Forestry Training Centre
Ort/Gmunden - Austria

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Synthetic fibre ropes for forestry use

Further Developments in Finding Criteria for the Replacement State of Fiber ropes –

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Introduction

- Fibre ropes for forestry use have been available for several years
  - Advantages in comparison to steel ropes:
    - Low weight
    - No accidents through broken wires
    - Minor danger through ropes breaking
  - Mainly two types of ropes are offered:
    - 12 strand braided cover-less **U**ltra **H**igh **M**olekular **P**oly **E**thylene (Dyneema®)
    - 12 strand braided **UHMPE** – core, protected by an tightly braided Dyneema® cover
- Clear decision-making aids are needed in order to assess the replacement state of a rope
    - For safety reasons – before the tensile strength falls below the required minimum two-fold pulling force of the winch
    - Simply detectable for users - out in the forestsite

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Coated Synthetic Ropes

- For coated synthetic ropes, the abraded coat is a clear decision-making aid for its timely replacement
- The tensile strength of the core will still be 100%

Could we use Criteria from nautic applications for replacement of cover-less ropes in forestry applications?

- Risk assessment for nautical ropes:
  - if 25% or more of the fiber is broken or worn away, the rope should be removed from service.
- The harsh conditions in forestry let the rope‘s surface wear out rapidly like Fig. 3 shows
- So visible damages through abrasion at ropes in forestry applications would not be very useful as a criterion
- There are no specifications given for the residual tensile strength of differently abraded ropes


fig. 1 New rope


fig. 2 Used rope


fig. 3 Severely abraded rope

All Pictures: (Samson Rope Technologies, Inc.)

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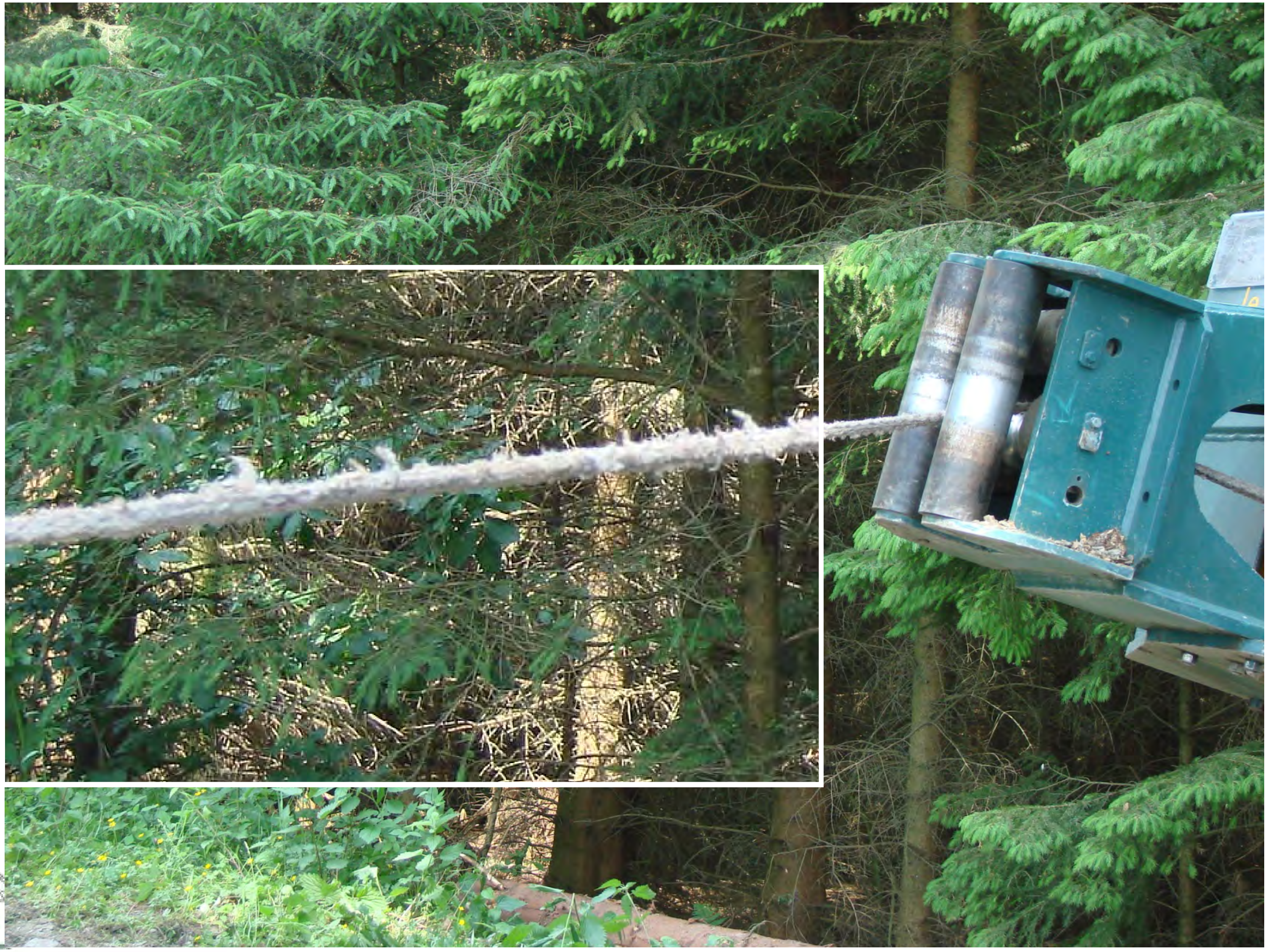
State of the art is still
to use the rope until it breaks!



