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Long Term Monitoring of Vectran Filaments Immersed in Ultra Pure Water

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1. Proposal:

It is proposed to place a specimen of Vectran filament, under load, in a test tank containing water which approximates the chemistry and temperature of the water in the Sudbury Neutrino Observatory (SNO) detector. A length of filament, sufficient for four test specimens will be removed every six months and tested according to the procedure AdSM D885 – Modified, in order to ascertain any change in the filament strength due to the ultra pure water environment of the SNO acrylic vessel.

2. Test Specimens:

The filament to be used for the test specimens was prepared during the fabrication of the ropes used to suspend the SNO Acrylic
Vessel. It is identical to the material used in the construction of the final rope. The specification of this rope is given in appendix 1.
A total filament length of 50 meters will be used, allowing for approximately 100, 50cm long test samples. Four samples will be removed for testing every 6 months over a period of 10 years

3. Test Conditions:

The test conditions are described in the proposal "Test Tanks for the Sudbury Neutrino Observatory", N. Jelly and J. Lyon, October 5 1995. The test filament, under a constant load of 3.5 kg, will placed in a polypropylene tank of 965mm internal diameter, filled to a depth of 700mm with water returning from the SNO cavity. The exchange rate of the water will be approximately one volume per day at temperature of 12^{o}C. The pH and resistivity of the water will be constantly monitored. The test tanks are hermetically sealed and provided with a nitrogen cover gas at above ambient pressure.

4. Test Apparatus:

The constant load of 3.5 kg is applied to the filament by the apparatus shown in figure 1. All components of the test apparatus are constructed of stainless steel and PVC plastic and will not detract from the purity of the water in the test tank. The four sided spool holds 25 turns of filament. Each turn provides sufficient material for 4 test specimens, the amount required for each biannual test.

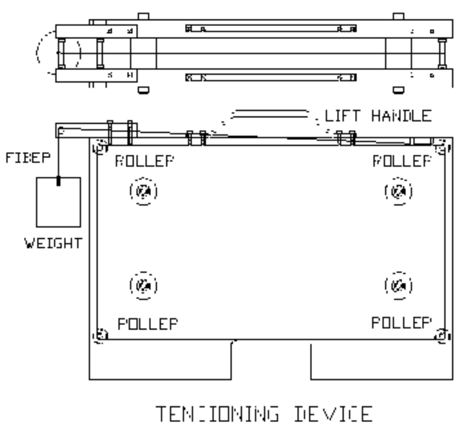

Figure 1: side and top view of the filament testing apparatus.

5. Test Procedure:

50 meters of Vectran filament will be wound on the spool of the test apparatus, the load weight attached and the apparatus inspected to ensure that the filament is correctly loaded. If the inspection is satisfactory, the apparatus is fully submerged in the test tank, the tank is sealed and the long term Vectran test log is filled out.

An additional 50 meters of reference filament, cut from the same spool as the immersed filament is stored in a clean, sealed plastic bag along with the test log located on the top of the test tank.

After an appropriate time, not to exceed 6 months, the test apparatus is removed from the test tank. One turn (two meters, sufficient for four test specimens) is removed from the spool and placed in a clean plastic bag. The bag will be identified in the following way:

Vectran water sample # + Date + operator

This information will also be recorded on the test log along with measurements of the water temperature and resistivity. The load will be reapplied to the filament remaining on the test spool and the apparatus fully submerged in the test tank and the tank shall be sealed.

Two meters of filament will be cut from the reference spool and placed in a clean plastic bag. The bag will be identified in the following way:

Vectran reference sample # + Date + operator

The remaining reference spool shall be returned to its bag and placed in safe storage on top of the test tank.
The two bags of test specimens will be send for testing according to
The method described in AdSM D885 - Modified:

Guide length: 10 inches (length of sample being tested)
Total length sample: 20 inches
Rate of test: 10%/minute or 1"/minute
Twist: 0.4 turns/inch or 4 turns in 10". - twist in SNO ropes.

The test results will be recorded by Davis Earle who is custodian of the long term test results.

LONG TERM VECTRAN TEST SPECIMEN

LOG SHEET

SPECIMEN INSERTION:

DATE INSERTED ___________
WATER TEMP. (C) ___________
RESISTIVITY (MEG.) ___________

SPECIMEN REMOVAL:

DATE	SPECIMEN I.D.	TEMP.	REST.	OPERATOR

APPENDIX 1: The following summarizes the construction specifications of the rope supporting the acrylic vessel.

Specifications:
Material: Vectran HS
Total Denier of rope: 2,916,000 denier.
Denier/filament bundle: 1500 denier.
Num. filament bundle: 1944
Denier/filament = 5 denier
filaments/filament bundle: 300
Loading per rope: 5 tons

Construction:
(s & z refer to direction of twist which are opposite of each other)

1st Twist:
7 bobbins created where each bobbin is 13500 denier using 7 filament bundles around 2 filament bundles: (9 x 1500).
1 bobbins created where each bobbin is 27000 denier using 18 filament bundles (18 x 1500)
Done separately for each direction (s and z).

2nd Twist:
7 (13500 twist) around one 1 (27000) bobbins to create 121,500 denier bobbin
Done separately for each direction (s and z).

Winding:
Take two (121,500) bobbins to create 243,000 denier bobbin.
Done separately for each direction (s and z).

Braiding:
Take 6s and 6z (243,000) bobbins to create final rope (12 x 243,000) = 2,916,000.