How to select right pulp and refining for paper & board –
utilization of laboratory refining, microscopic analysis and SoftaCell™ furnish optimization software

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Separate or co-refining?

There are many opinions on what refining concept would be better, but does anybody really know?

We decided to compare co-refining to separate refining

and to

Simulate the same using the GloCell software

Pulps used and our plan

- Commercial Scandinavian softwood and birch pulps
- Separate refining of each pulp
- Co-refinings
  - 30% SW:70% HW
  - 70% SW:30% HW
- Blend sheets from the separately refined pulps
  - 30% SW:70% HW
  - 70% SW:30% HW
- Sheet forming, testing of pulps and lab sheets, microscopy evaluation of fibers.
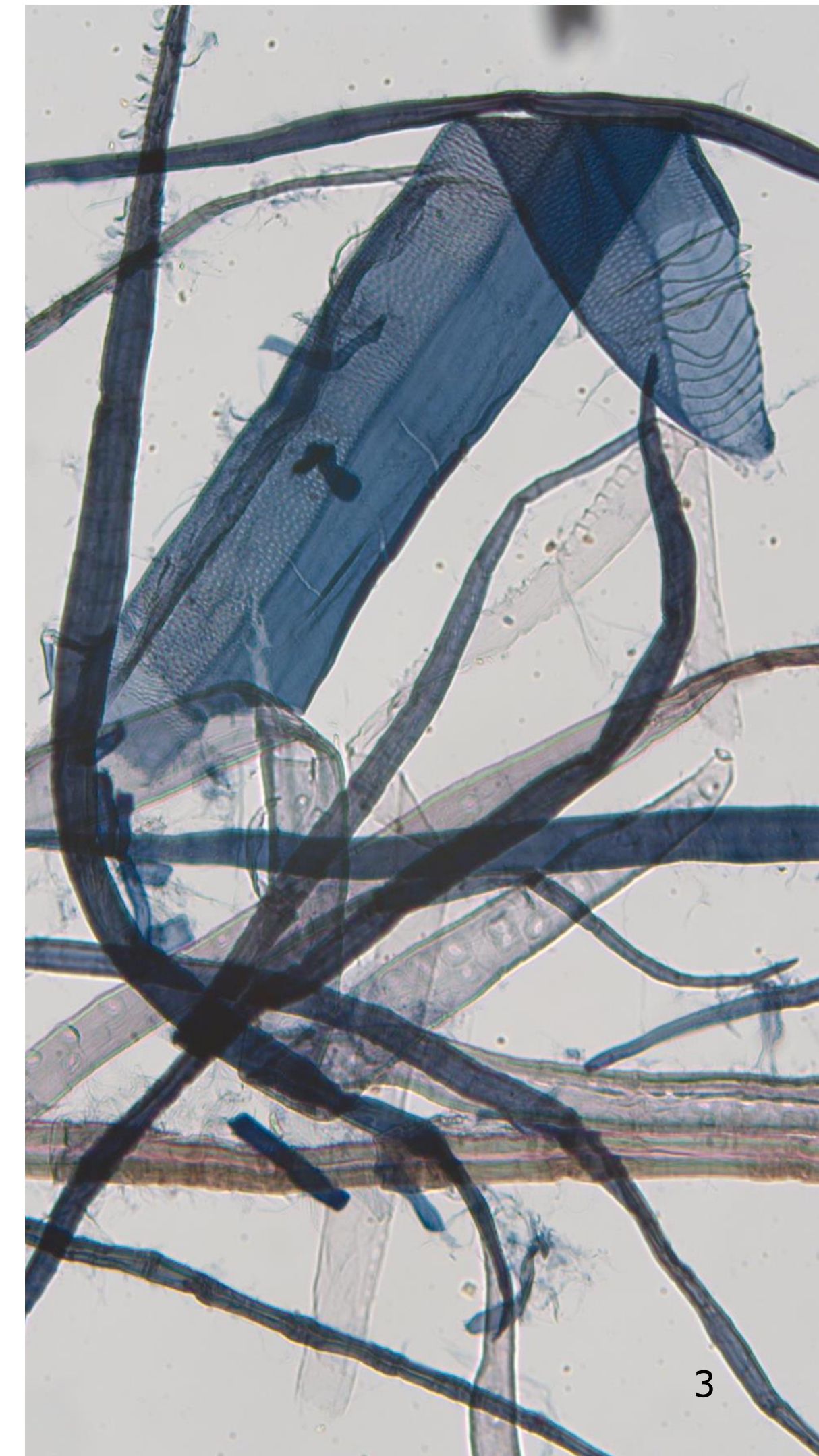
Refining conditions

