Designed for Mining: Mining Working Lines

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Overview

- **Introduction to Samson**
- **Synthetic Rope Overview**
  - **Synthetic Rope vs. Wire Rope**
  - **Applications**
- **Research and Development**
  - **Degradation modes of mining working lines**
  - **Mining environment**
    - *Harsh, abrasive conditions and equipment*
  - **Engineered abrasion testing**
    - *Replicate field damage with repeatable lab testing*

Introduction to Samson

- **Who we are in the mining industry**
  - **High performance cordage manufacturer**
  - **Innovating new rope technologies for over 135 years**
  - **AmSteel®-Blue: the original “blue rope guys”**
  - **Most advanced R&D organization**
  - **Network of fabricating distributors**

Introduction to Samson

- **The Samson Advantage – Where People and Technology Make the Difference**
  - **Differentiates Samson from other synthetic rope manufacturers**
  - **Expertise and product performance: embodies what customers can expect**
  - **5 key elements that set Samson apart**
    - *Technology*
    - *Products*
    - *Service*
    - *Manufacturing*
    - *Experience*

Introduction to Samson

- **The Samson *Mining* Advantage**
  - **All Samson sales personnel are MSHA New Miner certified**
  - **Extensive distribution network**
    - *Servicing your job, on your site. There when you need us.*
  - **Pre-Sale services**
    - *On-site surveys to determine the best product*
  - **Post-Sale services**
    - *Technical sales team for installation, inspections, troubleshooting, etc.*
    - *Comprehensive crew training*
    - *Corporate training available*
  - **Ongoing partnership program**
    - *Dedicated Samson factory representative*
    - *Dedicated Samson engineer and application specialists*
    - *Qualified service technicians*
    - *Residual testing program*
    - *Ongoing upgrades to crew training*

Synthetic Rope vs. Wire Rope

- Replaces wire rope or chain in many mining applications
- Size-for-size the same strength as wire rope
- 1/7th the weight as the same size wire rope
- Longer tension fatigue life
- Reduced recoil
  - Torque-neutral and lighter weight
- Increased handling safety with elimination of broken wires
- Weather and chemical resistant
- Doesn’t rust
- Doesn’t damage equipment

