Study of bending behavior in Nb$_3$Sn strands


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1.1 Background

The superconducting property of Nb$_3$Sn strands is very sensitive to strain. The transverse electromagnetic loading has been considered as a major origin of the degradation of Nb$_3$Sn cable-in-conduit conductor (CICC) due to the periodic local bending. The degradation of each strand due to this bending should be evaluated to be able to perform the CICC. Thus, an analytical model considered with the plastic deformation of copper and filament breakages was developed.

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1.2 Objectives

- Evaluation of bending strain distribution and filament breakage in Nb$_3$Sn strands using neutron diffraction measurement and numerical model.
- Critical current calculated by proposed model shows agreement with the measurements.

5. Conclusion

- The bending strain of Nb$_3$Sn strands can be measured by the neutron diffraction technique quantitatively and non-destructively. The procedure using the convolution between the profile of non-bent Nb$_3$Sn strand and bending strain distribution was applied.
- In addition, the neutron diffraction profile of the bent Nb$_3$Sn strand shows the filament breakage quantitatively.
- Numerical model is developed to calculate the strain distribution, the filament breakage and Ic behavior of the test strand is corresponding to the HTRM with filament breakage starting from 0.6%.

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