- Refining conditions for both SW and HW pulps
  - Softwood filling (60C), 4% conc., SEL 1.5 J/m, SRE-levels 0, 50, 100, 150 kWh/t
- Birch (HW) pulp was also refined at "HW conditions"
  - Hardwood filling (40D), 4% conc., SEL 0.4 J/m, SRE-levels 0, 50, 100, 150 kWh/t
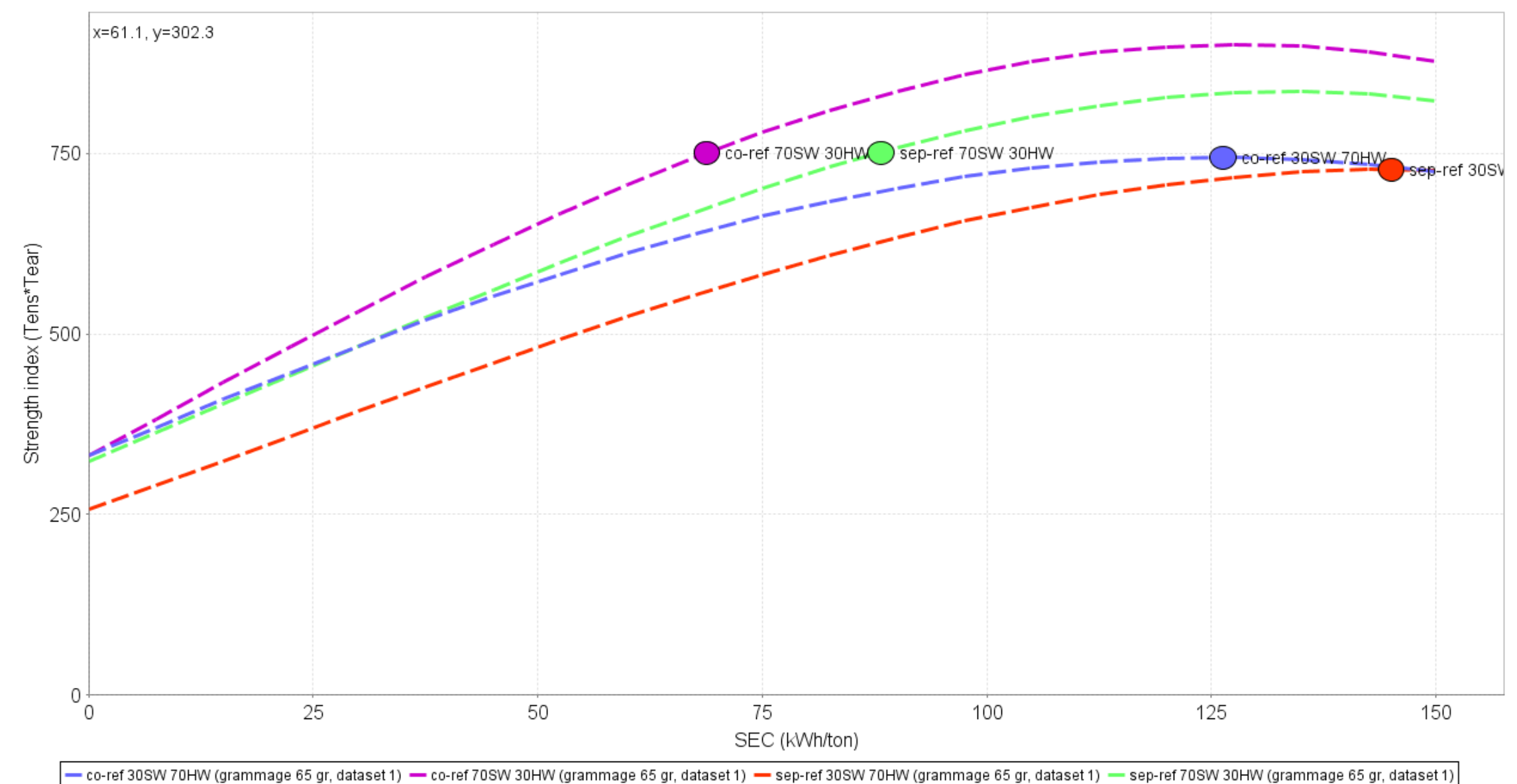

3-1.0-**60C**

2/3-1.46-**40D**

KCL laboratory refining – Voith Labrefiner

- Simulation of mill scale LC refining using KCL's Voith Labrefiner
  - Specific Edge Load range 0.2-4 J/m, depending on filling
  - 7 different filling available
  - 6 samples taken automatically at different refining levels
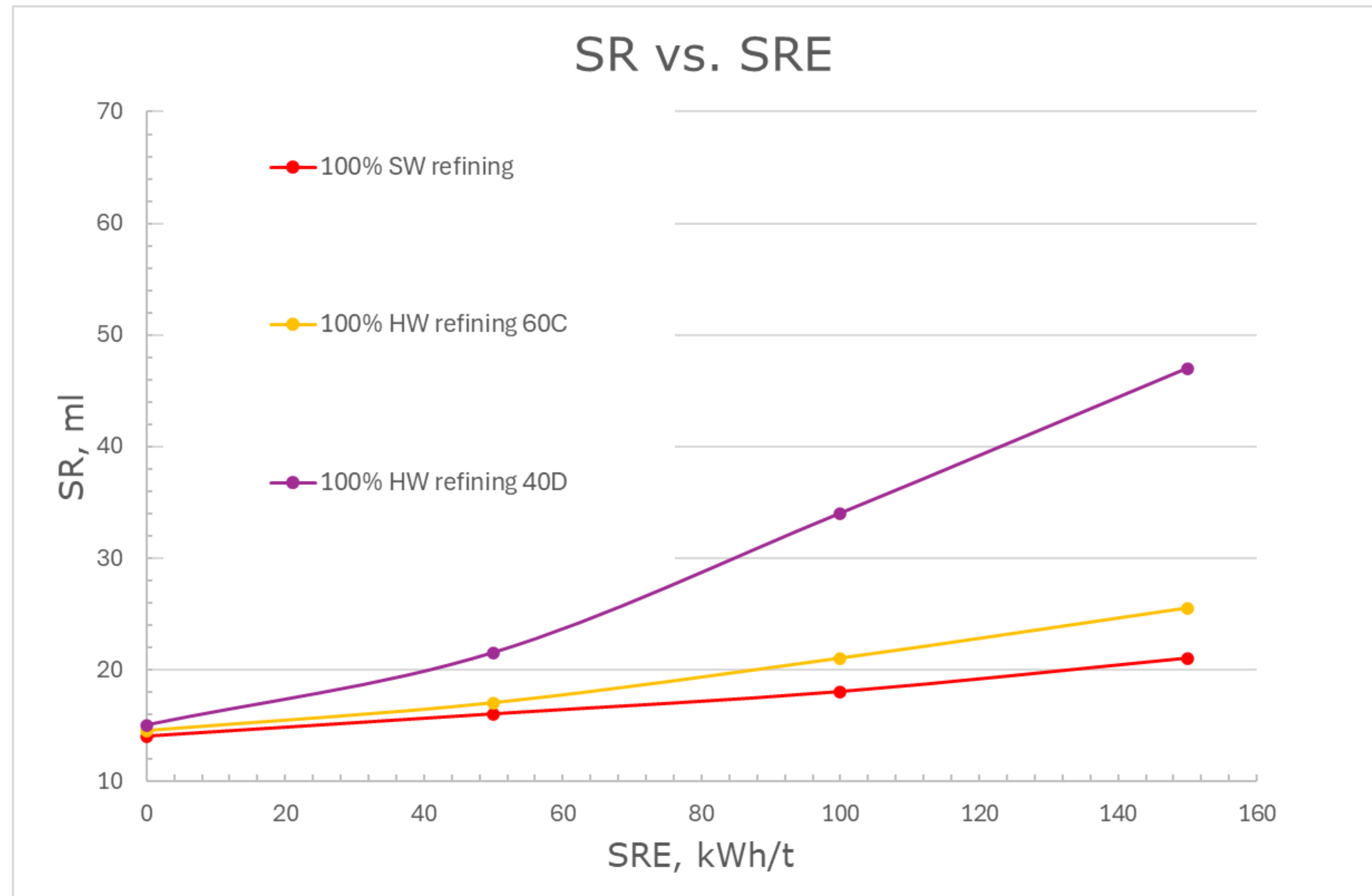

