

§11. Database for Design of Superconducting Magnet Systems with He II Cooling

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i) Introduction

Recently, R&D and constructions of large superconducting magnet systems cooled with superfluid helium (He II) have been performed. The phase II of LHD is an example of those systems. However, when we plan to design the cooling system for LHD, the data for design of the system are not arranged systematically and insufficient to be used. Therefore, it is important to arrange the necessary information for application of the data to design large superconducting systems with the He II cooling.

We have performed construction of the database for He II, which researchers can use and apply for design, by arrangement of a large number of data and by investigation of complementary data of He II. These works were performed with a Grant-in-Aid for scientific research of the MEXT for three years from year 2000. The continuous maintenance of database and researches of He II cooling have been followed by the collaborative program of NIFS.

ii) Construction of database

In FY 2003, we constructed the database of He II for design of superconducting magnet systems with the He II cooling by searching and collecting data from related literatures until year 2000. The data more than 1000 have been collected from accessible papers by works at the four institutions. Those data have been checked in the effectiveness and reliability, and the graphs, figures and necessary information have been integrated into the database. The works for construction of the database for the information until the year 2000 were completed. The collected data are categorized as shown in Table I.

iii) Experimental studies for the He II database

We have performed the following supplementary experimental investigations:

1. experimental and analytical studies on heat transfer in He II to apply to large superconducting magnet systems,
2. pressure dependence of heat transfer function of He II,
3. heat transfer in pressurized He II through narrow channels, and
4. heat transfer and boiling-off properties in He II.

By studies 1 and 2, we could make clear phenomena peculiar to large superconducting magnet systems cooled with He II, and revise previous data to the more precise ones for pressure dependence of the heat transfer function. Moreover, we could confirm reliability of some data in the database.

iv) Published papers

The following papers were published.

1. T. Haruyama, et al., "Database for He II-cooled superconducting magnet system design", Proceedings of ICEC19 (2003), pp. 795-798.
2. A. Sato, et al., Steady state heat transport in a channel containing He II at high pressures up to 1.5Mpa, Proceedings of ICEC19, 2003, pp. 751-754.

Table I Technical items for document

Head items	Items	Sub items
Heat transfer	He II pressurized	plate
		channel
	He II saturated	plate
		channel
System	Cryostat	
	Heat exchanger	JT HeIIp-HeIIs
	Pumping	vacuum pump cold compressor
	Materials	
Cooling technology	Measurement	temperature
		pressure
		flow rate
		level
		miscellaneous
	Special technique	seal miscellaneous
Operated cases	Refrigeration Magnet Magnet stability Conductor	