Case Study

Thermal Performance of Overmolding vs. Potting Materials

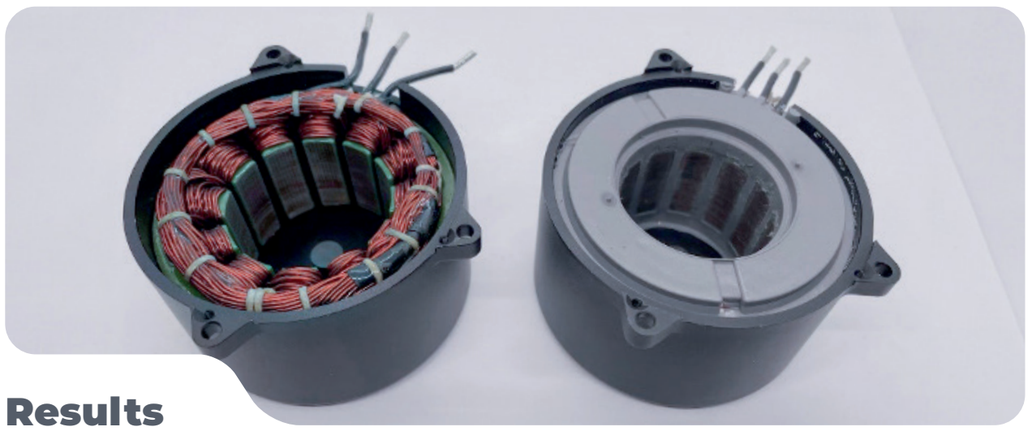
For electric motors of e.g. eBikes there is a requirement to withstand relatively high torque for an extended period without overheating or losing power.

Motor stators are often filled with a potting material, which can improve heat dissipation. In that case story, electric Motors with bare windings, solid potting, and overmolding (by the usage of KERAMOLD® 20) have been tested to explain the difference in the thermal performance.

Methods

The thermal test setup consisted of a motor dynamometer (“dyno”) and thermistors inside the motor housing. The dyno applies a constant torque to the motor using an eddy current brake, and this torque is monitored using a dynamic torque sensor.

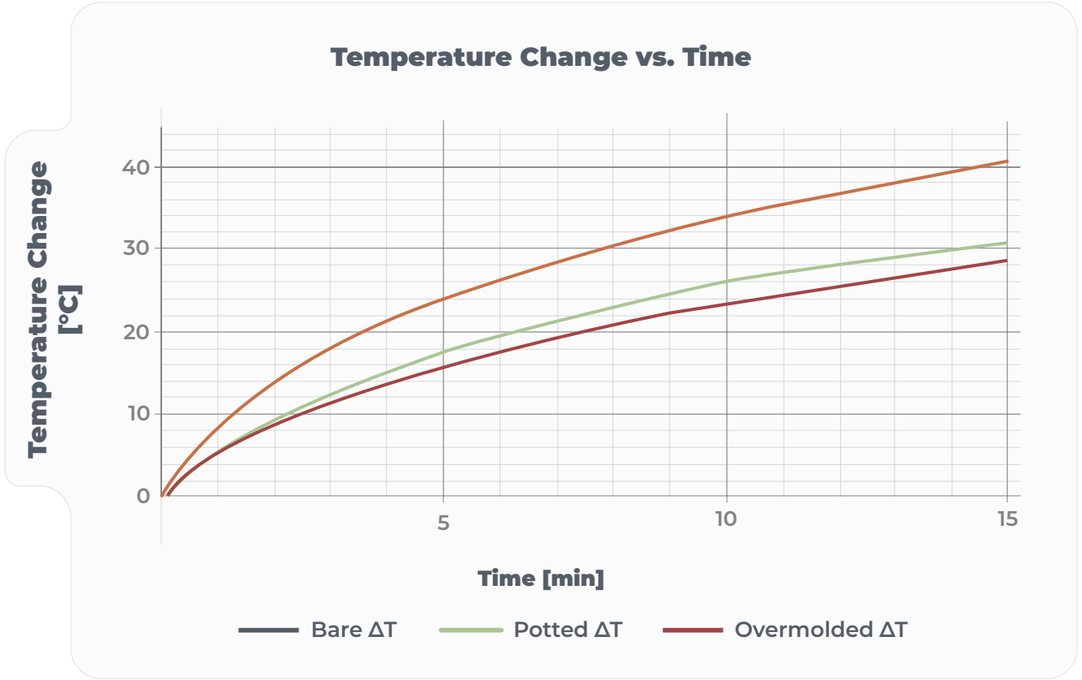
The motor is run at 1760 RPM, and once it reaches a steady speed, 1 Nm of torque is applied using the eddy current brake. This test is run until the motor reaches a steady temperature or, in some cases, when the eddy current brake exceeds its rated operating temperature of 100°C. The eddy current brake is then powered off, and the motor is allowed to continue running until it reaches a steady temperature. This test generally takes between 30 minutes and an hour to perform, exposing the motors to a realistic use cycle, with a reasonable climbing speed for half of the test, and a mostly unloaded, but still running, “downhill” section. All the motors used the same faceplate, electronics, rotors, and bearings to ensure a properly controlled test. Several motors were tested, including one without potting material (“bare”), three with solid potting (“potted”), and four with KERAMOLD® 20.



Results

The following charts show, that the thermal performance of the KERAMOLD® 20 was better than the potted option, and of course way better than the bare option. In that case study, the molding process was not optimized due to cost reasons. This leads to the assumption, that the thermal performance can be still improved which will even further increase the difference to the potted material.

On average, the overmolded motors were able to maintain low temperatures longer than the potted and bare motors. Also the average time to reach 30° is much longer in comparison to the other options. This result is consistent with the expectations, as the KERAMOLD® 20 material was chosen as a possible material due to its stated superiority to the current potting material.



	AVERAGE TIME*
Bare	8
Potted	13
Overmolded	17

*in minutes

Fig. 1 Temperature change curves for the first 15 minutes of all three options

Fig. 2 Test run until the electric motors reaches 30°C