



Copper Rotors for Pumps & Induction Motors

New Technologies Make Commercial Scale Copper Rotor Die-Casting Viable



WHAT IS A COPPER ROTOR?

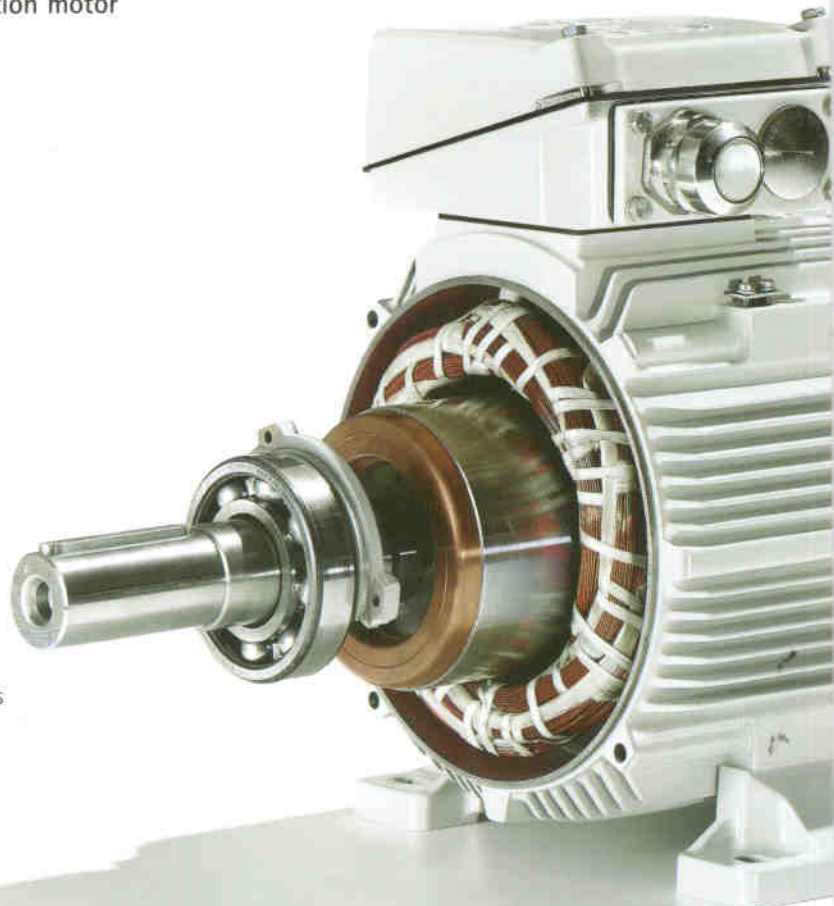
A copper rotor is a rotor made of electrical steel (laminations) in which the rotor bars and end rings are made of cast copper instead of cast aluminium.

WHY COPPER?

Copper is an excellent material to use for rotors because of its high conductivity. Copper's conductivity is rated at 57 MS/m, which is significantly higher than that of aluminium (37 MS/m). This makes copper the material of choice for a number of induction motor applications worldwide.

The use of copper in place of aluminium can lead to significant benefits:

- **Higher efficiency** – A first possibility of design is to get higher efficiency, while using approximately the same motor size as the aluminium rotor version. Copper's higher electrical conductivity allows the rotor to conduct electricity more efficiently, resulting in lower resistive losses and lower operating temperature.
- **Extended life expectancy** – As motor life is doubled for every 10°C reduction in operating temperature, this lower operational temperature results in extended motor life expectancy. The lower operating temperature combined with the high thermal conductivity of copper allows for fewer forced cooling units. This further improves efficiency.
- **Smaller size and cost** – A second design avenue consists in the reduction of the overall size and weight of the motor by using a copper rotor, while maintaining the motor efficiency. This is because the higher efficiency of the copper rotor allows the overall length of the rotor (and motor) to be decreased, while still matching the performance of a motor utilizing an aluminium rotor. Shortening the motor eliminates some of the rotor and stator laminations; decreases the number of stator windings; and reduces the length of the shaft. A more compact and lighter machine is possible, and the rotor more easily fits into a monoblock motor system.



VEM motor with copper rotor casted by Breuckmann

WHY NOT COPPER?