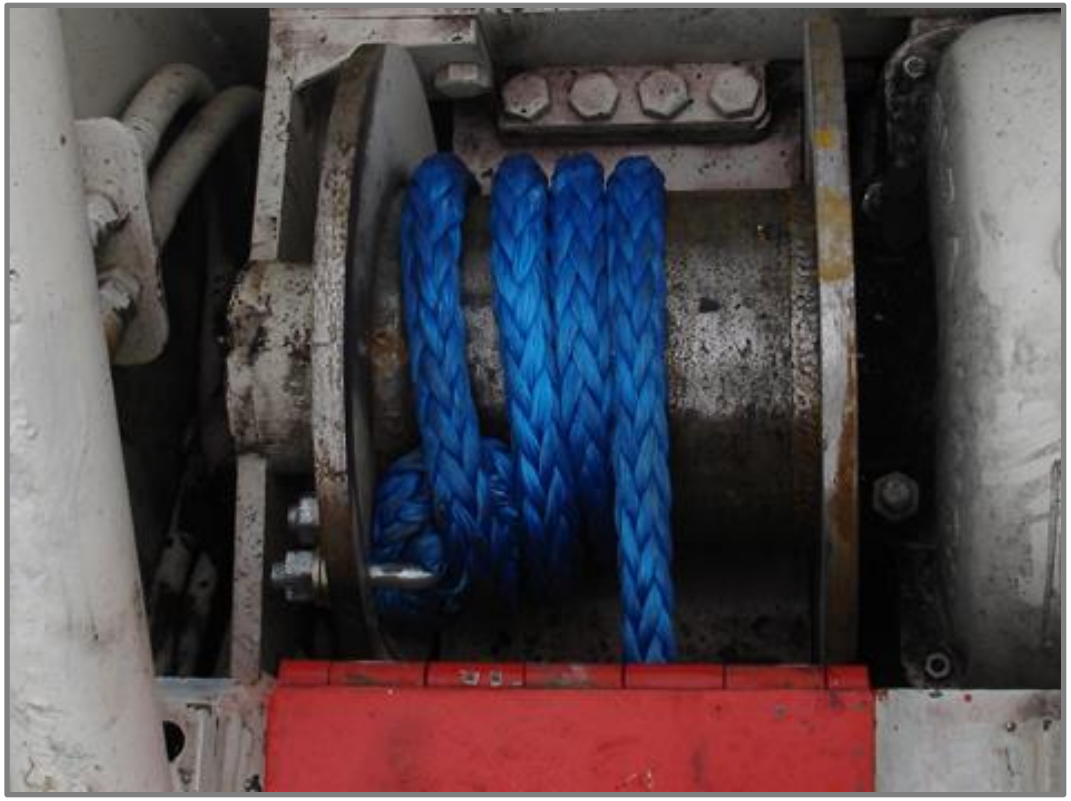
Synthetic Rope vs. Wire Rope

None of this!

Synthetic Rope vs. Wire Rope

Or this!

Synthetic Rope vs. Wire Rope



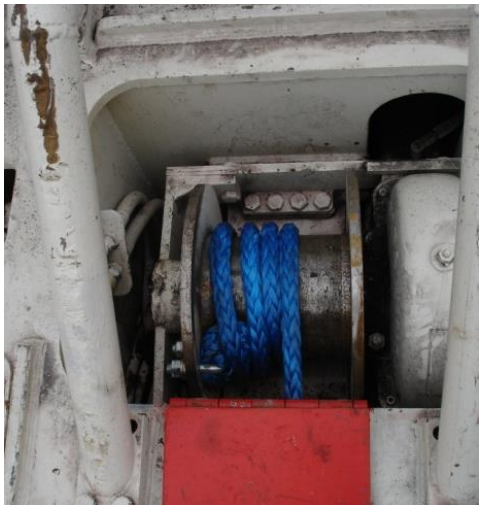
But rather, this!

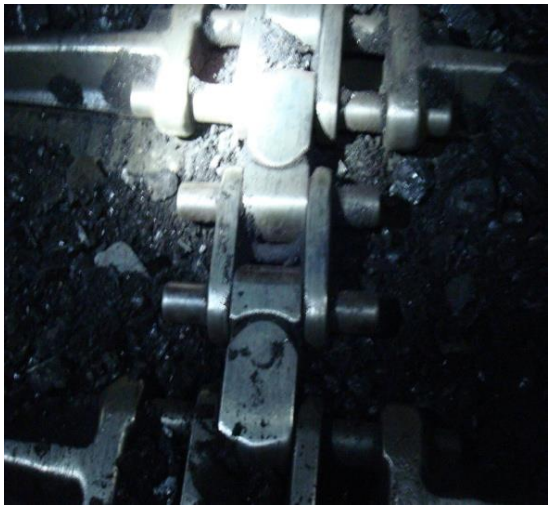
AmSteel®-Blue Winch line

- **Minimal shape memory**
- **Easy to spool and manipulate**

Mining Applications

- **Samson's high-performance synthetic ropes are used in:**
  - **Towing/recovery**
  - **Winching**
  - **Lifting**
  - **Other**
    - *Continuous miner belt changeover*
    - *Conveyor belt changeover*





