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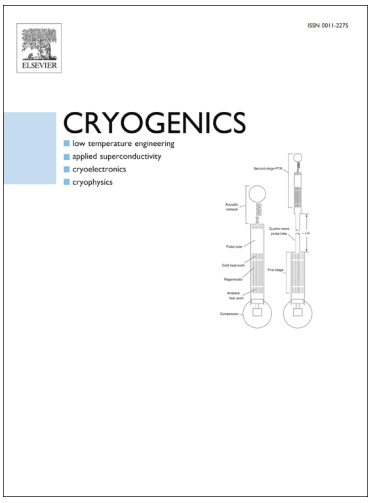

Research paper

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PII: S0011-2275(17)30448-4
DOI: https://doi.org/10.1016/j.cryogenics.2018.06.001
Reference: JCRY 2825

To appear in: *Cryogenics*

Received Date: 22 December 2017
Revised Date: 30 May 2018
Accepted Date: 4 June 2018

Please cite this article as: Hou, Z., Zhu, Z., Zhang, K., Zhao, L., Wang, M., Zhou, J., Li, P., Hu, X., Zhang, Y., Wang, Z., Excitation characteristics of magnets impregnated with paraffin wax, *Cryogenics* (2018), doi: https://doi.org/10.1016/j.cryogenics.2018.06.001

Excitation Characteristics of Magnets Impregnated with Paraffin Wax

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***Abstract*—**The Superconducting Electromagnetic Iron Separator (SEIS) based on paraffin wax vacuum pressure impregnation (VPI) technology was developed to remove magnetic impurities from coal. The superconducting coil was wound by Cu/NbTi wires. The inner and outer diameter of the coil are 928 mm and 1022 mm respectively. The height of the coil is 355 mm. The magnet generates a 3 T central field at 165 A of operating current.

There are three SEIS devices that have been manufactured and tested. All the design requirements are achieved by the first device. However, the others can't be charged to the design current in 20 minutes, which is a requirement of coal handing port. This paper presents the details of the VPI process and the charging tests. The excitation characteristics of three SEIS devices are shown in the results.

***Index Terms*—Paraffin wax, Magnet, Vacuum pressure impregnation, magnetic separator.**

I. Introduction

Superconducting Electromagnet Iron Separator (SEIS) [1] is a kind of electromagnet iron separators [2]. It is specifically designed to remove ferromagnetic substances from coal in large mining projects, coal handling port and thermal power plants. Low temperature superconducting technology is adopted to manufacture the SEIS magnet, because superconducting magnet can generate strong magnetic forces with low energy consumption [3].

Three SEIS devices have been produced. The coils of the SEIS were filled with paraffin wax by VPI. The first SEIS was produced in 2008. It was installed in Rizhao Port for trial operation in 2009 and quenched for the first time in 2015. Then we improved the current leads and recovered the normal operation. The other two SEIS devices, named CDCTQ001 and CDCTQ002, were charged to 170.6 A and 172.2 A respectively at low current ramp rate. In the process of increasing current ramp rate, CDCTQ001 can be charged to 165 A in 21 minutes. However, the current of CDCTQ002 was lower than 165 A after several tests. The details of the tests will be presented in this paper.

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II. Magnet

Magnet is the main component of the SEIS. It is designed to generate a 3 T central field and a 0.4 T field at the magnetic axis 860 mm far from the center of the coil, with 165 A of operating current. Fig. 1 shows the structure of the magnet, which mainly includes two cryocoolers, one superconducting coil, cryostat, liquid helium vessel, a pair of current leads, etc.

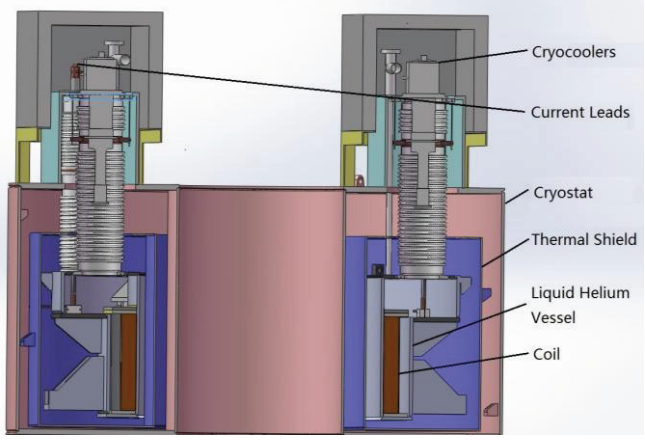

Fig. 1. Structure of superconducting magnet

Main parameters of the magnet, coil and wire are listed in Table I. The magnet cryostat has dimensions of 628 mm in inner diameter, 1800 mm in outer diameter and 900 mm in length. The coil of the magnet was wound by NbTi superconducting wire with insulator. The inner and outer diameters of the coil are 928 mm and 1022 mm, respectively. The height of the coil is 355 mm. After the coil winding, the coil was installed in the VPI device and started the process of VPI with paraffin wax. VPI was adopted to enhance the operation stability of the magnet. The superconducting coil was