Copper melts at 1083°C, compared to 660°C for aluminium. The higher melting point of copper has historically led to die-casting problems. In fact, the die-casting of (pure) copper was technically difficult or virtually impossible for a long time. This meant that

copper had not been greatly utilized for industrial rotor production. However, all these problems now belong to the past, thanks to the availability of new processes.



INNOVATIONS STIMULATE MARKET GROWTH

New technological breakthroughs

Several breakthroughs in copper die-casting have removed the previous problems. The technology has been fine-tuned to make it economically viable. A number of companies in Europe, US and Asia are now up and running with copper die-casting production facilities.

Mass production is now possible and commercially viable. Around 2 million copper die-cast units are already in use worldwide. As a result, the market for copper die-cast rotors is expected to grow significantly.

Benefits of CMR to motor manufacturers

CMR offers significant benefits in comparison with regular motors. The higher conductivity of copper enables a range of design options, including, but not limited to:

1. Reaching the next level of energy efficiency with the same motor size.
2. Maximizing energy efficiency to higher and "super premium" levels by redesigning rotors with copper conductors and optimizing stator design to achieve desired performance.
3. Maintaining a specific energy efficiency level, reducing motor size and possibly weight.
4. Reducing the total manufacturing cost for the same efficiencies.

Benefits of CMR to end users

1. Economic benefit of reduced electrical energy consumption.
2. Economic benefit of motor life, with proper maintenance, being potentially extended by several years due to cooler operation and hence have enhanced reliability.
3. Image enhancement, as end-use companies can credibly project labels such as "green", "responsible corporation", "environmentally friendly".

Current applications proven; new ones under development

Initial interesting applications include industrial high efficiency low voltage induction motors (100 W – 100 kW) and traction applications. More applications in niche sectors are following closely behind. These include corrosive atmospheres, special cooling needs and cranes.

With benefits like Improved Efficiency, Reliability & Reduced Size, the potential applications for copper motor rotors are:

Agricultural pumps • Fluid circulation pumps • Oil well pumps
• Conveyors for material / baggage handling • Aeronautic applications • Refrigeration compressors

Recycling: Technologically and economically feasible

Beyond manual processes for separation of copper from iron, a number of automated sorting techniques, such as X-ray fluorescence, are tested and proved. Similarly, new tools like laser induced breakdown spectroscopy (LIBS) are under development. Copper rotors contain typically around 25% copper in weight (the rest is steel). 9/10 of the scrap value corresponds to copper. There is then a strong economic rationale to recycle copper rotors.

Recycling of copper is also environmentally responsible. It leads to the emission of few, if any, harmful gases and avoids its expensive disposal in landfills. It also leads to significant energy savings. To extract copper from copper ore, the energy required is approximately 100 GJ/tonne. Recycling copper uses much less energy, about 10 GJ/tonne. This energy saving leads to the conservation of valuable reserves of fossil fuels and consequent reduction of CO₂ emissions. Finally, recycling helps as well to preserve raw material reserves.

Frequently Asked Questions about CMR

- Will Copper Motors Rotors be heavier?

There is a belief that motors with CMR will be heavier than aluminum rotors. However, to achieve similar efficiency levels as copper rotors, aluminum rotors need to be 25-35% longer to accommodate higher amount of active material, leading to increasing the weight of the rotor. Whereas in CMR, the impact of short rotors, with a corresponding reduction in stator length, leads to an overall weight reduction. This decrease in weight

often means that the overall size of the motor house can be made smaller.

- Are Copper Motor Rotors expensive?

There is similar misconception that motors with CMR will be expensive. However, reduced material content for a given efficiency performance of the same motor with copper will result in lower costs.

WANT TO KNOW MORE?

Here is the website where you can discover more about innovative copper rotor technologies and applications:

www.coppermotor.com

The website focuses on copper rotor induction motors for automotive applications and is packed full of manufacturing and design resources.

Contact the International Copper Association India at hemanth.kumar@copperalliance.asia to discuss how you can play a role in the further growth of the copper rotor phenomenon.



Leading Indian copper rotor manufacturer:

www.kitraind.com

- 1st in Asia to die cast copper rotors
- Established in 1963
- Only Company in India supplying commercially in large quantities
- Continues R&D for new prototype die castings
- Lowest process cost in the world

For enquiry email: info@kitraind.com

For more information on International Copper Association India visit www.copperindia.org

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