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piloting knowledge

SoftaCell™ Furnish Optimization Tool

- Data produced in KCL laboratory was processed by SoftaCell software

- By SoftaCell it is possible to simulate both separate and co-refining

- Refining results are comparable with industrial conditions

- This means that end results of different refining options can be tested digitally and compared with each other, both quality and costwise
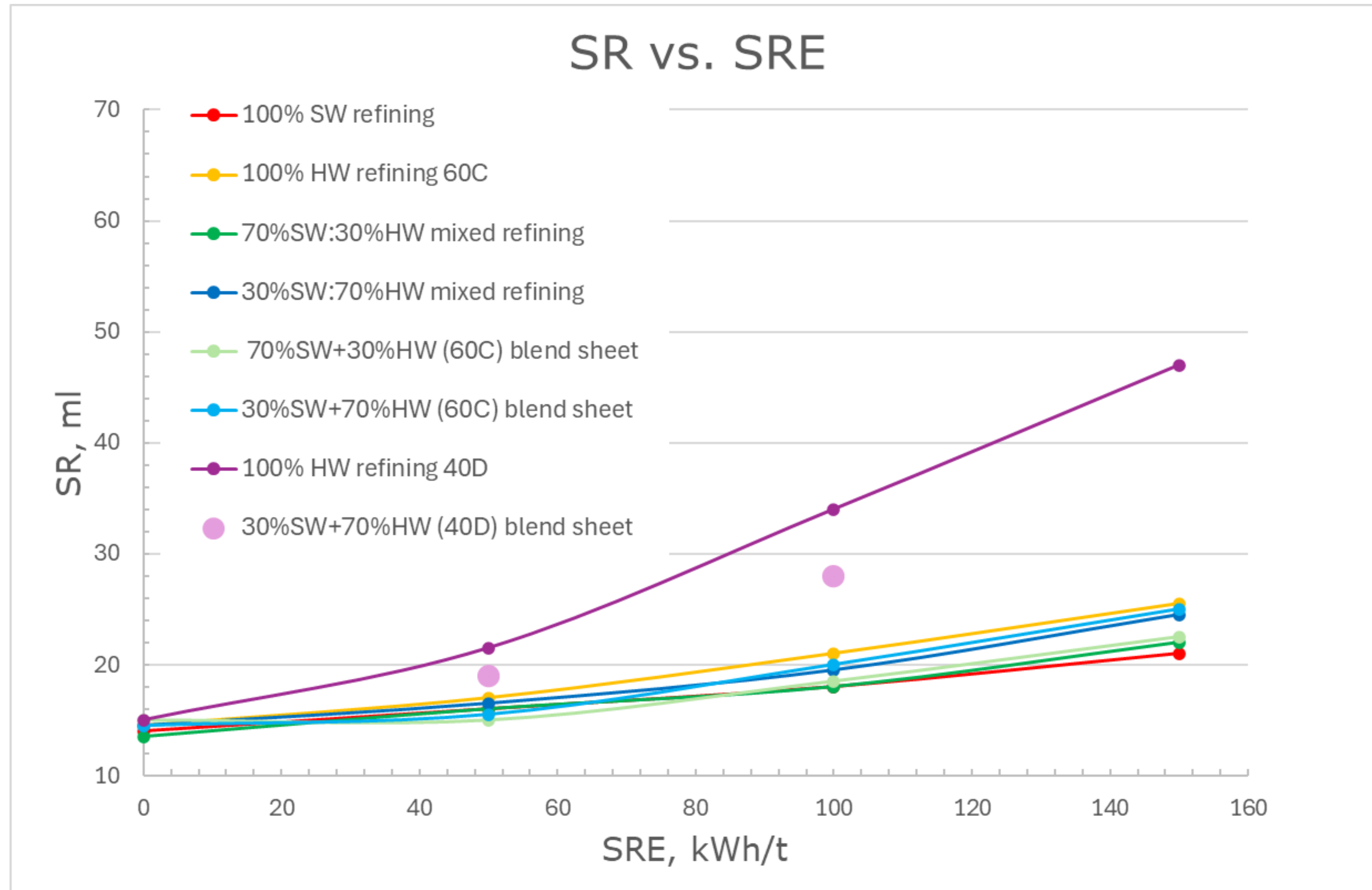
Testing results

Effect of fillings on the refining result

Testing results

SR vs. SRE

Legend:
- 100% SW refining
- 100% HW refining 60C
- 70%SW:30%HW mixed refining
- 30%SW:70%HW mixed refining
- 70%SW+30%HW (60C) blend sheet
- 30%SW+70%HW (60C) blend sheet
- 100% HW refining 40D
- 30%SW+70%HW (40D) blend sheet