Mining Applications: Overcoming Challenges

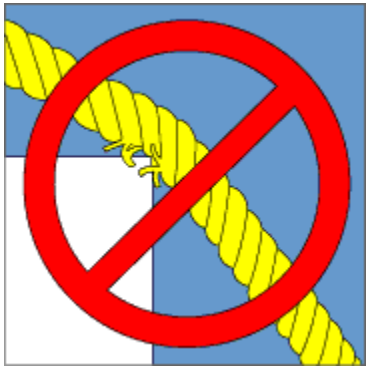
- **Safety concerns that need to be addressed:**
  - **Ease of handling/efficiency**
    - *Easier for crew to pick up and maneuver*
    - *Less time for set-ups and hook-ups*
  - **Reduce back injuries**
    - *Weight reduction in rope decreases back injuries*
  - **Reduce hand injuries**
    - *No broken strands*
  - **Recoil**
    - *Torque-free, 12-strand construction of AmSteel®-Blue and Saturn-12 allows rope ends to follow predictable path*

Mining Applications: Overcoming Challenges

- **Common degradation mechanisms**
  - **Cutting**
  - **Tension – tension fatigue**
  - **Abrasion**
- **R&D testing to find where we can improve**
  - **From here we developed methods to test for improvement**

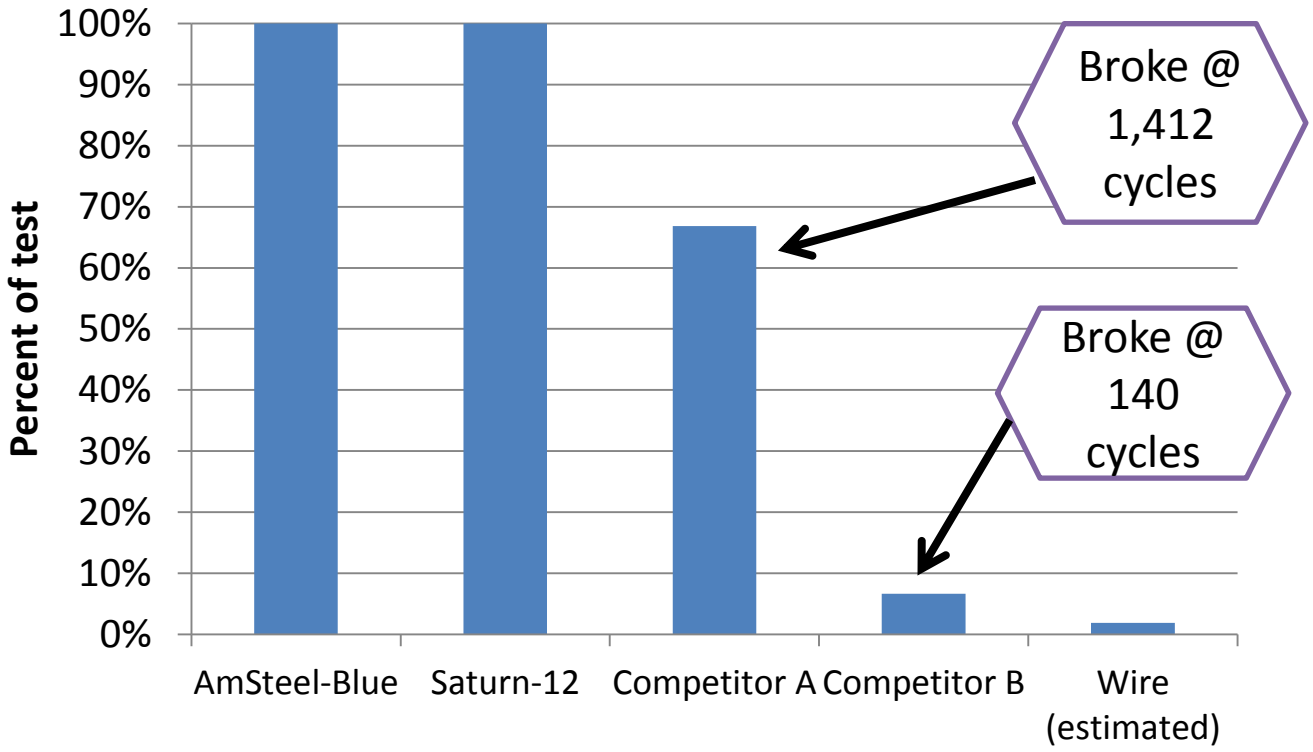
Degradation Mechanisms: Cutting

- **Cutting prevention**
  - Miner usage, care, and inspection training
  - Added protection from add-ons, such as thimbles, hardware and chafe gear
  - Using sheaves to work around corners



