M.Sc.

Phone +49 421 2246-108
Fax +49 421 2246-77108
casting@ifam.fraunhofer.de

www.ifam.fraunhofer.de



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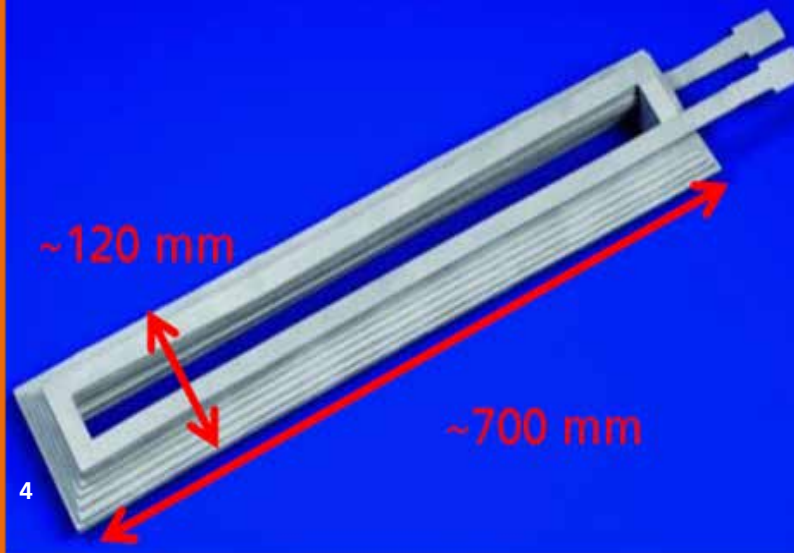

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The bending radii that must be maintained for conventional winding technology do not apply here. The design freedom of casting technology allows slot fill factors of up to 90 percent to be realized. Wound coils, in contrast, normally only have slot fill factors of up to 50 percent.

Lloyd Dynamowerke GmbH & Co. KG installed four of these lost foam cast coils in a 330 kW direct current motor for a crane and evaluated this on a test stand. Despite the lower specific electrical conductivity of aluminum, the electrical resistance of a cast coil is similar to that of a wound copper coil due to the increased slot fill factor.

Besides maximizing the conductor area, the geometric design of the cast commutator pole coils improved the heat dissipation from the commutator poles. As such, the temperature rise of the commutator poles during continuous operation could be decreased from 75 to about 45 kelvin. Due to the lower temperature there was simultaneously a slight reduction in the total losses in the motor.

For the example of the direct current motor of LDW, the raw material costs for the aluminum coils compared to conventional copper coils were reduced from 52 euros to 6 euros per coil. The weight of the motor was also reduced by about 50 kilograms.

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3 *Cast coil construction, conductor with distance for production in the casting process.*

4 *Compressed cast coil.*