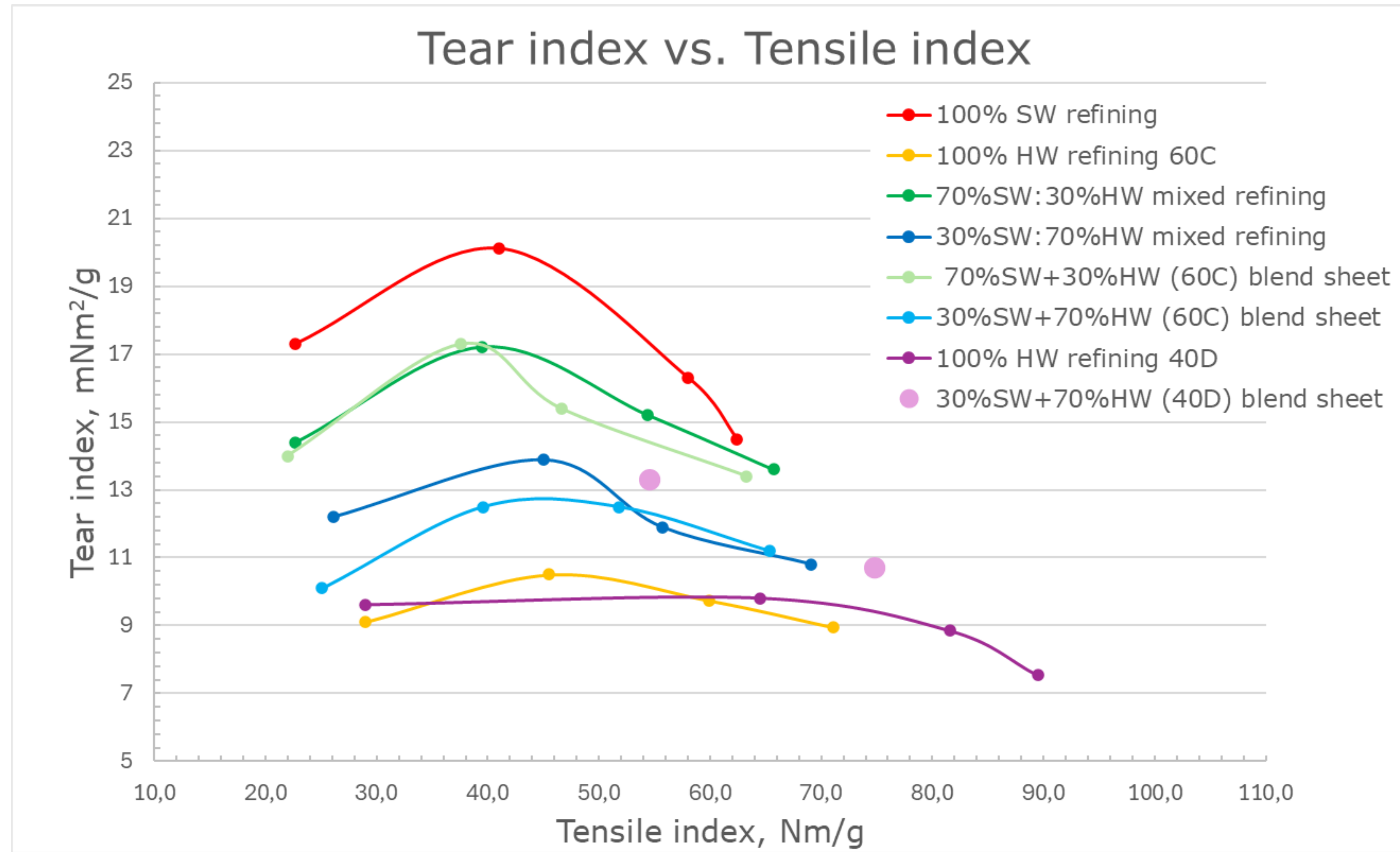Effect of co-refining compared to separate refining

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Testing results

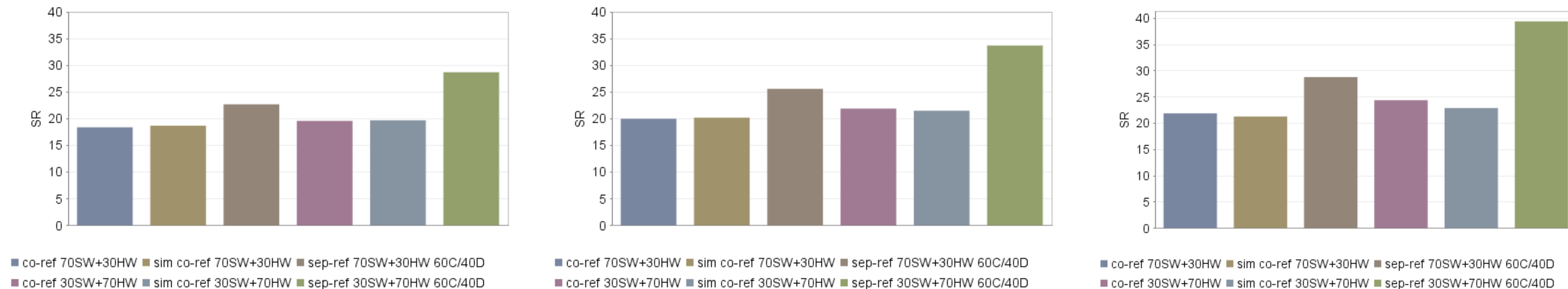Effect of refining conditions on the strength development

Strength index = Tensile index * Tear index

Testing results

Refining concept will affect end-product properties

Simulation result example, SR number

- Three first bars: 70% SW / 30% HW, three last bars vice versa
- First and fourth bar: co-refined mix
- Second and fifth bar: co-refined mix created by simulation
- Third and sixth bar: separately refined mix, pulp specific fillings
- Specific energies 100, 125 and 150 kWh/t from left to right