Degradation Mechanism: Tension Fatigue

- **Tension – tension fatigue testing**
  - **OCIMF TCLL – 2,113 cycles to 80% minimum break strength**
    - *Oil Companies International Marine Forum*
      - Thousand Cycle Load Limit
    - *AmSteel®-Blue and Saturn-12 survived test with no observable strength loss*



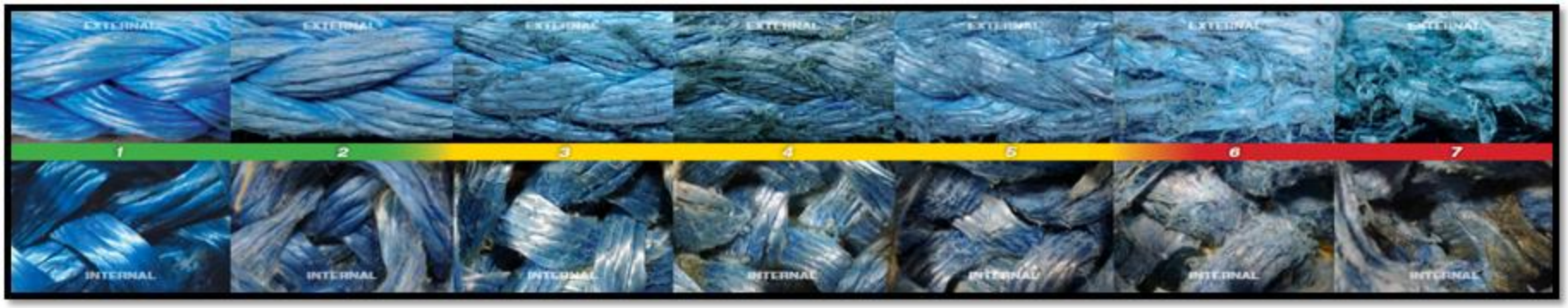
Degradation Mechanism: Abrasion

- **Abrasion life**
  - **Abrasion from general use is NOT as significant as most believe**
  - **Initial abrasion will cause the rope to “fuzz.” This actually prevents further abrasion**

- **Bending radius**
  - **Synthetic ropes can use much lower D/d ratios**
  - **Wire bend-over-sheave diameter ratio of 20:1 or 25:1**
  - **Synthetics operate at 8:1**

Degradation Mechanism: Abrasion

- **Abrasion from surfaces and heavy particulates**
  - **Developed a pocket abrasion comparator featuring ropes used in the field**
  - **Identified as an area of further investigation**
    - *Surface preparation – removing burs*
    - *Rope construction*
    - *Coating technology*



Degradation Mechanism: Abrasion

- **Protection options**
  - **Jacketed rope**
    - *Benefit: offers an outer layer that protects strength member*
      - AmSteel® II Plus, but will need to increase rope diameter
  - **Localized chafe protection**
    - *Benefit: protection for connection points*
  - **Fiber**
    - *Dyneema® offers increased abrasion resistance*
  - **Coating**
    - *Investigated with mining abrasion testing*
      - Add protection from particulate intrusion
      - Can decrease friction between rope and surfaces