State of knowledge

- John GARLAND et al. have been pioneers making first investigations at the new rope (GARLAND et al., 2001, 2003 + 2004a)
  - most of them concerning the ergonomic aspects
  - but also one laboratory test was made concerning the decreasing tensile strength by cutting off 1, 2 or 3 strands of a 12-stranded rope – there he found a loss of 9, 19 or 40 % of original tensile strength
- PILKERTON et al. gave some indication on rope life in 2003 (PILKERTON, GARLAND et al., 2003)
  - The rope initially fuzzes up and should be replaced, when 25% of ist profile are worn by abrasion
  - But GARLAND et al. also reported in 2004 that replacement criteria were needed (GARLAND et al., 2004a)
- First Test Series of BFW have shown, that the state of wear cannot clearly be identified through visible damages to the rope‘s surface (NEMESTOTHY, N., 2010)

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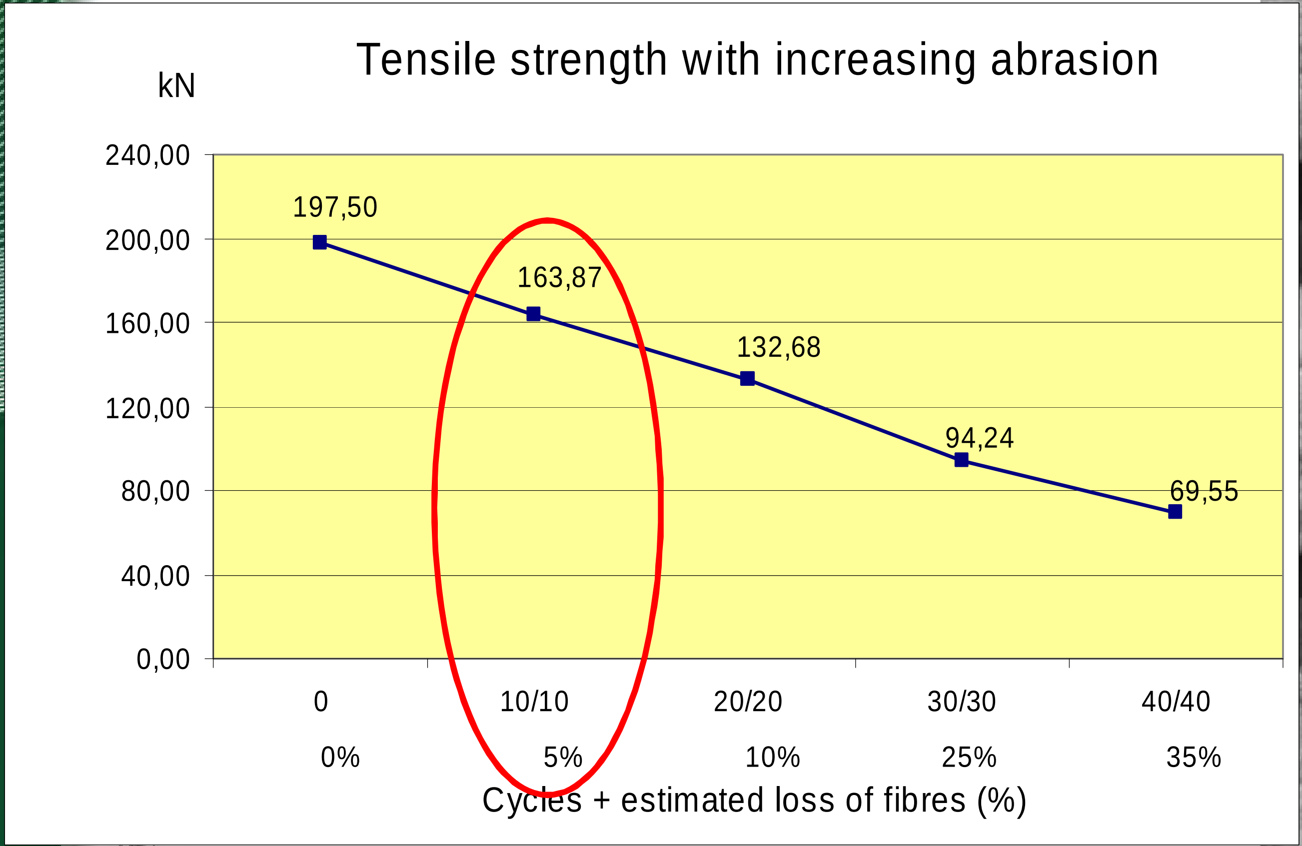
- In contrast to missing identifiable wear, checking the tensile strength of differently worn ropes gave clear results