- Simulation matches quite well the real physical refining
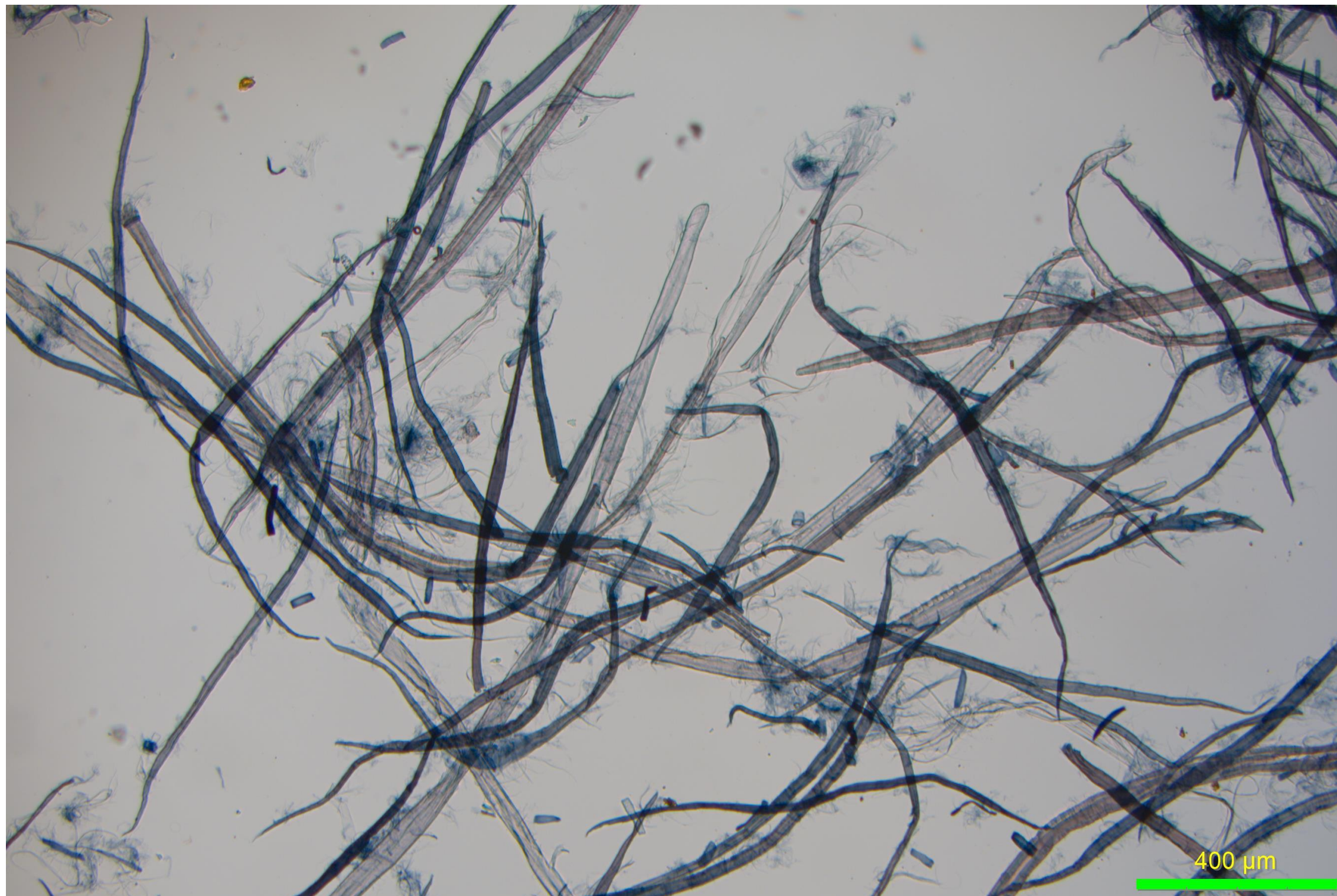- Refining levels are clearly higher with separate refining

