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Detailed analysis of conduction-cooled MgB2 for use in superconducting magnetic density separation

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Superconducting MgB2 wire is characterized to analyze the optimum working point of a magnet system for magnetic density separation (MDS) in terms of the magnetic field and operating temperature. MDS is an innovative recycling technology that selectively separates particles in a waste stream based on their mass density by suspending them in a ferro-fluid that flows through a strong vertical magnetic field gradient. Application of superconducting MDS on an industrial scale will require a user-friendly conduction-cooled magnet system. With its relatively high critical temperature and relatively low cost, MgB2 is a prime candidate material to realize such a magnet. Since the separation forces depend on the product of the magnetic field and the ferro-fluid magnetization, the optimal design of a superconducting MDS system has to balance magnet cost (CAPEX, higher field implies a more expensive magnet) against the ferro-fluid price (OPEX, higher field allows for a more dilute fluid) and cooling requirements (OPEX, lower temperature implies higher power consumption). To be able to achieve this optimal balance, the critical surface of MgB2 wire produced by Columbus Superconductors SpA is measured in detail and used as starting point to calculate the most adequate operating point of an MgB2-based MDS system. This work is part of the research programme "Innovative Magnetic Density Separation for the optimal use of resources and energy"with project number P14-07, which is (partly) financed by the Netherlands Organisation for Scientific Research (NWO).

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