RVTEC 2017

Rick Trask
UNOLS Wire Pool Manager
Overview

• Brief Overview of the UNOLS Wire Pool Activities

• Summarize Wire Pool progress to date evaluating various synthetic ropes with emphasis on recent laboratory test results.
What does the Wire Pool do?
UNOLS Wire Pool

• Supports the wire rope and cable needs of the UNOLS research vessel fleet
UNOLS Wire Pool

• Supports the wire rope and cable needs of the UNOLS research vessel fleet
• Maintains a wire database for each vessel in the fleet
UNOLS Wire Pool

• Supports the wire rope and cable needs of the UNOLS research vessel fleet
• Maintains a wire database for each vessel in the fleet
• Evaluates the condition of UNOLS vessels’ cable and wire rope
UNOLS Wire Pool

• Supports the wire rope and cable needs of the UNOLS research vessel fleet
• Maintains a wire database for each vessel in the fleet
• Evaluates the condition of UNOLS vessels’ cable and wire rope
• Evaluates tension members for special applications
Synthetic Tension Members

A letter to the UNOLS Fleet Improvement Committee from the National Science Foundation (NSF) stated:

“NSF is extremely interested in promoting the use of synthetic ropes throughout the Academic Fleet.”

The UNOLS Wire Pool began investigating what manufacturers recommended as a 9/16” diameter trawl wire alternative and evaluating the candidate ropes.
Objectives of Synthetic Evaluation

• Evaluate different rope materials and constructions as alternatives for 9/16” diameter 3x19 wire rope

• Evaluate the feasibility of using synthetic rope with existing ship’s equipment

• Evaluate the use of synthetic rope for coring operations
Initial Synthetic Evaluation

• Select rope products to evaluate
• Select a vessel from which to work
• Conduct several dock-side test to evaluate the compatibility of the synthetics with the winch system on the vessel
• Utilize the synthetics during at sea tests
R/V Endeavor with its traction winch selected as the test vessel

Reconditioning of Endeavor’s traction heads

Ready for heavy lifts
# Initial Synthetic Rope Products Evaluated

<table>
<thead>
<tr>
<th></th>
<th>Phillystran</th>
<th>Samson</th>
<th>Cortland BOB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>PST</td>
<td>DM-20</td>
<td>B.O.B.</td>
</tr>
<tr>
<td><strong>Diameter</strong></td>
<td>9/16&quot;</td>
<td>9/16&quot;</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td><strong>MBS</strong></td>
<td>32,500 lbs.</td>
<td>33,200 lbs.*</td>
<td>51,400 lbs.</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>7-strand &quot;wire lay&quot; with an overall braided jacket</td>
<td>12-strand single braid</td>
<td>12-strand single braid</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Aramid (Technora®)</td>
<td>HMPE (Dyneema® DM-20 Fiber)</td>
<td>Blend of LCP (Vectran®) and HMPE</td>
</tr>
<tr>
<td><strong>Specific Gravity</strong></td>
<td>1.39</td>
<td>0.98</td>
<td>1.18</td>
</tr>
<tr>
<td><strong>Elongation @ 30% of MBS</strong></td>
<td>1.24%</td>
<td>0.96%</td>
<td>1.12%</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>1000 m</td>
<td>1000 m</td>
<td>100 m</td>
</tr>
</tbody>
</table>

*At the time of testing the MBS was estimated at 32,500 lbs.*
Each rope type was wound onto the winch and then used to raise a 15,000 lbs. weight.

Gravity Coring (April 2016) using both the Phillystran and Samson products.

B.O.B (larger diameter) used to lift 25,000 lbs.
Continuation of Synthetic Testing
2016 & 2017

• Repeat of lift tests using the traction winch on the R/V Neil Armstrong in preparation for a piston coring application

• Laboratory Tension Tests to compare candidate ropes and identify a viable option for piston coring
Load Tests using the Armstrong’s Traction winch and lifting 20,000 lbs.
In House Laboratory Testing

4 Rope Samples Tested using the Thousand Cycle Load Level (TCLL) Determination:

- 5/8” Cortland B-O-B
- 9/16” Samson Product with DM-20 fiber
- 9/16” Phillystran PST with Multiplex jacket
- 9/16” Cortland Plasma® HiCo
Thousand Cycle Load Level Procedure

(TCLL)

TCLL is the load at which failure would occur in 1,000 cycles
Expressed as a % of the manufacturer’s minimum breaking strength

• 1,000 cycles @ 50% of breaking strength, if it survives
• 1,000 cycles @ 60%, if sample survives
• 1,000 cycles @ 70%, if sample survives
• 2,000 cycles @ 80%

Using Predetermined Equivalents:
• 1,000 cycles @ 50% = 251 cycles @ 60%
• 1,000 cycles @ 50% + 1,000 cycles @ 60% = 215 cycles @ 70%
• 1,000 cycles @ 50% + 1,000 cycles @ 60% + 1,000 cycles @ 70% = 113 cycles @ 80%

CTF = Number of Cycles to Failure
TLL = Test Load Level at which CTF occurred

TCLL can be calculated:  TCLL = 100% - ((6.91 (100% - TLL))/Ln CTF)
## TCLL Test Results

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product</th>
<th>TCLL [% MBS]</th>
<th>MBS [Lbs.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortland</td>
<td>B-O-B</td>
<td>71.4</td>
<td>51,400</td>
</tr>
<tr>
<td>Phillystran</td>
<td>PST</td>
<td>79.4</td>
<td>32,500</td>
</tr>
<tr>
<td>Samson</td>
<td>DM-20</td>
<td>81.9*</td>
<td>32,500</td>
</tr>
<tr>
<td>Cortland</td>
<td>Plasma® HiCo</td>
<td>81.9</td>
<td>37,900</td>
</tr>
</tbody>
</table>

* Used an estimated minimum breaking strength
Looking Forward

What’s next for the Wire Pool?
Questions?
Keep the slides below for reference
Breaking Strength Results

- PST
- DM-20  38,025 lbs,  29,600 lbs.
- HiCo  42,125 lbs.
6,804 kg
(15,000 lbs.)
Load Test
Gravity Coring using the Phillystran PST from the R/V Endeavor
Rope configuration following the first coring operation after being disconnected from the core head.
Spiral pattern evident in jacket of the Phillystran product after taking the first core.
Additional Testing of a Third Synthetic Sample

- 250 ft sample of a Cortland product called BOB for Braid Optimized for Bending.
- Used the Samson product as a winch leader to which the BOB was attached.
- BOB sample diameter = 5/8”
- MBS = 23314 kg (51,400 lbs.)
- Specific Gravity = 1.18
- Elongation at 30% of MBS = 1.12%
- Blend of fibers that improve the bend over sheave CTF
- Conducted dock side load tests using the BOB