Simulation result example, Tensile index
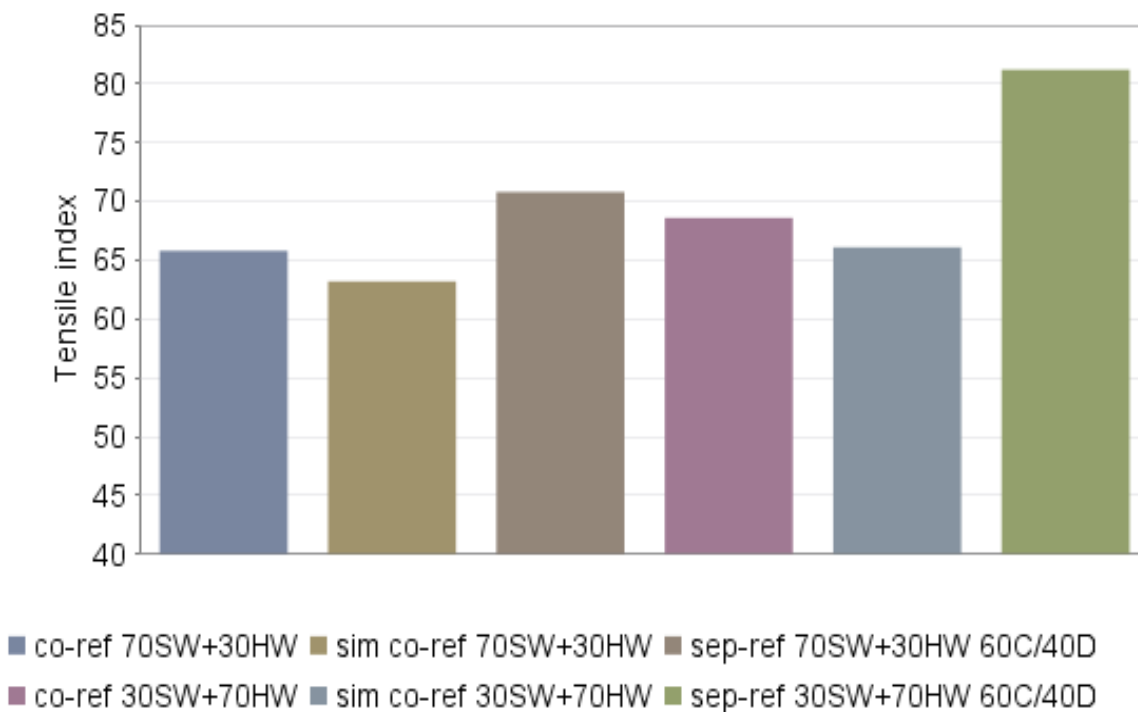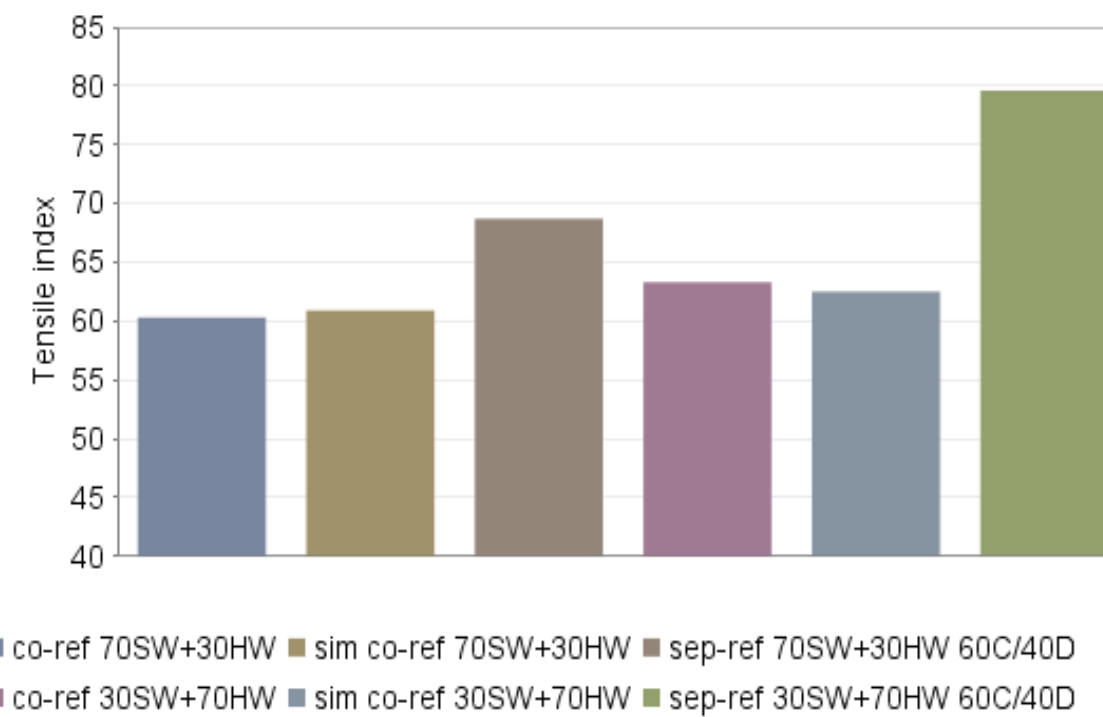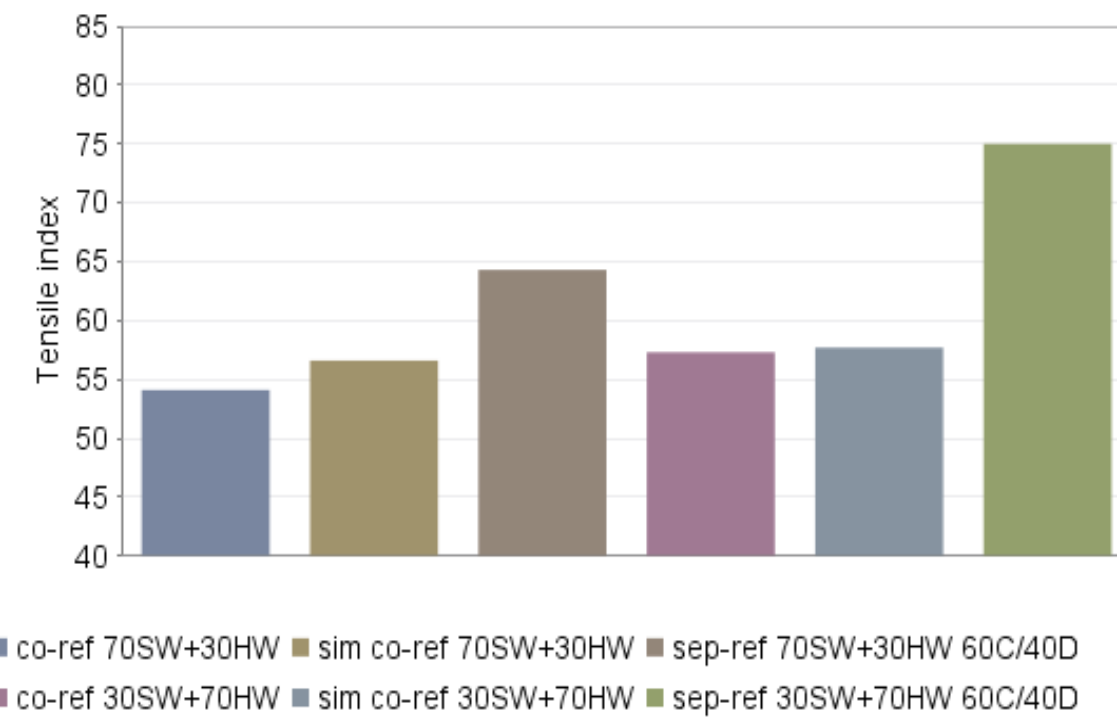
- Same specifications as on the previous page
- Simulation matches again quite well the reality
- Separate refining gives higher strength with both mixes