Designing Abrasion Testing for Mining Applications

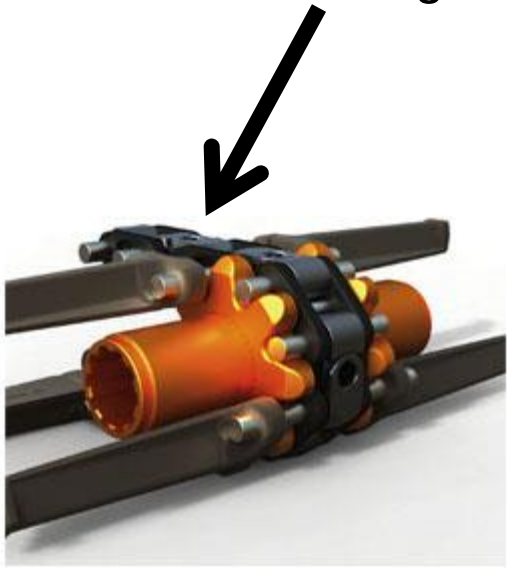
Increase service life by increasing abrasion protection

Designing Abrasion Testing for Mining Applications

- **Challenges in underground mining**
  - Traditional abrasion testing does not account for harsh mine environment
  - Confined space of an underground mine often creates situations with non-ideal rigging setups
  - Equipment with sharp edges
  - Contact with rock faces
  - Abrasives such as limestone

Designing Abrasion Testing for Mining Applications

- **Continuous miner conveyor chain rope**
  - Chain moves material up
  - Replacing and repairing requires stringing line to route chain through system



Abundance of abrasive particulates and sharp edges

Designing Abrasion Testing for Mining Applications

- **Traditional abrasion testing surfaces**
  - **Designed for abrasion on rope contact surfaces**
    - *Fairleads, chocks, rollers*
  - **Common with long-term contact with a given rope use system**
    - *Smooth distribution across contact surface*
  - **Not representative of mining conditions**

