AmSteel Blue in Logging

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Abstract
High strength synthetic ropes are an excellent candidate for wire replacement in logging application. These ropes have the equivalent strength of the same diameter wire rope but only one-seventh of the weight of wire. AmSteel Blue, a premium synthetic High Modulus Polyethylene (HMPE) rope developed by Samson, has already been used in various logging applications. This paper discusses the benefits to use synthetic ropes in logging, including ergonomics and safety considerations, efficiency improvement and cost reduction.

1. INTRODUCTION

There are 749 million acres of forest land in the United States split evenly east and west of the central plain of the country. The total forested land has grown 0.3% since 1997. Roughly 504 million acres (67%) of forest land is classified as timberland – land capable of producing in excess of 20 cubic feet of lumber per acre per year. 80% of pacific region forest land is classified as timberland.

Over the past 40 years the growing stock on timberland has increased substantially. Since 1953, timberland has increased 39% from 616 billion cubic feet of lumber to 856 billion cubic feet. The major increases in growing stock have occurred in the northern states (+96%) and south (+80%). Growing stock in the pacific coast region has declined due to the harvesting of older, higher volume stands and large areas of “set-asides” that are not available for logging. On a national basis, however, growing stock has exceeded harvesting for the past 40 years.

The logging industry makes extensive use of wire rope in harvesting operations. The wire is used above ground for lifting and transporting logs from the field to trucking operations. Wire is also used on the ground to hold and drag the logs. High strength synthetic ropes are an excellent wire replacement in various logging applications. These synthetic ropes have the equivalent strength of the same diameter wire rope but only one-seventh of the weight of wire. AmSteel Blue, a premium synthetic High Modulus Polyethylene (HMPE) rope developed by Samson, has already been successfully introduced and used in various logging applications.

2. AMSTEEL BLUE

In 1986, Samson pioneers use of High Modulus Polyethylene (HMPE) for a variety of Marine Applications to replace wire. The 2nd generation HMPE fiber, SK-75, became available in 1996 and Samson used it to create AmSteel Blue – a 12 strand HMPE rope.

AmSteel Blue was first introduced into the Commercial fishing industry and has been used successfully for over a decade in the following areas:

- Commercial Fishing
- Tree care
- Utility and power lines
- Fall Protection
- Entertainment Industry
- Mooring
- Tug

It is the primary wire replacement, based on its high strength, light weight and ease of repairability. Figure 1 compares strength and weight between AmSteel and Wire cables. The size for size strengths compare with those of wire.

Figure 1. Strength and Weight comparison – AmSteel Blue vs. Steel
3. ADVANTAGE OF AMSTEEL BLUE OVER STEEL WIRE

- **LIGHTWEIGHT,**
  - Easy to pull to fallen logs, especially uphill
- **FASTER CYCLE TIMES** (time to get rope in place and return)
  - Means more production per operating hour!
- **PHYSICALLY LESS STRENUIOUS**
  - Reduces fatigue build up, and associated aches and pains compared with steel wire rope. Less fatigue can reduce injuries and create safer operations.
- **NO JAGGERS!** (fish hooks)
  - No irritating lacerations and puncture wounds to the hands and arms.
- **NO SNARLED WINCH DRUM WHEN WINCH IS SET TO FREE SPOOL:**
  - Upon release of the drum to pull the line off, the torque tension stored in the spooled steel line creates a backlash similar to an open face fishing reel. These snarled spools frustrate operators and cause operational delays in pulling the line out to the logs.
- **ELIMINATION OF THE DRAG ADJUSTMENT:**
  - Used to limit snarling associated with coiled energy release and coil expansion of the steel rope. This is a benefit to the worker reducing the force required to rotate the drum when pulling out the line.
- **DIVING** (line becoming buried between wraps on the drum).
  - On the rare occasion a synthetic line dives, it can easily be pulled free by hand. No need to use pry bars or hook the line to a fixed (tree, stump) and pull the skidder ahead to pull the stuck line free off the unlocked pool.
- **REDUCTION OF DELAYS**
  - Equals more productive time.
- **ABILITY TO LONG LINE SHORT CORNERS WITH SKIDDER** (reach out to logs on a site typically harvested with cable yarding systems).
  - Saves time and expense of setting up a more expensive system. Typically, short corridors take longer to rig and de-rig than to yard the logs.
- **ABILITY TO ACHIEVE DESIGNATED SKID TRAIL SPACING** (trails for skidder to travel on instead of traveling all over the forest soils).
  - Reduces environmental impact of ground based skidding systems.
SKIDDING EQUIPMENT CAN BE KEPT OUT OF RIPARIAN AREAS (stream sides) AND OTHER SENSITIVE SOIL SITES WHILE HARVESTING.
- Using AmSteel-Blue allows logs from these areas to be winched and pulled further distances than steel wire rope.