Fiber microscopy
Effect of filling and refining conditions – Birch pulp
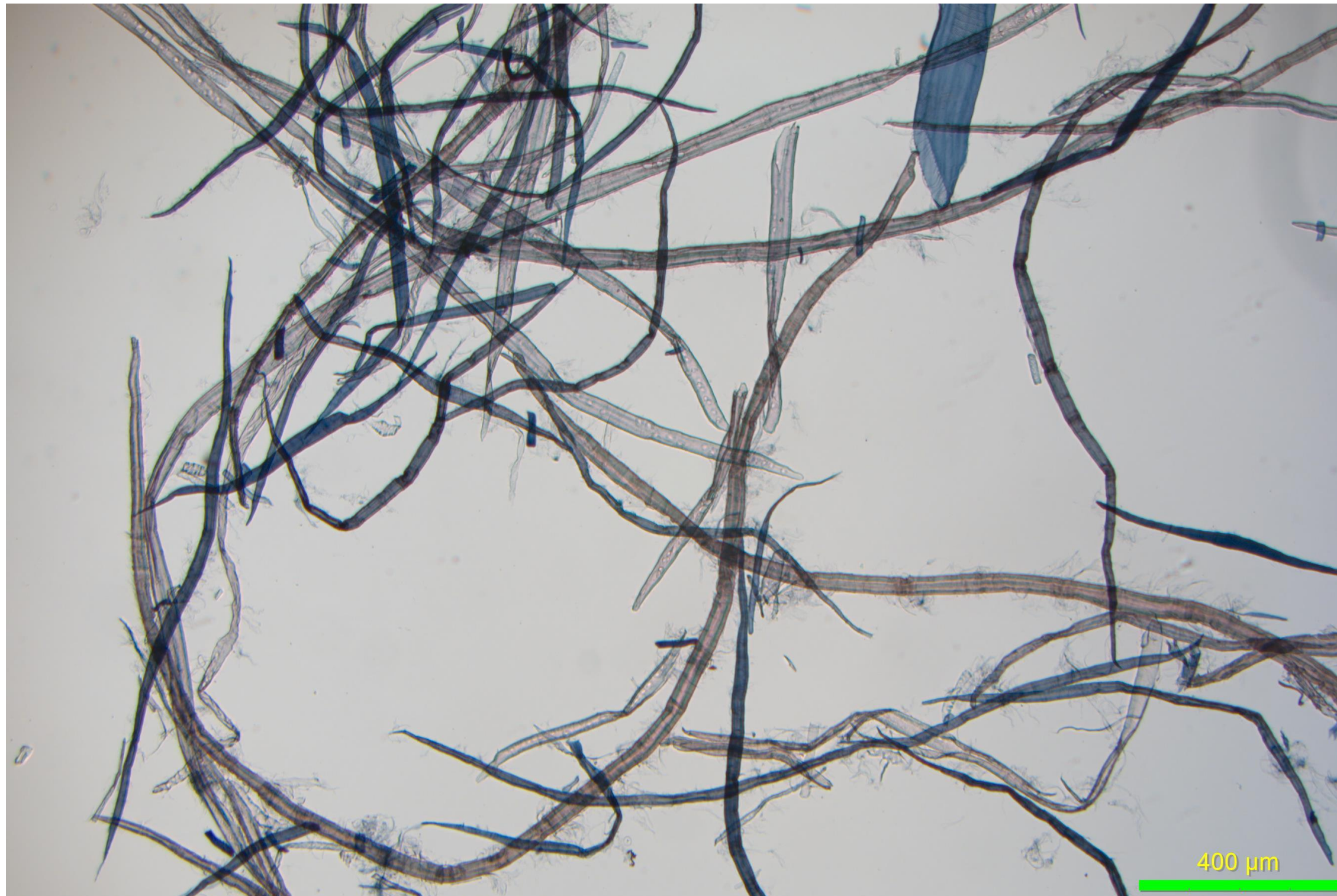

40D HW fillings used for birch refining more fibrillating (SEL 0.4 J/m, 150 kWh/t)

60C SW fillings used for birch refining more crushing (SEL 1.5 J/m, 150 kWh/t)

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Fiber microscopy
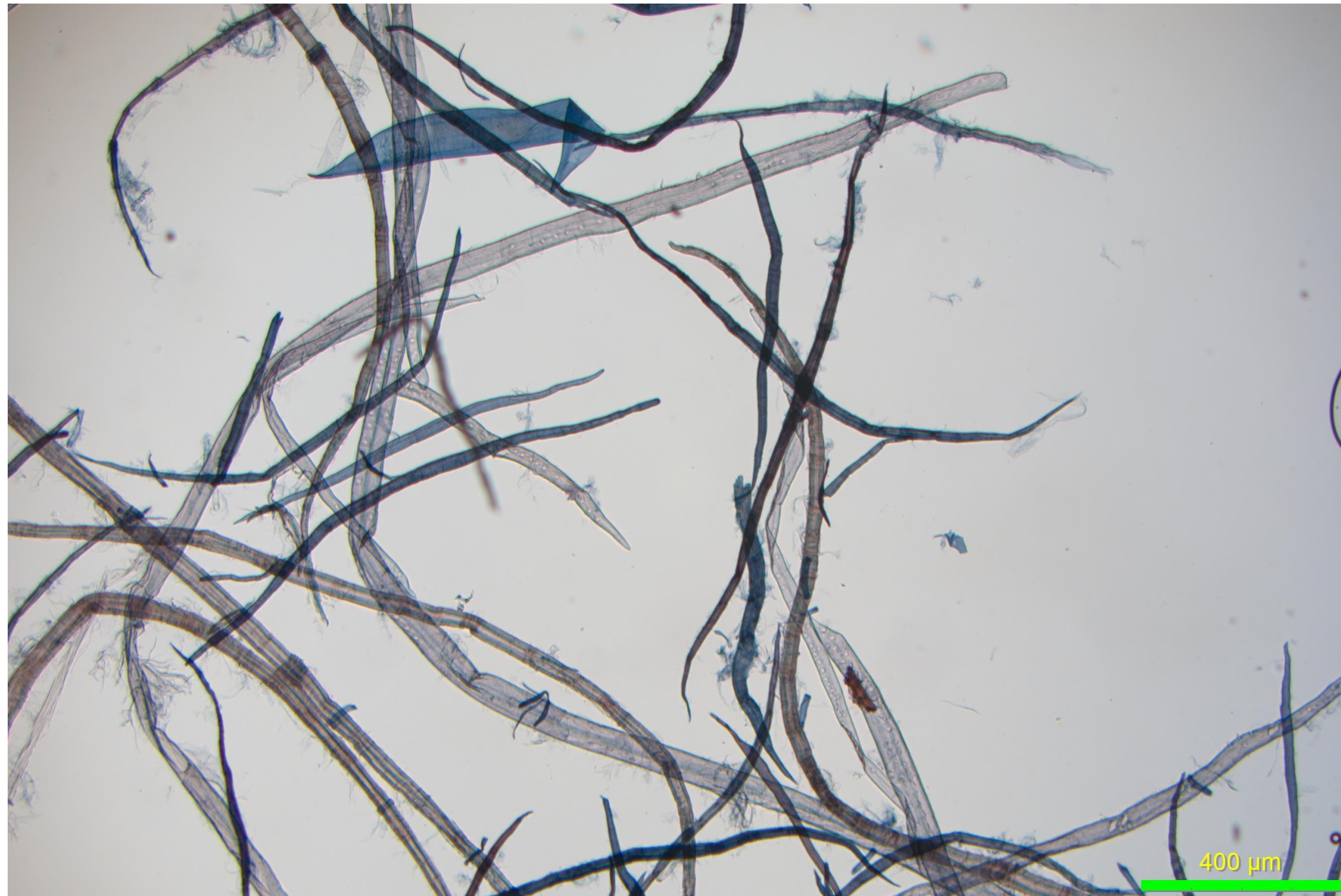## Separate or co-refining **70%SW**:30%HW(60C) @150 kWh/t