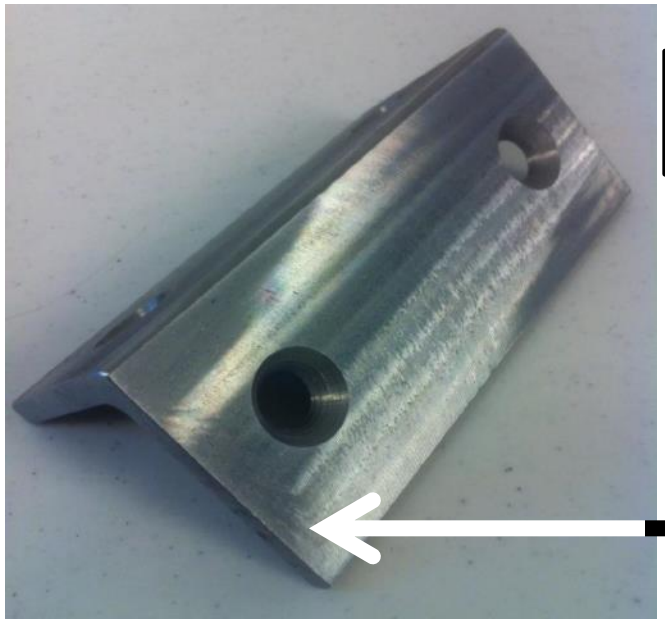
VS

Abrasion tester contact surface

Rough battery truck surface

Designing Abrasion Testing for Mining Applications

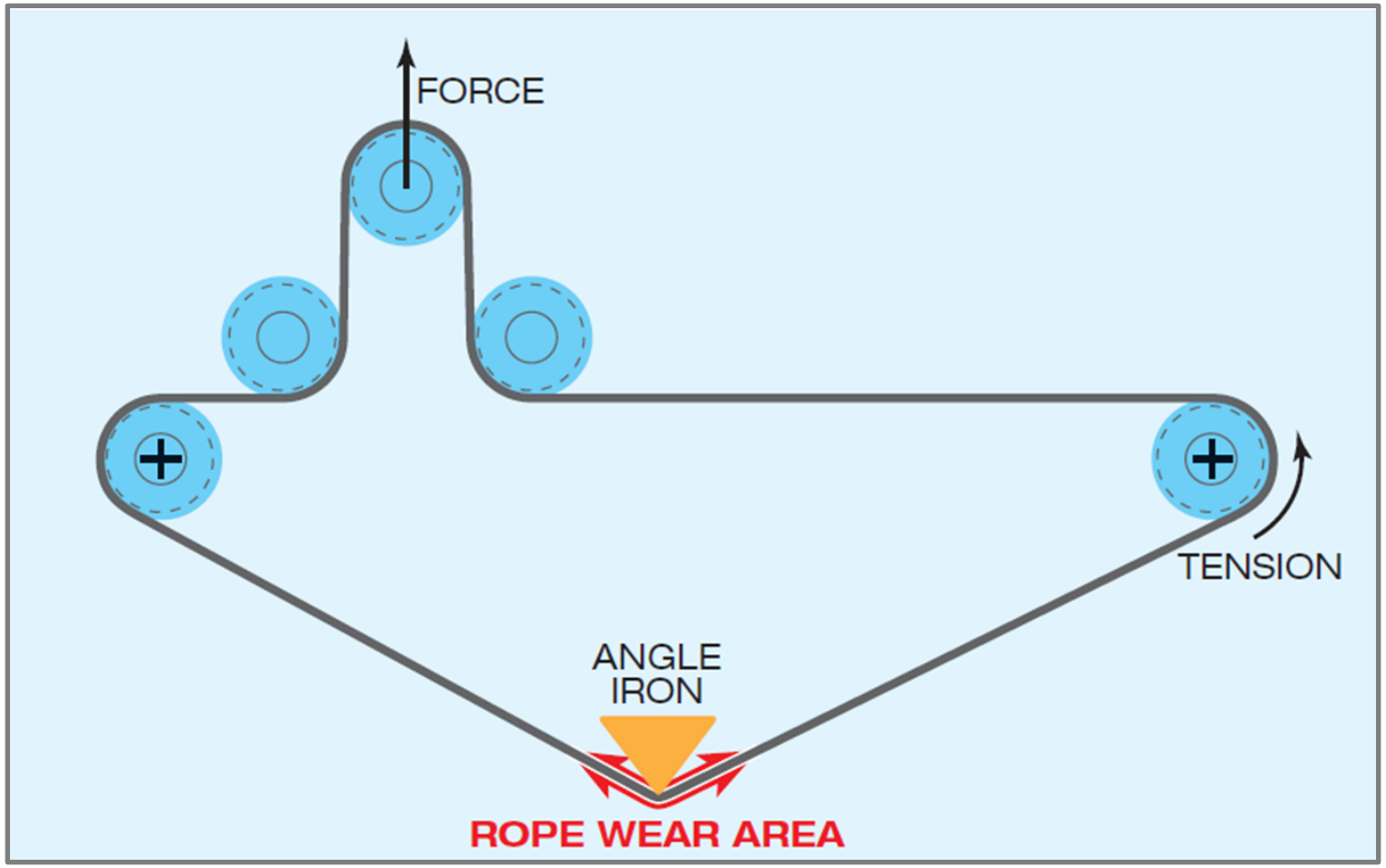
- **Mining abrasion testing**
  - Traditional abrasion testing with smooth, round substrate does not capture sharp edges found in mining
  - **Goal:** Recreate abusive environment seen in underground mining with sharp edge substrate and limestone particulate



Rope encrusted with limestone

Sharp edge test substrate

Designing Abrasion Testing for Mining Applications



Tester diagram

Designing Abrasion Testing for Mining Applications

- **Test parameter**
  - **4 different ropes with different coatings**
    - *Samson and competitor ropes (Purple and Yellow)*
    - *Included Samson's Type E coating used on Saturn-12*
  - **½" diameter rope samples**
  - **Some ropes were impregnated with underground coal mine rated limestone**
    - *ASTM C737-08 certified limestone*