FEWER TRIPS BETWEEN RIGGING TREES.
- All required lines and rigging can be moved in as few as one trip across the hillside.

FASTER AND EASIER RIGGING OF TAIL AND INTERMEDIATE SUPPORT TREES.
- Rigging straps and guylines can be attached to the climbing belt while on the ground, and raised with the climber during climbing motion. This is not feasible with wire rope guylines. With steel guylines, a block would need to be raised, strapped to tree, and then a pass rope used to hoist the guylines to get them to required attachment height.
- Guyed trees are less likely to move compared to trees rigged with steel guylines when the skyline load is applied to the tail or intermediate lift trees because the slack has been removed from the line. Lighter AmSteel-Blue ropes have significantly less catenary effect (belly). Eyes with shackles meet most needs.

GUYLINES CAN BE RIGGED “TIGHTLY” BY ONE WORKER WITH A COME-ALONG. THERE IS LITTLE TO NO “BELLY” IN THE GUYLINES WHEN RIGGED.
- Guyed trees are less likely to move compared to trees rigged with steel guylines when the skyline load is applied to tail or intermediate lift trees because the slack has been removed from the line. Lighter AmSteel-Blue ropes have significantly less catenary effect (belly). Eyes with shackles meet most needs.

4. REPAIRABILITY OF AMSTEEL-BLUE:

The ease of splicing AmSteel-Blue 12-strand ropes permits easy and quick repairs to terminal ends, such as eyes, with the Buried Eye Splice. Additionally, repairs to inline sections of working lines may be performed as well with the End for End splice (Long Splice).
Repairs to AmSteel-Blue ropes or eyes should be performed when two or more strands have been severed. Repair of individual cut strands is not an approved practice. Repairing a single strand would also be more difficult and take longer than a complete rope splice repair.

A significant advantage with splicing of AmSteel-Blue ropes is the reduced length of the splice. The length of buried rope for each end of the End for End splice shown in Figure 2 is 4 feet to each side for the 3/4″ AmSteel-Blue rope (3 fids lengths, 1 fid length = 16 inches). (One fid = 21 x rope diameter and each end of one buried tail = 63 x rope diameter). If this had been 3/4″ steel wire rope, each end of rope to be tucked for the long splice would have been 15 feet. Thus, the total splice length for 3/4″ rope is 8 feet for synthetic compared to 30 feet for steel!

Another particularly significant advantage with synthetic winch lines is the ability to splice additional length onto an existing line using the End for End splice as seen in Figure 4. The Long Splice is not done with steel wire rope winch lines. The spooled remaining good length of steel winch lines is removed and replaced with a new longer section.

With practice, field personnel can become proficient with both Eye and End-for-End splices, even if they have no experience splicing wire rope. Splicing can be performed in the field with just a knife and a length of bailing wire. This can avoid downtime associated with getting repairs performed at rigging shops.

5. AMSTEEL BLUE IN LOGGING

AmSteel Blue can also be used in the following logging applications:
- Haywire / Strawline
- Guylines & Extensions
- Tree & Ground Straps
- Skidder Lines, Winch Lines
- Skyline Extensions
- Drop lines / Mainlines
- Chokers

Using Haywire as an example, AmSteel Blue provides the following benefits over wire:
- Light weight – Faster to rig
- No need to carry heavy wire
Run longer lengths without connecting sections
Can be set-up on a winch and pulled off easily

Small diameter (1/4 to 3/8-inch) steel wire rope lines are used to rig larger steel lines on cable logging systems. These are known as haywire or straw lines. Most yarders contain a drum for spooling haywire. Additionally, coils of haywire are also used for laying out sections on the hillside. These coils are typically 200 feet in length, and weigh about 50 pounds each. The sections are connected to each other, to the haywire drum, and to the line to be pulled out. For example, to pull a 1-inch diameter skyline out 1000 feet, 2000 feet of haywire would need to be laid out: 1000 feet from the yarder to the tailhold, through a block, and then 1000 feet back to the yarder for connecting to the skyline. The haywire drum would then be spooled in, pulling the skyline out to the tailhold. AmSteel-Blue ropes are an ideal replacement for steel wire ropes in this application.

![Image of a tree stump with haywire]

Fig. 5: AmSteel-Blue can reduce the weight of your haywire by 80%! This drastically reduces the time needed to rig the haywire.