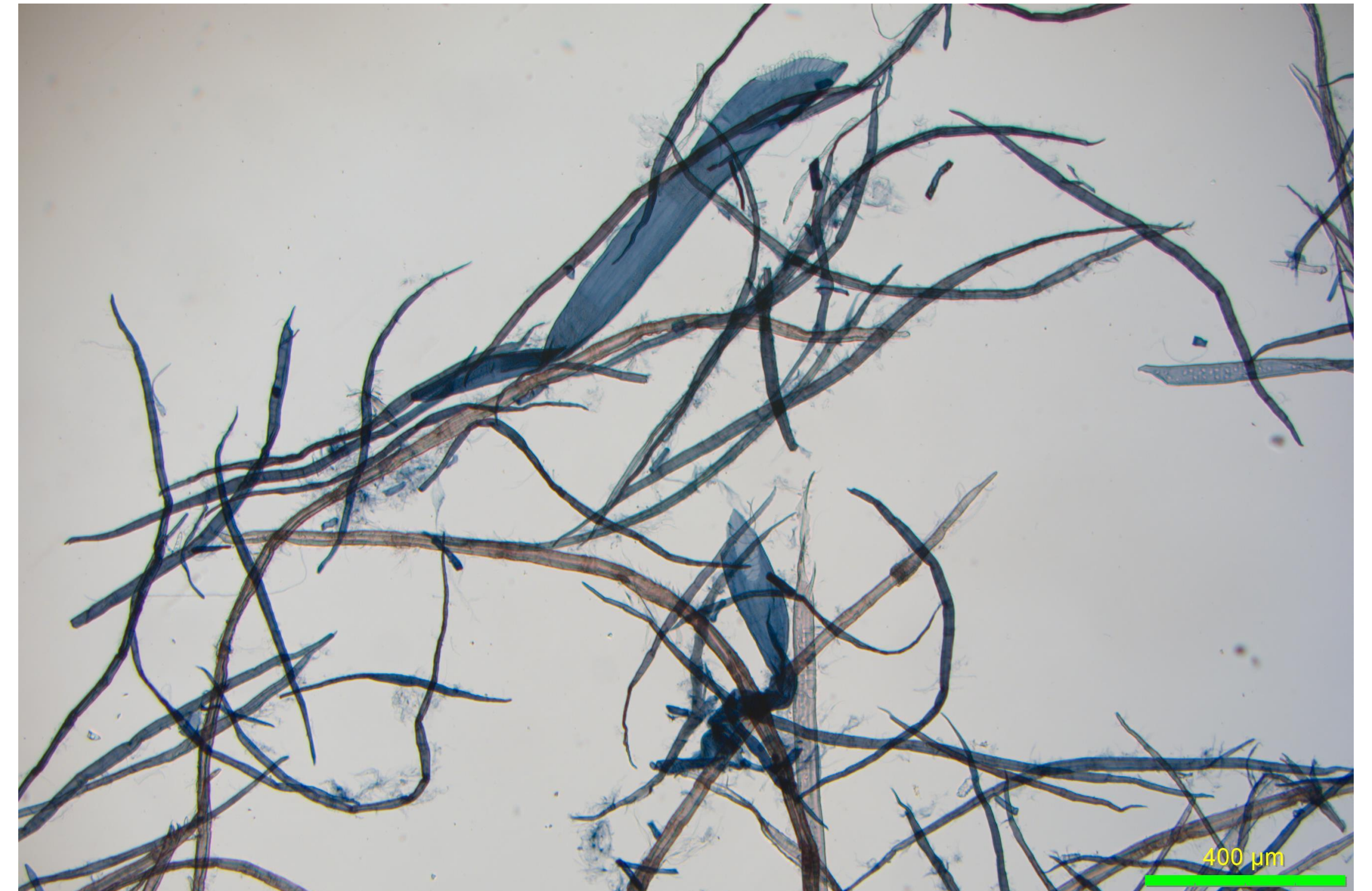Co-refining – more fine material

Separate refining

Fiber microscopy
Separate or co-refining **30%SW**:70%HW(60C) @150 kWh/t

Co-refining

Separate refining

Looks quite similar

Conclusions based on lab results and simulation

- Hardwood fibre refined at too harsh conditions will cause more damaged fibres – but not necessarily bad strength quality

- Difference in paper properties between co- and separate refining was smaller than expected, but this can be explained by choice of unsuitable fillings for birch refining

- We still don't know if SW or HW fibres will suffer more in co-refining, but when there is more SW in proportion to HW, then HW seem to suffer more. Opposite when there is more HW it is hard to see which fibre suffers more, that is, will be more refined.

- A reasonable conclusion can be drawn that separate refining would be preferred, at least based on these results, especially at higher refining energies (higher SR)

- Combination of laboratory refining, microscopic analysis and software simulation is a very powerful and cost-effective toolbox when defining refining strategies

Thank you!

Inquiries

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