Designing Abrasion Testing for Mining Applications

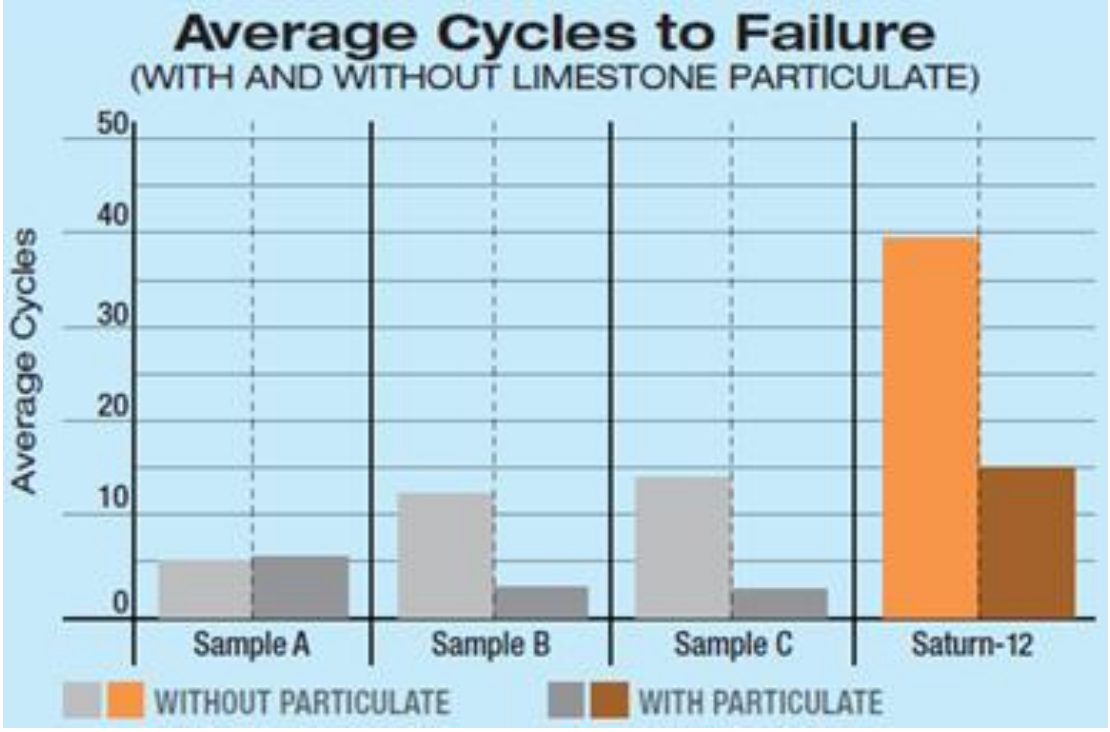
AmSteel®Blue conveyor pulling line, broken while being used to restring a conveyor belt.

Saturn-12 sample, broken during testing.

Field Broken vs. Mining Abrasion Tester

Designing Abrasion Testing for Mining Applications

- **Abrasion testing results**
  - Saturn-12 lasted 5 times longer than the average of the other 3 ropes tested with particulate
  - Of the ropes **without** particulate, Saturn-12 lasted 3 times longer than the next competing rope



Conclusion

- **Mining working lines common degradation mechanisms**
  - **Cutting**
    - *Samson and our distributors perform on-site training sessions (Rope Usage, Care and Inspection)*
    - *Use of appropriate chafe gear and hardware helps eliminate cutting*
  - **Tension – tension fatigue**
    - *Over 2,100 cycles with no loss of strength with Samson's AmSteel®-Blue and Saturn-12*
    - *Wire and other synthetic ropes fail in under 2,100 cycles*
  - **Abrasion resistance**
    - *5x more abrasion resistance with Samson's specially-formulated Type E coating found on Saturn-12*
  - **Samson's Saturn-12 offers the greatest value to the customer by lasting up to 5 times longer**

For more information stop by and see us in booth #20.

Thank you!