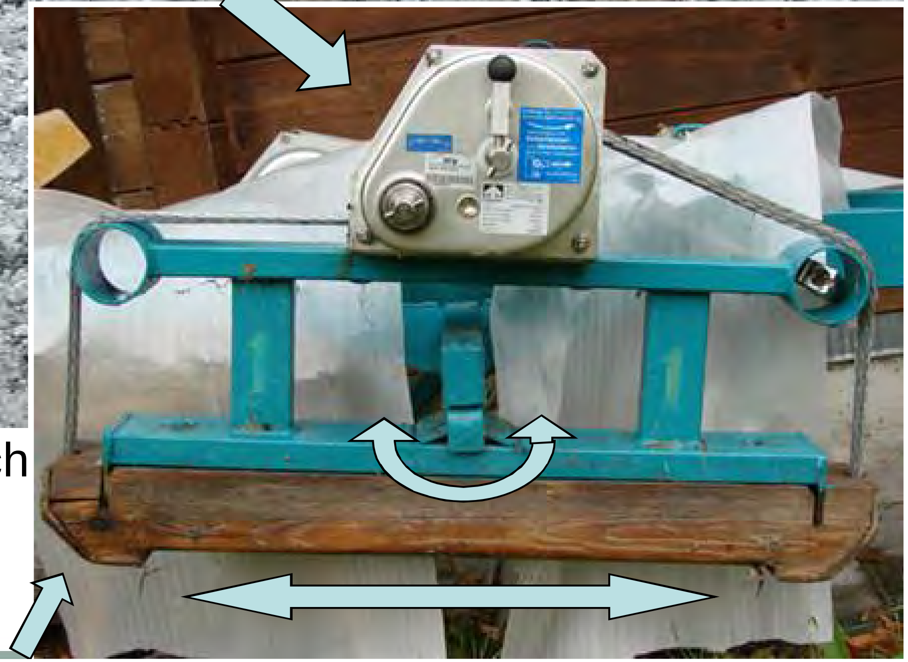
Research Projekt „Ropesecurity 2 +“

- Aims of the project
  - To investigate the correlation between measurable loss of fibers in field-used ropes and loss of breaking force.
  - To find a method for measuring the loss of fibers feasible on working ropes in forestsite.

  → Find a useable decision-making aid in order to be able to assess the replacement state of wear.
- Experimental design
  - About 200 rope-samples in different states of wear should be produced artificially under nearly natural conditions.
  - Determination of fiber loss.
  - Determination of residual breaking force.
  - Comparison of the test results with material used in forest practice.

Design of the Abrasion station

- Abrasive surfaced test track,
  - 40 m long, 2 m wide.
  - Limestone gravel (0/32) mixed with ~25% humus.
  - Seven concrete sleepers were built in transversally.
    - To simulate fixed obstacles.
    - To prevent the track from gradual depression.
- The test carriage
  - with four pivotal wooden skids
  - designed to abrade the test ropes only longitudinally
  - prepared for pretensioning the rope with ~3 kN
- Different frequencies of rides
  - (2, 5,) 10, 20, 30, 40 rides
  - Each rope product rotating on each



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Preparing the rope samples

- Cleaning and drying
- photo-documentation

Method for Determination of Fiber Loss

- First idea was to estimate the loss on the individual yarns of every 2nd strand
  - + No tools for measurement would be needed
  - – Not free from subjective perceptions
  - – Disaggregation of the rope too strong
- Final method → measuring the strands‘ circumference by means of a twine loop and a sliding calliper under constant measuring force (10 N)
  - + Objektive
  - + Low disaggregation of the rope
  - – Measuring equipment is needed

