

§13. Study on AC Losses and Stabilities of the Rutherford Cable

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Superconducting cables of fusion reactor coils are usually composed of stranded wires because they should flow large current as tens kA. Many problems have to be studied in AC losses and stabilities. AC losses depend on inter-strand resistances which are related to surface conditions of strands, contact pressure and so on. Moreover, stabilities caused by current sharing between strands are related also to the contact resistances. Since these phenomena are contradictory with each other, the control of the contact resistances is very important to be compatible.

This study aims at obtaining basic data for resolving AC losses and stabilities.

We have measured AC losses of many kinds of compacted strand cables, named the Rutherford cable, using equipment at KEK. We have carried out the AC loss measurement of many samples of cables which have been prepared under some conditions, i.e. pressure, sample curing temperature and so on. From the measurement, it is clarified that the AC losses are not affected by pressure on cables, contact resistances become small by break of copper oxide layers during sample preparation with curing, resistive CuMn layers inside strands are effective to reduce AC losses, and so on. The obtained curing temperature dependence on AC losses of

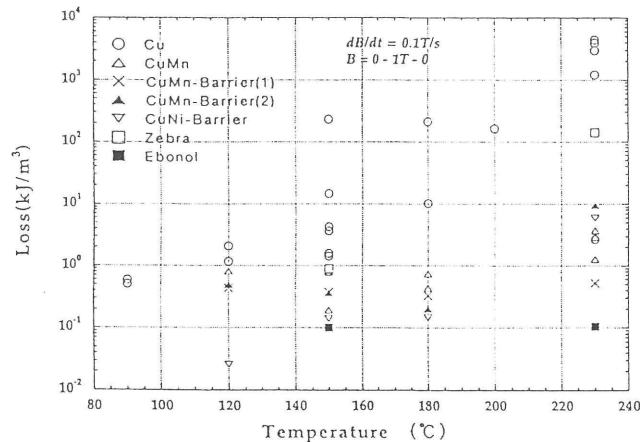


Fig. 1 AC losses of various types of Rutherford cables dependent on curing temperature.

Rutherford cables are shown in Fig. 1. These results have been reported at the Cryogenic Engineering Conference in Japan and other conferences[1~3].

In order to study the stabilities of the Rutherford cables, experiments to measure current sharing phenomena in the cables have been carried out by detecting signals with pick-up coils and voltage taps with the cable test facility at NIFS. One of the obtained results is shown in Fig. 2.

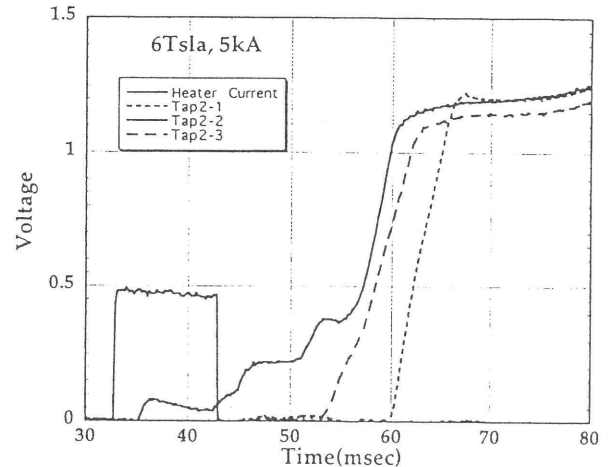


Fig. 2 Voltage wave forms of normal zone of Rutherford cable show current sharing phenomena.

Interstrand AC losses are relatively small for the cables with CuMn in the strands in compared with typical cables with a Cu matrix. This gives us suggestion for reduction and control of AC losses in such cables.

On the other hand, the current sharing phenomena have been detected within one twist pitch of the cables. This seems to give us some information to control the AC losses and stabilities.

However, the further studies for the current sharing phenomena have to be performed for various cable samples to get positive evidences.

References

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- 3) Kimura, A., et al., Influence of Curing on AC Losses of Cables for Superconducting Accelerator Magnets, IEEE Trans. on Applied Superconductivity, 3 (1993) 747