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Developing a Vacuum Pressure Impregnation Procedure for CORC® Wires

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Superconducting magnets designed for high energy physics and nuclear fusion require mechanical stabilization and electrical insulation to perform at high currents and magnetic fields. Vacuum pressure impregnation (VPI), a process of curing epoxy in and around the superconducting wires, is most commonly used to support and consolidate a magnet. However, the heat and mechanical stresses associated with the process can degrade the wires, significantly lowering the critical current. This study explores different methods of potting and curing CORC® wire with the aim of reducing wire performance degradation to less than 3% measured at 77 K, self-field. The wires were 2.9 mm in diameter consisting of six REBCO tapes each (three layers of two tapes). Two bending diameters (40 mm and 100 mm) were tested to mimic the winding shape of a magnet. Mix 61 epoxy was used in preliminary tests for potting due to its relatively lower temperature cure of 16 hours at 60 °C followed by 24 hours at 100 °C. For each test, two wires were used and their critical currents were measured simultaneously in liquid nitrogen at 77 K - in their straight form, then bent, followed by the heat treatment used for Mix 61 but without epoxy and finishing with the full epoxy impregnation test. Here we report the experimental results with multiple CORC® wires and different curing schedules. The VPI process with minimum degradation in critical current, as demonstrated by this work, will provide a proven VPI procedure to develop high-field dipole magnets using CORC® wires.

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