6. COST ANALYSIS

A cost analysis is conducted to estimate the saving from using AmSteel vs. Wire cable, as Haywire, shown in Table 1.

The analysis is based on the assumption of using 5000 ft of 3/8” dia rope. Conservatively we estimate that the synthetic line last only half of the life of the wire.
Table 1. Haywire Cost Analysis – AmSteel Blue vs. Wire Cable

<table>
<thead>
<tr>
<th></th>
<th>AmSteel Blue</th>
<th>Wire Rope</th>
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</thead>
<tbody>
<tr>
<td><strong>Assumptions</strong></td>
<td>500</td>
<td>500</td>
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<tr>
<td>Annual Layouts</td>
<td>6 months</td>
<td>12 months</td>
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<tr>
<td>Estimated Life</td>
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<td></td>
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<tr>
<td><strong>Fixed cost</strong></td>
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<td></td>
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<tr>
<td>Total Weight of Haywire</td>
<td>180 lb</td>
<td>1300 lb</td>
</tr>
<tr>
<td>Price of Rope per Foot, $/ft</td>
<td>$1.48</td>
<td>$1.00</td>
</tr>
<tr>
<td>Total Haywire Price / Year</td>
<td>$14,800</td>
<td>$5,000</td>
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<tr>
<td>Rope cost per operation</td>
<td>$29.60</td>
<td>$10</td>
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<tr>
<td><strong>Variable cost</strong></td>
<td></td>
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<tr>
<td>Man Hours per Layout</td>
<td>2 hour</td>
<td>8 hours</td>
</tr>
<tr>
<td>Labor Rate/Hour - Hook Tender</td>
<td>$18</td>
<td>$18</td>
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<tr>
<td>Downtime / Layout</td>
<td>0 hour</td>
<td>2 hours</td>
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<tr>
<td>Labor Rate/Hour - Crew (average)</td>
<td>$15</td>
<td>$15</td>
</tr>
<tr>
<td>Labor Cost / Layout</td>
<td>$36</td>
<td>$174</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approximate Cost per Layout</td>
<td>$66</td>
<td>$184</td>
</tr>
<tr>
<td>Annual Operation Cost</td>
<td>$32,800</td>
<td>$92,000</td>
</tr>
<tr>
<td>Annual Savings - (Per Haywire)</td>
<td>$59,200</td>
<td></td>
</tr>
<tr>
<td><strong>Break-Even Life</strong></td>
<td></td>
<td>2 Months</td>
</tr>
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**Annual Savings - 25 Haywires** $1,480,000

As the analysis shows, although AmSteel is more expensive than Wire rope, the operation cost with the synthetic rope is much lower than the wire cable. It only takes about 2 months to recover the investment of the synthetic lines. Furthermore, with more operations taking place, more saving is realized with AmSteel. For example, if an operation uses 25 Haywires the annual saving is about 1.5 million dollars.
The main features and benefits of AmSteel Blue are listed in Table 2.

Table 2. Main Features and Benefits of AmSteel Blue

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits vs. Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>15% of the weight of wire</td>
<td>Easier to handle</td>
</tr>
<tr>
<td>Will not kink</td>
<td>Fewer injuries</td>
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<tr>
<td>No jagers</td>
<td>Less strain on workers</td>
</tr>
<tr>
<td>No Contamination from Lubricants</td>
<td>Better for the environment</td>
</tr>
<tr>
<td>High wear and flex fatigue life</td>
<td>Repair instead of replace</td>
</tr>
<tr>
<td>Weather resistant</td>
<td>Faster rigging</td>
</tr>
<tr>
<td>Chemical resistant</td>
<td>Easily Field Repaired</td>
</tr>
<tr>
<td></td>
<td>Won’t Rust</td>
</tr>
<tr>
<td></td>
<td>Won’t damage equipment</td>
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</table>

These features and benefits make Amsteel Blue a viable wire replacement offering lower operating costs in logging due to:

- Safety Improvement
  - Reduced health care costs
  - Less stress and strain on workers
  - Fewer injury claims
  - Less down time

- Efficiency Improvement
  - Reduced operations time
  - Reduced man hours per setup

ABOUT SAMSON

For well over 100 years, Samson has been recognized as a worldwide leader in the development and manufacture of high performance ropes. Among its many innovations, Samson invented the double braid and pioneered the first high modulus polyethylene fiber ropes. Today Samson engineers continue to pioneer the use of new fiber technology and the development of innovative coatings and constructions to produce ropes with unprecedented performance characteristics. Samson’s research and development team is meeting an ever expanding market need for products with exceptional performance in critical applications. Samson is part of Wind River Holdings™ portfolio of operating companies.