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Measurment of Strands

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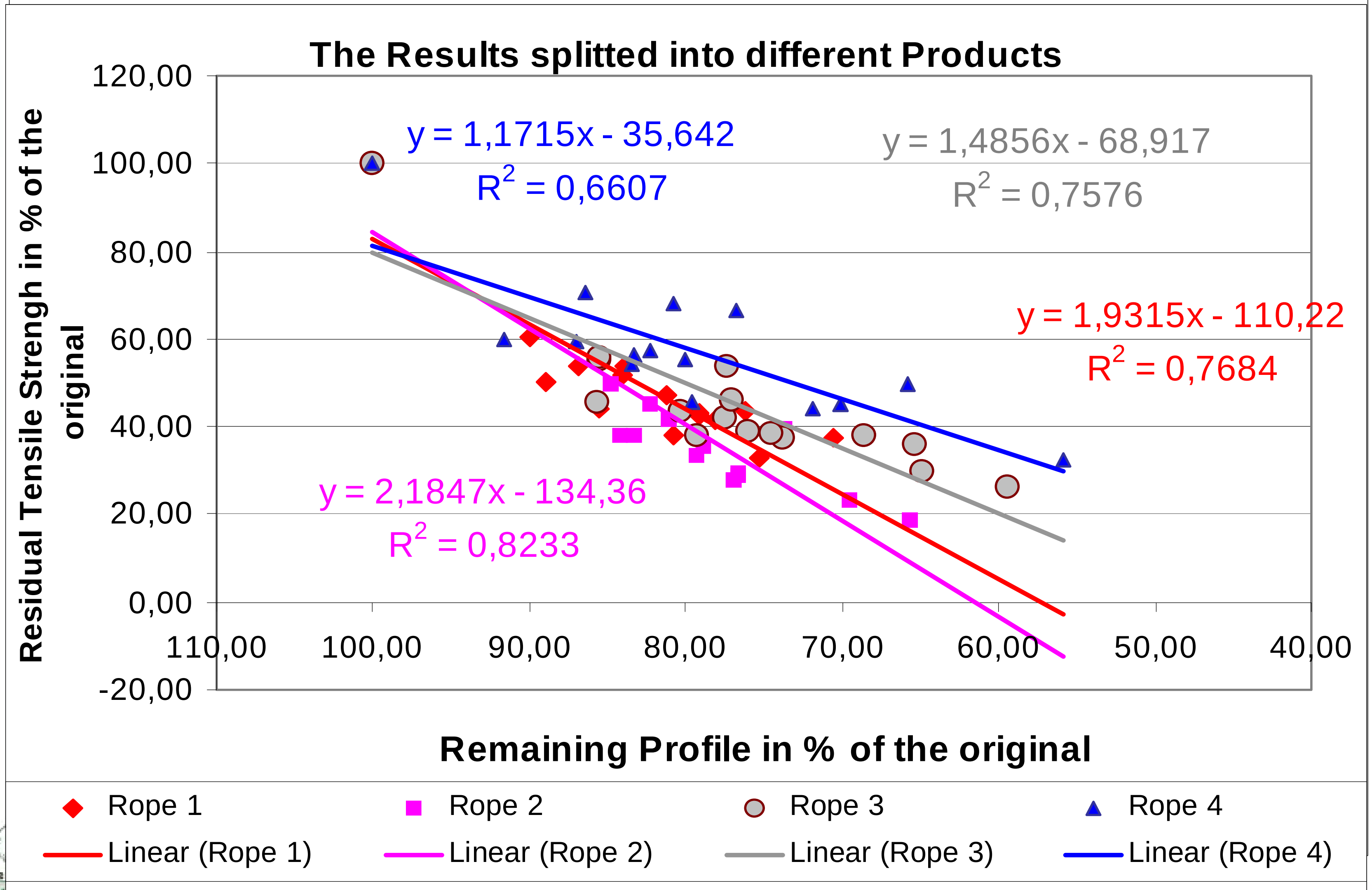
Intermediary Results

- Results of 76 rope samples (64 worn out and 12 new)



Conclusions

- Reduction of the tensile strength starts at a marginal loss of fibres
- The required safety coefficient 2, can be lost after initial use
- This underlines the urgent need for criteria for timely detection of the state, determining replacement
- Measuring the circumference of new and worn strands and calculation of the relative profile-loss could be a good aid to estimate the related residual strength of ropes
- The first results have also shown that ropes from different producers are suffering differently through wear by abrasion

Thank you for your attention

- Many thanks to Karl Stampfer, Rudi Kirth and Erich Rührnössl supporting the tests with useful tips and testing the tension strength. Thanks also to the Companies supporting the tests with test ropes.